COLLEGE OF MARIN
INDIAN VALLEY CAMPUS
JONAS CENTER AND BLDG. 18 ALTERATIONS

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NOVATO, CA 94949

BRIDGING DOCUMENTS
100% SCHEMATIC DESIGN
NOVEMBER 21, 2017

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NOT FOR CONSTRUCTION

rev	date	issue
	11/21/17	100% SD
	10/06/17	80% SD
	07/10/17	60% SD
	06/16/17	50% SD

COLLEGE OF MARIN IVC
JONAS CENTER & BLDG 18
ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04
plot date: 12/1/2017 5:03:29 PM

scale: as noted
date:

COVER SHEET

G0.0

GRAPHIC SYMBOLS

1. GRAPHIC SYMBOLS REPRESENT OBJECTS, ELEMENTS, EQUIPMENT, INSTRUCTIONS, LOCATION, CONVENTIONS, ETC. THEY DO NOT REPRESENT THE SHAPE, SIZE, DIMENSION OF THE ACTUAL OBJECT.

2. EACH DRAWING GROUP (I.E. MECHANICAL, ELECTRICAL) HAS ITS OWN SYMBOLS, ABBREVIATIONS, LEGEND AND NOTES. THE INFORMATION AND SYMBOLS ON THIS DRAWING ARE GENERAL AND APPLY TO ALL DRAWINGS.

GENERAL SYMBOLS

- 101 — DOOR SYMBOL (LETTER DESIGNATES NUMBER OF DOOR IN ROOM) SEE A7.0-7.3 & FOR DOOR SCHEDULE
- F11 — WINDOW TYPE SEE A7.5 FOR WINDOW SCHEDULE
- SF1 — STOREFRONT SEE A7.5 FOR STOREFRONT SCHEDULE
- E0001 — EQUIPMENT SYMBOL
- 1 — REVISION
- MATCH LINE; SHADED PROTION IS THE SIDE CONSIDERED.
- WORK POINT, CONTROL POINT OR DATUM POINT
- 12 / A3.01 — SECTIONS: SECTION IDENTIFICATION; SHEET WHERE SECTION IS DRAWN
- 1 / A3.01 / 2 — ELEVATIONS (UNFOLD ELEVATIONS CLOCKWISE.) DETAIL NUMBER INDICATES ELEVATION DRAWN. SHEET WHERE ELEVATION IS DRAWN.
- 12 / A3.01 — DETAILS: DETAIL NUMBER; SHEET WHERE DETAIL IS DRAWN
- OFFICE 108 — FLOOR PLANS, REFLECTED CEILING PLANS, ROOM IDENTIFICATION: ROOM NAME; ROOM NUMBER
- 108 — EQUIPMENT TAG
- 2' - 6" — DIMENSION LINES
- ALIGN — ALIGN; FIN. FACE TO FIN. FACE
- LIMIT OF WORK

PARTITIONS

- A1 — PARTITION TAG SEE A9.1 - A9.2
- NEW PARTITIONS
- NEW DOORS; FLOOR FINISH TRANSITION WHERE INDICATED AT CENTER LINE OF DOOR, TYPICAL.
- NEW WINDOW; REFER TO SCHEDULE IN

CASEWORK

- WALL HUNG CABINETS OR SHELVES
- BASE CABINET; COUNTER TOP
- N.I.C. — OWNER FURNISHED ITEMS (NOT IN CONTRACT)

EQUIPMENT

- RH — ROBE HOOK
- CLOCK
- F.E.C. — FIRE EXTINGUISHER CABINET
- HANDRAIL / WALL PROTECTION
- VISUAL DISPLAY BOARDS
- CORNER GUARD
- EDGE GUARD

PLUMBING

- FD — FLOOR DRAIN

MECHANICAL

- SUPPLY DIFFUSER
- RETURN AIR GRILLE
- EXHAUST GRILLE

ELECTRICAL

- 2' X 4' LIGHT FIXTURE
- 2' X 2' LIGHT FIXTURE
- RECESSED DOWNLIGHT
- STRIP LIGHTING FIXTURE
- SURFACE MOUNTED DOWNLIGHT
- RECESSED WALL WASHER
- ROUND PENDANT
- WALL MOUNTED LIGHT
- TRACK LIGHT
- EXIT SIGN
- SD — SMOKE DETECTOR
- TV — TELEVISION AND BRACKET
- S — SPEAKER

SYMBOL LEGEND

℄	CENTERLINE
∠	ANGLE
ACOUS.	ACOUSTICAL
ADJ.	ADJUSTABLE
AGG.	AGGREGATE
AL.	ALUMINUM
APPROX.	APPROXIMATE
ARCH.	ARCHITECTURAL
A.P.L.	ASSUMED PROPERTY LINE
A.F.F.	ABOVE FINISH FLOOR
ADD'L	ADDITIONAL
BD.	BOARD
BITUM.	BITUMINOUS
BLDG.	BUILDING
BLKG.	BLOCKING
BM.	BEAM
BOT.	BOTTOM
BTWN.	BETWEEN
CAB.	CABINET
C.B.	CATCH BASIN
C.T.	CERAMIC TILE
C.C.T.	CUBICLE CURTAIN TRACK
C.I.	CAST IRON
CLG.	CEILING
CL.	CENTER LINE
CLR.	CLEAR
COL.	COLUMN
CONC.	CONCRETE
CONT.	CONTINUOUS
CORR.	CORRIDOR
CTSK.	COUNTERSUNK
C.M.U.	CONCRETE MASONRY
C.D.U.	COMBINATION DISPENSING UNIT
D.A.	DISABLED ACCESSIBILTY
DBL.	DOUBLE
DEPT.	DEPARTMENT
D.F.	DRINKING FOUNTAIN
DET.	DETAIL
DIA.	DIAMETER
DIM.	DIMENSION
DISP.	DISPENSER
DN.	DOWN
DR.	DOOR
DS.	DOWNSPOUT
DWG.	DRAWING
D.D.	DECK DRAIN
D.F.	DOUGLAS FIR
(E)	EXISTING
EA.	EACH
E.J.	EXPANSION JOINT
EL.	ELEVATION
ELEC.	ELECTRICAL
ELEV.	ELEVATOR
EMERG.	EMERGENCY
ENCL.	ENCLOSURE
EQ.	EQUAL
EQPT.	EQUIPMENT
E.W.C.	ELECTRIC WATER COOLER
EXP.	EXPANSION
EXT.	EXTERIOR
F.A.	FIRE ALARM
F.C.O.	FLOOR CLEAN OUT
F.D.	FLOOR DRAIN
FDN.	FOUNDATION
F.E.	FIRE EXTINGUISHER
F.E.C.	FIRE EXTINGUISHER CAB.
F.H.C.	FIRE HOSE CABINET
FIN.	FINISH
FL.	FLOOR
FLUOR.	FLUORESCENT
F.O.C.	FACE OF CONCRETE
F.O.F.	FACE OF FINISH
F.O.S.	FACE OF STUDS
F.S.S.	FOLDING SHOWER SEAT
FT.	FOOT OR FEET
FTG.	FOOTING
FURR.	FURRING
F.H.S.	FLAT HEAD SCREW
F.R.	FIRE RETARDANT
GA.	GAGE
GALV.	GALVANIZED
G.B.R.	GRAB BAR REINFORCEMENT
GL.	GLASS
GND.	GROUND
GYP.	GYPSUM
G.W.B.	GYPSUM WALL BOARD
GEN.	GENERAL
H.B.	HOSE BIBB
H.C.	HOLLOW CORE
H.M.	HOLLOW METAL
HORIZ.	HORIZONTAL
HR.	HOUR
I.D.	INSIDE DIAMETER
INSUL.	INSULATION
INT.	INTERIOR
IVT.	INTRAVENOUS TRACK
JAN.	JANITOR
J.T.	JOINT
KIT.	KITCHEN
LAB.	LABORATORY
LAM.	LAMINATE
LAV.	LAVATORY
LT.	LIGHT
MAT.	MATERIAL
MAX.	MAXIMUM
M.C.	MEDICINE CABINET
MECH.	MECHANICAL
MEMB.	MEMBRANE
MET.	METAL
MFR.	MANUFACTURER
MIN.	MINIMUM
M	MIRROR (FRAMED)
MISC	MISCELLANEOUS
M.O.	MASONRY OPENING
MTD.	MOUNTED
MUL.	MULLION
MG	MEDICAL GAS PANEL
M.B.	MACHINE BOLT
MK	MARKER BOARD
MBH	MOP AND BROOM HOLDER
(N)	NEW
N.I.C.	NOT IN CONTRACT
NO. or #	NUMBER
NOM.	NOMINAL
N.T.S.	NOT TO SCALE
O/	OVER
O.A.	OVERALL
O.C.	ON CENTER
O.D.	OUTSIDE DIAMETER
OPP.	OPPOSITE
O.F.D.	OVERFLOW DRAIN
OFOI	OWNER FURNISHED, OWNER INSTALLED
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
O.T.A	OPEN TO ABOVE
PEN.	PENETRATION(S)
PL.	PLATE
P.LAM.	PLASTIC LAMINATE
PLYWD.	PLYWOOD
PR.	PAIR
PTD	PAPER TOWEL DISPENSER
PTD.	PAINTED
P.A.D.	POWER ACTUATED DEVICE
P.I.P.	POURED-IN-PLACE
P.T.	PRESSURE TREATED
PTN	PARTITION
PV	PHOTOVOLTAIC
Q.T.	QUARRY TILE
R.	RISER
RAD.	RADIUS
R.D.	ROOF DRAIN
REF.	REFERENCE
REFR.	REFRIGERATOR
REINF.	REINFORCED
REQD.	REQUIRED
RESIL.	RESILIENT
R.H.	ROBE HOOK
RM.	ROOM
R.O.	ROUGH OPENING
RT	RESILIENT TILE
RWD.	REDWOOD
R.W.L.	RAIN WATER LEADER
S.C.	SOLID CORE
SCD	SEAT COVER DISPENSER
SCHED.	SCHEDULE
SD	SOAP DISPENSER
SECT.	SECTION
SH.	SHELF
SHWR.	SHOWER
SHT.	SHEET
SIM.	SIMILAR
S.M.S.	SHEET METAL SCREW
SND	SANITARY NAPKIN DISPOSAL
SNV	SANITARY NAPKIN VENDOR
SSD	SEE STRUCTURAL DRAWINGS
STD.	STANDARD
STL.	STEEL
STOR.	STORAGE
STRL.	STRUCTURAL
SUSP.	SUSPENDED
TCD	TOILET SEAT COVER DISPENSER
T.D.	TRENCH DRAIN
TRD.	TREAD
T.B.	TOWEL BAR
T.O.C.	TOP OF CURB/CONCRETE
TEL.	TELEPHONE
TER.	TERRAZZO
T.&G.	TONGUE AND GROOVE
THK.	THICK
TK.BD.	TACKBOARD
T.P.	TOP OF PAVEMENT/TELEPHONE PANELBOARD
TPD	TOILET PAPER DISPENSER
T.V.	TELEVISION
TYP.	TYPICAL
T.O.S.	TOP OF STEEL
T.O.W.	TOP OF WALL
U.O.N.	UNLESS OTHERWISE NOTED
VCT	VINYL COMPOSITION TILE
VDB	VISUAL DISPLAY BOARD
VERT.	VERTICAL
VEST.	VESTIBULE
W/	WITH
W.C.	WATER CLOSET
WD.	WOOD
W.O.	WHERE OCCURS
W/O	WITHOUT
WP.	WATERPROOF
WR	WASTE RECEPTACLE
WT.	WEIGHT

ABBREVIATIONS

BLDG. 19 (JONAS CENTER)

OCCUPANCY:	A-2
OCCUPANT LOAD RATIO PER CBC CH. 4 TABLE A :	1/15
FLOOR AREA:	5,635 SF
CALCULATED OCCUPANT LOAD:	376
MALE (50%):	188
FEMALE (50%):	188

CBC PLUMBING 2016 CHAPTER 4 TABLE 422.1

	WATER CLOSETS				LAVATORIES			BATHTUB/ SHOWER	DRINKING FOUNTAIN	OTHER (1 SERVICE SINK OR LAUNDRY TRAY)
	UNISEX	MALE	M. URINAL	FEMALE	UNISEX	MALE	FEMALE			
REQ'D.	0	3	1	4	0	2	2	0	2	1
PROVIDED	0	3	2	6	0	3	3	0	2*	1

NOTES:
M WC PER PERSON: 1: 1-500, 2: 51-150, 3: 151-300, 4: 301-400, 1/200 FOR REMAINDER OVER 400
M UR PER PERSON: 1: 1-100, 2: 201-300, 3: 201-400, 4: 401-600, 1/300 REMAINDER OVER 600
F WC PER PERSON: 1: 1-25, 2: 26-50, 3: 51-100, 4: 101-200, 6:201-300, 8: 301-400, 1/125 FOR REMAINDER OVER 400
M LAV PER PERSON: 1: 1-150, 2: 151-200, 3: 201-400, 1/250 FOR REMAINDER OVER 400
F LAV PER PERSON: 1: 1-150, 2: 151-200, 3: 201-400, 1/200 FOR REMAINDER OVER 400
DF PER PERSON: 1: 1-250, 2: 251-500, 3: 501-750, 1/500 FOR REMAINDER OVER 750. WHERE FOOD IS CONSUMED INDOORS, WATER STATIONS MAY BE SUBSTITUTED FOR DF. BOTTLE FILLING STATIONS SHALL BE PERMITTED TO BE SUBSTITUED FOR DRINKING FOUNTAINS UP TO 50 PERCENT OF THE REQUIREMENTS FOR DRINKING FOUNTAINS. (SEC. 415.2) .
* JONAS CENTER AND BLDG. 18 BOTH HAVE ACCESS TO SINK FOR POTABLE DRINKING WATER.

BLDG. 18

OCCUPANCY:	B
OCCUPANT LOAD RATIO PER TABLE A CPC:	1/200
FLOOR AREA:	1896 SF
CALCULATED OCCUPANT LOAD:	10
MALE (50%):	5
FEMALE (50%):	5

CBC PLUMBING 2016 CHAPTER 4 TABLE 422.1

	WATER CLOSETS				LAVATORIES			BATHTUB/ SHOWER	DRINKING FOUNTAIN	OTHER (1 SERVICE SINK OR LAUNDRY TRAY)
	UNISEX	MALE	M. URINAL	FEMALE	UNISEX	MALE	FEMALE			
REQ'D.	1	0	0	0	1	0	0	0	0	1
PROVIDED	1	0	0	0	1	0	0	0	0	1

NOTES:
M WC PER PERSON: 1: 1-50, 2: 51-100, 3: 101-200, 4:201-400, 1/500 FOR REMAINDER OVER 400
M UR PER PERSON: 1: 1-100, 2: 101-200, 3: 201-400, 4:401-600, 1/300 FOR REMAINDER OVER 600
F WC PER PERSON: 1: 1-15, 2: 16-30, 3: 31-50, 4: 51-100, 6:101-200, 8:201-400, 1/150 FOR REMAINDER OVER 400
M LAV PER PERSON: 1: 1-75, 2: 76-150, 3: 151-200, 4:201-300, 5:301-400, 1/250 FOR REMAINDER OVER 400
F LAV PER PERSON: 1: 1-50, 2: 51-100, 3: 101-150, 4:151-200, 5:201-300, 6:301-400 1/200 FOR REMAINDER OVER 400
DRINKING FOUNTAIN SHALL NOT BE REQUIRED FOR AN OCCUPANT LOAD OF 30 OR LESS (CPC 415.2)
PER CPC 422.2 EXCEPTION 2, IF TOTAL OCCUPANT LOAD DOES NOT EXCEED 50, UNISEX FACILITIES OK

MINIMUM PLUMBING FIXTURE CALCS

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APPLICABLE CODES

1. ALL DIMENSIONS ARE TO FACE OF FINISHED SURFACE, CENTERLINE OF COLUMN, OR OTHER GRID POINT, AND CENTERLINE OF DOOR OR OTHER SCHEDULED OPENING UNLESS OTHERWISE NOTED.
2. DATUM ELEVATION 0'-0" IS GIVEN AS THE BENCHMARK FOR T.O. LEVEL 1.
3. THE CONTRACTOR SHALL COORDINATE LAYOUT DIMENSIONS INDICATED ON THE ELECTRICAL, MECHANICAL, AND PLUMBING DRAWINGS WITH THOSE INDICATED ON THE ARCHITECTURAL BEFORE PROCEEDING WITH THE WORK.
4. REFER TO ARCHITECTURAL DRAWINGS FOR LAYOUT DIMENSIONS AND ELEVATIONS.
5. IN THE EVENT CERTAIN FEATURES OF THE CONSTRUCTION ARE NOT FULLY SHOWN ON THE CONSTRUCTION DOCUMENTS, THEN THEIR CONSTRUCTIONS SHALL BE OF THE SAME CHARACTER AS FOR SIMILAR CONDITIONS THAT ARE SHOWN.
6. THE CONTRACTOR SHALL VERIFY ALL EXISTING ELECTRICAL, MECHANICAL, TELEPHONE, FIRE, AND SECURITY REQUIREMENTS PRIOR TO COMMENCING WITH CONSTRUCTION.
7. ALL DIMENSIONS, ELEVATIONS, AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED ON THE PROJECT SITE BY THE CONTRACTOR AND EACH TRADE PRIOR TO COMMENCING WITH CONSTRUCTION. ANY ERRORS, OMISSIONS, AND DISCREPANCIES SHALL BE BROUGHT TO THE ARCHITECT'S ATTENTION BEFORE CONSTRUCTION BEGINS.
8. ALL ITEMS ARE NEW UNLESS SPECIFICALLY INDICATED OR NOTED AS EXISTING.
9. BRICK INC. HAS PREPARED THESE DOCUMENT ONLY FOR THE SPECIFIED, DETAILED, INDICATED OR SHOWN AS NEW WORK AND ASSUMES NO RESPONSIBILITY FOR OTHER CONSTRUCTION, MATERIAL OR EQUIPMENT NOTED, OR INDICATED BY "PROVIDED BY OTHERS".
10. UNLESS OTHERWISE SPECIFIED, BRICK INC. HAS NEITHER CHECKED, NOR VERIFIED THE STRUCTURAL INTEGRITY, QUALITY OF CONSTRUCTION AND ANY OTHER WORK NOT INCLUDED AS PART OF THESE DOCUMENTS.
11. ALL "MIN", "MAX", AND "CLEAR" DIMENSIONS ARE FROM FACE OF FINISH/SURFACE.
12. PERFORM DEMOLITION OF EXISTING AREAS WITH GREAT CARE IN ORDER NOT TO JEOPARDIZE STRUCTURE AND EQUIPMENT TO REMAIN.
13. ALL WORK SHALL BE PERFORMED IN CONFORMANCE WITH ALL LOCAL, COUNTY, STATE, AND FEDERAL CODES, LAWS, ORDINANCES, AND REGULATIONS APPLICABLE. NOTHING IN THE CONTRACT DOCUMENTS IS TO BE CONSTRUED TO PERMIT WORK NOT CONFORMING TO THESE CODES, LAWS, ORDINANCES AND REGULATIONS.

GENERAL NOTES

PROJECT DIRECTORY

APPLICABLE STATE & LOCAL CODES
- 2016 CALIFORNIA ADMINISTRATIVE CODE (CAC), PART 1, TITLE 24 C.C.R.
- 2016 CALIFORNIA BUILDING CODE (CBC), PART 2, TITLE 24 C.C.R. (2015 INTERNATIONAL BUILDING CODE VOL. 1 & 2, AND 2016 CALIFORNIA AMENDMENTS)
- 2016 CALIFORNIA ELECTRICAL CODE (CEC), PART 3, TITLE 24 C.C.R. (2014 NATIONAL ELECTRICAL CODE AND 2016 CALIFORNIA AMENDMENTS)
- 2016 CALIFORNIA MECHANICAL CODE (CMC), PART 4, TITLE 24 C.C.R. (2015 IAMPO UNIFORM MECHANICAL CODE AND 2016 CALIFORNIA AMENDMENTS)
- 2016 CALIFORNIA PLUMBING CODE (CPC), PART 5, TITLE 24 C.C.R. (2015 IAMPO UNIFORM PLUMBING CODE AND 2016 CALIFORNIA AMENDMENTS)
- 2016 CALIFORNIA ENERGY CODE (CEC), PART 6, TITLE 24 C.C.R.
- 2016 CALIFORNIA FIRE CODE, PART 9, TITLE 24 C.C.R. (2015 INTERNATIONAL FIRE CODE AND 2016 CALIFORNIA AMENDMENTS)
- 2016 CALIFORNIA EXISTING BUILDING CODE (CEBC), PART 10, TITLE 24 C.C.R. (2015 INTERNATIONAL EXISTING BUILDING CODE AND 2016 CALIFORNIA AMENDMENTS)
- 2016 CALIFORNIA GREEN BUILDING STANDARDS CODE (CALGREEN), PART 11, TITLE 24 C.C.R.
- 2016 CALIFORNIA REFERENCED STANDARDS CODE, PART 12, TITLE 24 C.C.R.
- 2016 TITLE 19 C.C.R., PUBLIC SAFETY, STATE FIRE MARSHAL REGULATION
- 2013 ASME A17.1/CSA B44-13 SAFETY CODE FOR ELEVATORS AND ESCALATORS
- WILDFIRE URBAN INTERFACE ZONE

PARTIAL LIST OF APPLICABLE STATE STANDARDS
- NFPA 13, STANDARD FOR THE INSTALLATION OF SPRINKLERS SYSTEMS (CA AMENDED) 2016 EDITION
- NFPA 14, STANDARD FOR THE INSTALLATION OF STANDPIPE AND HOSE SYSTEMS, 2016 EDITION
- NFPA 17, STANDARD FOR DRY CHEMICAL EXTINGUISHING SYSTEMS, 2013 EDITION
- NFPA 17A, STANDARD FOR WET CHEMICAL EXTINGUISHING SYSTEMS, 2013 EDITION
- NFPA 20, STANDARD FOR THE INSTALLATION OF STATIONARY PUMPS FOR FIRE PROTECTION, 2016 EDITION
- NFPA 22, STANDARD FOR WATER TANKS FOR PRIVATE FIRE PROTECTION, 2013 EDITION
- NFPA 24, STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES, 2016 EDITION
- NFPA 72, NATIONAL FIRE ALARM CODE (CA AMENDED) 2016 EDITION
- NFPA 80, STANDARD FOR FIRE DOORS AND OTHER OPENING PROTECTIVES, 2016 EDITION
- NFPA 2001, STANDARD ON CLEAN AGENT FIRE EXTINGUISHING SYSTEMS, 2015 EDITION
- UL 300 STANDARD FOR FIRE TESTING OF FIRE EXTINGUISHING SYSTEMS FOR PROTECTIONOF COMMERCIAL COOKING EQUIPMENT 2005 (R2010)
- UL 464, AUDIBLE SIGNALING DEVICES FOR FIRE ALARM AND SIGNALING SYSTEMS, INCLUDING ACCESSORIES, 2003 EDITION
- UL 521, STANDARD FOR HEAT DETECTORS FOR FIRE PROTECTIVE SIGNALING SYSTEMS, 1999 EDITION
- UL 1971, STANDARD FOR SIGNALING DEVICES FOR THE HEARING IMPAIRED, 2002 EDITION
- ICC 300, STANDARD FOR CLEACHERS, FOLDING, AND TELESCOPIC SEATING, AND GRANDASTANDS, 2012 EDITION
- REFERENCE CODE SECTION FOR NFPA STANDARDS - CBC (SFM) 3504.1
- ASME A17.1-2016 FOR SECTION 7-3094 PART 7, C.C.R. TITLE 24
- ASME A18.1-2014 FOR SECTION 7-3094 PART 7, C.C.R. TITLE 24
- ANSI/BHMA A156.10-1985 AMERICAN NATIONAL STANDARD FOR POWER OPERATED PEDESTRIAN DOORS
- ANSI A156.19-1984 AMERICAN NATIONAL STANDARD FOR POWER ASSIST AND LOW ENERGY POWER OPERATED DOORS

APPLICABLE ACCESSIBILITY STANDARDS
- 2016 CALIFORNIA BUILDING CODE (CBC) CHPT. 11B
- AMERICANS WITH DISABILITIES ACT (ADA) USING 2010 ADA STANDARDS (ADAS) FOR ALL PUBLIC ACCOMMODATION AREAS

APPLICABLE CODES

PROJECT DIRECTORY

PROJECT DESCRIPTION

- APN: 150-480-12
- PROPERTY OWNER: COLLEGE OF MARIN
- PROPERTY: 333.42 ACRES (INDIAN VALLEY CAMPUS)
- ZONING DESIGNATION : CF (COMMUNITY FACILITIES)
- GENERAL PLAN DESIGNATION: CF (COMMUNITY FACILITIES)

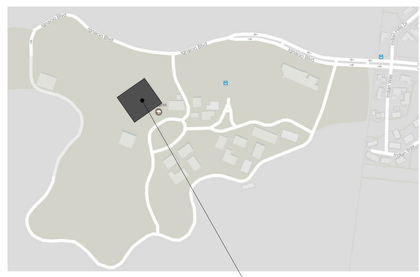
THE SCOPE OF WORK INCLUDES BRIDGING DOCUMENT LEVEL OF DESIGN FOR TWO SEPARATE BUILDINGS, A PARKING LOT AND GENERAL SITE WORK IN ASSOCIATION WITH THE BUILDINGS. THE DESCRIPTION OF SCOPE IS AS FOLLOWS:

NEW CONSTRUCTION OF THE BILL AND ADELE JONAS CENTER, (BUILDING 19, A COMMUNITY AND BANQUET EVENT FACILITY), THE NEW ONE-STORY 10,800 SF BUILDING WILL BE CONSTRUCTED PRIMARILY WITHIN THE FOOTPRINT OF THE EXISTING BUILDING FOUNDATION. THE FACILITY WILL PROVIDE CAPACITY FOR A 300 SEAT BANQUET HALL, A RAISED PLATFORM, RESTROOMS, PREP KITCHEN AND SUPPORT SPACE. THE SCOPE ALSO INCLUDES AN ADDITION OF A ONE-STORY LOUNGE SPACE.

ALTERATIONS TO EXISTING BUILDING 18
THE EXISTING BUILDING 18 IS A ONE-STORY, 4,800 SF TYPE V-B BUILDING. THE ALTERATION SCOPE INCLUDES DESIGN OF A NEW COMMERCIAL KITCHEN, LAUNDRY ROOM, STORAGE, OFFICE, MEETING ROOMS AND REPLACEMENT OF EXISTING WINDOWS AND EXTERIOR FINISH.

GENERAL SITE WORK
A NEW PARKING LOT WITH A PASSENGER DROP-OFF AREA, BICYCLE PARKING, SLOPED WALKWAY FROM THE UPPER LEVEL BLDG. 18 TO THE LOWER LEVEL JONAS CENTER, AN OUTDOOR PRE-FUNCTION SPACE, A COVERED TRELLIS AREA OUTSIDE THE LOUNGE, AN EXTERIOR DECK ADJACENT TO THE BANQUET HALL, A SLOPED WALKWAY CONNECTING BUILDING 18 TO THE PREP KITCHEN AND AN ACCESSIBLE PATH OF TRAVEL FROM BUILDING 18 AND THE JONAS CENTER TO THE EXISTING PEDESTRIAN BRIDGE #7 AND EXISTING PARKING LOT #4.

PROJECT INFORMATION



VICINITY MAP

SHEET INDEX

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rev	date	issue
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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 12/1/2017 5:21:36 PM

scale: as noted

date:

PROJECT INFORMATION, GENERAL NOTES

G0.1

BUILDING CODE ANALYSIS

OCCUPANCY AND CONSTRUCTION TYPE (CBC CH. 3)

CONSTRUCTION TYPE: VB
FIRE SUPRESSION: FULLY SPRINKLERED
OCCUPANCY GROUP: A2 (ASSEMBLY)
B (BUSINESS)

ALLOWABLE BLDG. HEIGHT AND NO. OF STORIES ABV. GRADE PLANE

	ALLOWABLE HEIGHT (CBC TABLE 504.3)	PROPOSED BUILDING HEIGHT	ALLOWABLE NO. OF STORIES (CBC TABLE 504.4)	PROPOSED NO. OF STORIES
OCCUPANCY GROUP A2, B	60'	29'-8"	2	1

ALLOWABLE AREA (PER CBC CH. 5)

OCCUPANCY CLASSIFICATION	ALLOWABLE AREA (CBC TABLE 506.2)	BUILDING AREA PER PLANS	
A2,B	24,000*	15,600	*MOST RESTRICTIVE ALLOWABLE AREA IS USED. PROJECT HAS NON-SEPARTED OCCUPANCIES BUILDING HAS AUTOMATIC NFPA-13 SPRINKLER SYSTEM AS AMENDED IN CBC. CH. 35, EXCEPT AS PROVIDED IN SECTION 903.3.1.1

FIRE RESISTANCE RATING REQUIREMENTS (CBC TABLE 601)

BUILDING ELEMENT	FIRE SEPARATION	FIRE RESISTIVE RATING (HRS)		REMARKS
		REQUIRED	PROVIDED	
PRIMARY STRUCTURAL FRAME		0	0	
BEARING WALLS - EXTERIOR & INTERIOR		0	0	
NON-BEARING WALLS - EXTERIOR BASED ON FIRE SEPARATION DISTANCE (CBC TABLE 602)	SEE PLANS	SEE PLANS	SEE PLANS	
NON-BEARING WALLS - INTERIOR	SEE PLANS	0	0	
FLOOR CONST. & ASSOC. SECONDARY MEMBERS		0	0	
ROOF CONST. & ASSOC. SECONDARY MEMBERS		0	0	

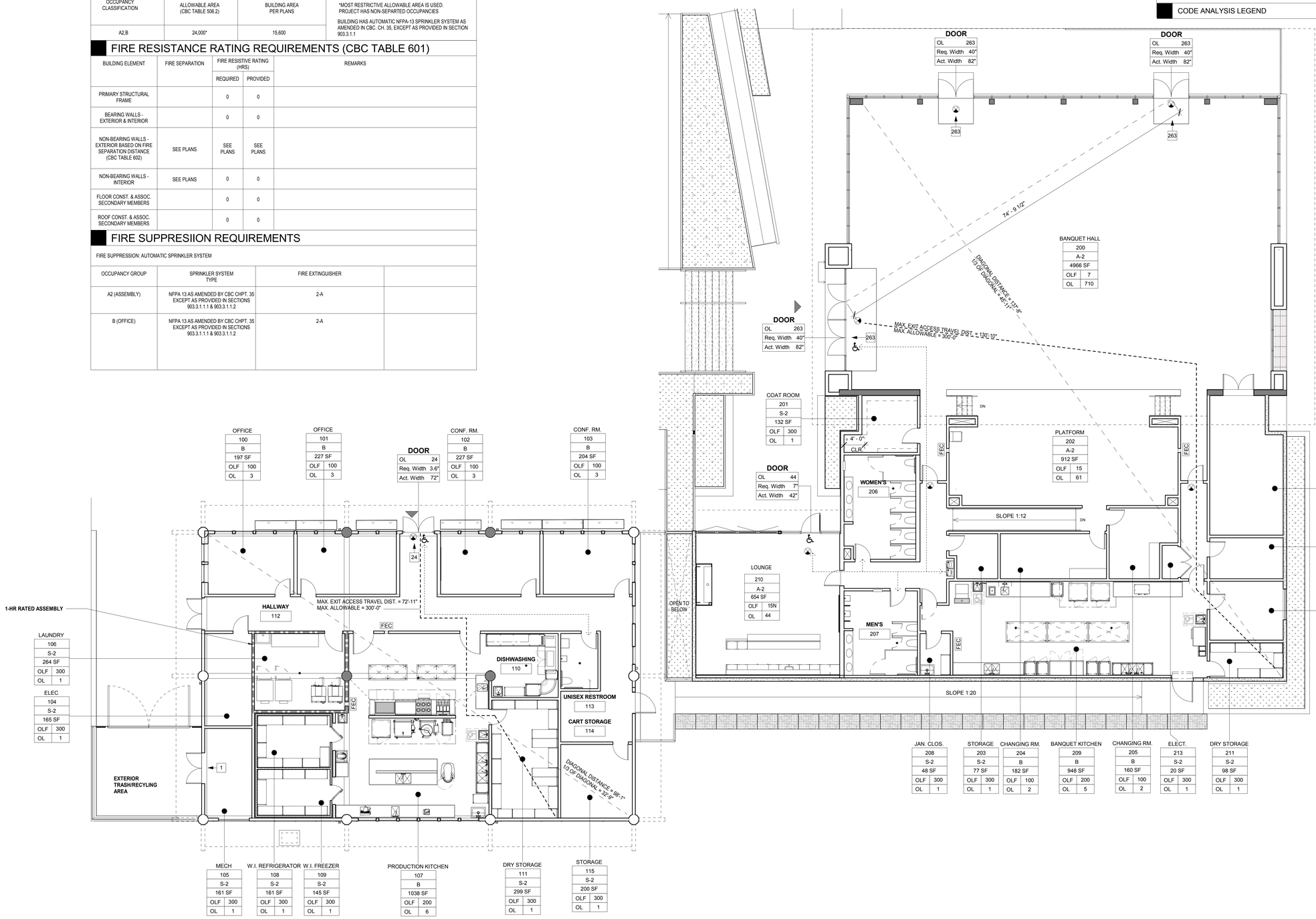
FIRE SUPPRESIION REQUIREMENTS

FIRE SUPPRESSION: AUTOMATIC SPRINKLER SYSTEM

OCCUPANCY GROUP	SPRINKLER SYSTEM TYPE	FIRE EXTINGUISHER	
A2 (ASSEMBLY)	NFPA 13 AS AMENDED BY CBC CHPT. 35 EXCEPT AS PROVIDED IN SECTIONS 903.3.1.1.1 & 903.3.1.1.2	2-A	
B (OFFICE)	NFPA 13 AS AMENDED BY CBC CHPT. 35 EXCEPT AS PROVIDED IN SECTIONS 903.3.1.1.1 & 903.3.1.1.2	2-A	

1 HR RATED WALL ASSEMBLY
ACCESSIBLE PATH OF TRAVEL
X — OCCUPANT LOAD AT EXIT
ROOM — ROOM NAME
B — OCCUPANCY GROUP
200 SF — AREA
OLF 100 — OCCUPANT LOAD FACTOR
OL 1 — OCCUPANT LOAD
ILLUMINATED EXIT SIGN
FEC — FIRE EXTINGUISHER CABINET
ENTRY

CODE ANALYSIS LEGEND



1 JONAS CENTER - CODE ANALYSIS — 1/8" = 1'-0"

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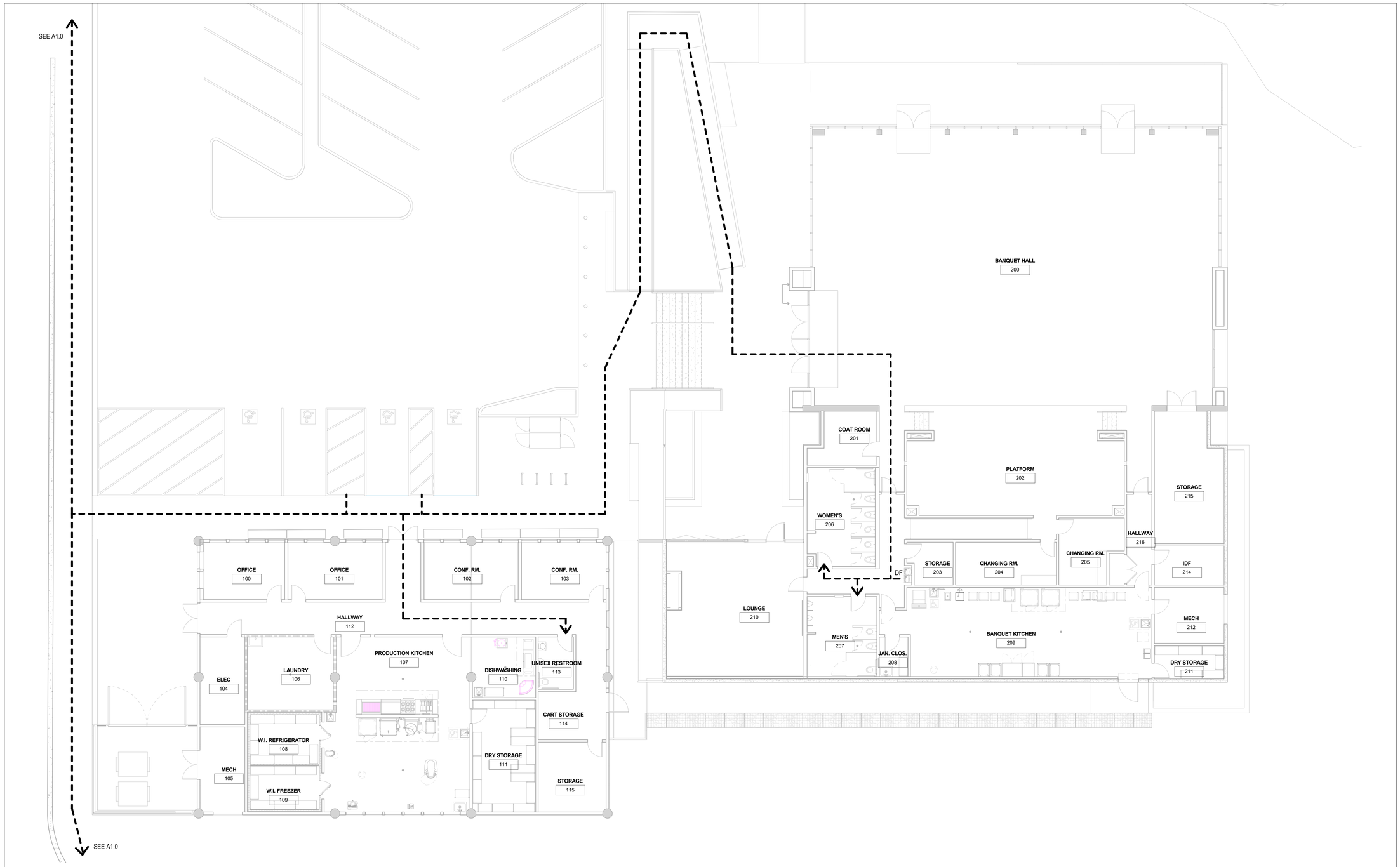
CODE ANALYSIS PLAN

G1.0



1 ACCESSIBLE PATH OF TRAVEL DIAGRAM 1/8" = 1'-0"

PER DSA PROCEDURE 15-01
DESIGN PROFESSIONAL IN GENERAL RESPONSIBLE CHARGE STATEMENT:
THE PATH OF TRAVEL (POT) IDENTIFIED IN THESE CONSTRUCTION DOCUMENTS MEETS THE REQUIREMENTS OF THE CURRENT APPLICABLE CALIFORNIA BUILDING CODE (CBC) ACCESSIBILITY PROVISIONS FOR PATH OF TRAVEL REQUIREMENTS FOR ALTERATIONS, ADDITIONS, AND STRUCTURAL REPAIRS. AS PART OF THE DESIGN OF THIS PROJECT, THE POT WAS EXAMINED AND ANY ELEMENTS, COMPONENTS, OR PORTIONS OF THE POT THAT WERE DETERMINED TO BE NONCOMPLIANT WITH THE CBC HAVE BEEN IDENTIFIED AND THE CORRECTIVE WORK NECESSARY TO BRING THEM INTO COMPLIANCE HAS BEEN INCLUDED WITHIN THE SCOPE OF THIS PROJECT'S WORK THROUGH DETAILS, DRAWINGS AND SPECIFICATIONS INCORPORATED INTO THESE CONSTRUCTION DOCUMENTS. ANY NONCOMPLIANT ELEMENTS, COMPONENTS, OR PORTIONS OF THE POT THAT WILL NOT BE CORRECTED BY THIS PROJECT BASED ON VALUATION THRESHOLD LIMITATIONS OR A FINDING OF UNREASONABLE HARDSHIP ARE INDICATED IN THESE CONSTRUCTION DOCUMENTS.

DURING CONSTRUCTION, IF POT ITEMS WITHIN THE SCOPE OF THE PROJECT REPRESENTED AS CBC COMPLIANT ARE FOUND TO BE NONCONFORMING BEYOND REASONABLE CONSTRUCTION TOLERANCES, THE ITEMS SHALL BE BROUGHT INTO COMPLIANCE WITH THE CBC AS A PART OF THIS PROJECT BY MEANS OF A CONSTRUCTION CHANGE DOCUMENT.

DSA PR 15-01

ACCESSIBLE PATH OF TRAVEL

ACCESSIBILITY LEGEND

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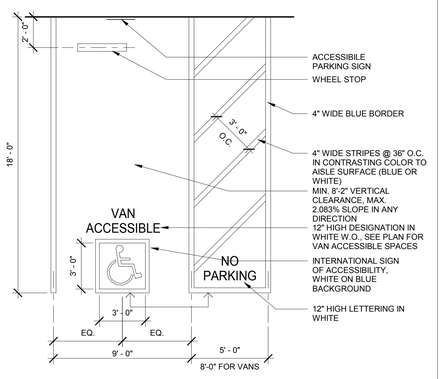
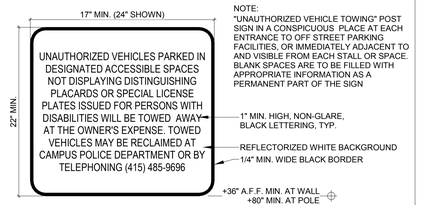
ACCESSIBILITY PATH OF TRAVEL PLAN

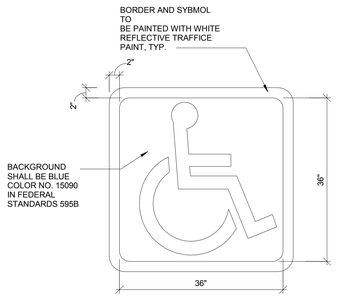
G2.0



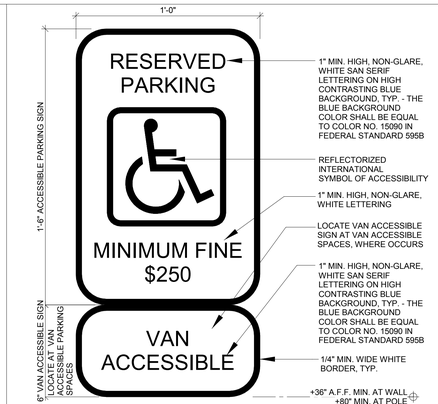
17 ACCESSIBLE PARKING STALL 1/4" = 1'-0"



16 UNAUTHORIZED VEHICLE TOWING SIGN 1 1/2" = 1'-0"



12 ACCESSIBLE FLOOR SYMBOL 1" = 1'-0"

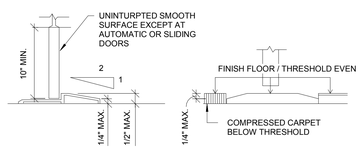


8 ACCESSIBLE PARKING STALL SIGN 3" = 1'-0"

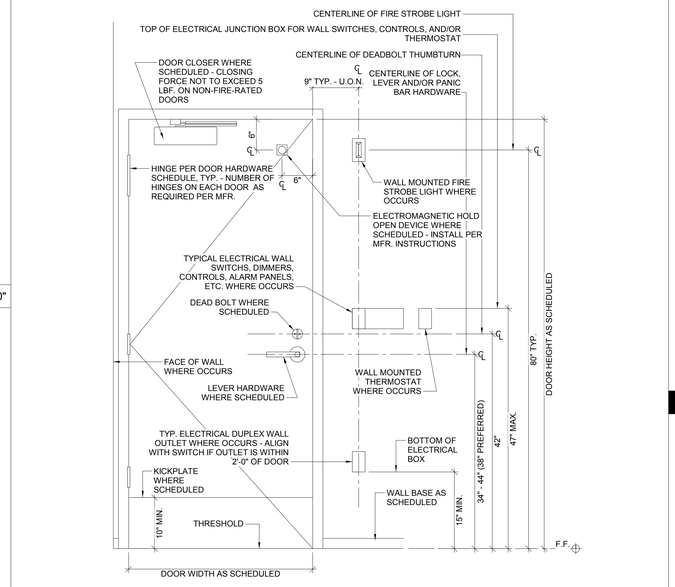
GENERAL BRAILLE NOTES:

1. BEADED BRAILLE CONTRACTED GRADE 2 "BEADED BRAILLE", DOTS, ROUNDED OR OVAL
2. THE INDICATION OF UPPERCASE LETTERS SHALL ONLY BE USED FOR FIRST WORDS, SENTENCES, PROPER NOUNS, INDIVIDUAL LETTER OF ALPHABET, INITIALS AND ACRONYMS.
3. DOT DIAMETER: 0.059 (1.5MM) TO 0.63 (1.6MM).
4. DISTANCE BETWEEN TWO DOTS IN SAME CELL MEASURED CENTER TO CENTER: 0.100 (2.5MM).
5. DISTANCE BETWEEN CORRESPONDING DOTS IN ADJACENT CELLS MEASURED CENTER TO CENTER: 0.395 (0.6MM) TO 0.37 (0.9MM).
6. DISTANCE BETWEEN CORRESPONDING DOTS FROM ONE CELL DIRECTLY BELOW MEASURED CENTER TO CENTER: 0.395 (10.0 MM) TO 0.400 (10.2 MM).
7. BRAILLE SHALL BE POSITIONED BELOW THE CORRESPONDING TEXT IN A HORIZONTAL FORMAT, FLUSH LEFT OR CENTERED. IF TEXT IS MULTILINED, BRAILLE SHALL BE PLACED BELOW THE ENTIRE TEXT. BRAILLE SHALL BE SEPARATED 3/8" (9.5 MM) MIN. ANDAND 1/2" (12.7 MM) MAX. FROM OTHER TACTILE CHARACTERS AND 3/8" (9.5 MM) MIN. FROM RAISED BOARDERS AND DOCORATIVE ELEMENTS.
8. BRAILLE SHALL BE PAINTED TO MATCH THE FIELD COLOR IN WHICH IT IS PLACED AND THE SIGN SHALL RECEIVE A CLEAR COAT TO PROTECT BRAILLE PLACEMENT.
9. ALL BRAILLE LAYOUTS SHALL BE INDEPENDENTLY VERIFIED BY AN APPROVED CITY VENDOR FOR EXAMPLE, LIGHTHOUSE FOR THE BLIND.
10. RAISED TEXT AND BARILLE SHALL NOT BE PLACED WITHIN A PICTOGRAM'S REQUIRED 6" (152 MM) MIN. FIELD HEIGHT.

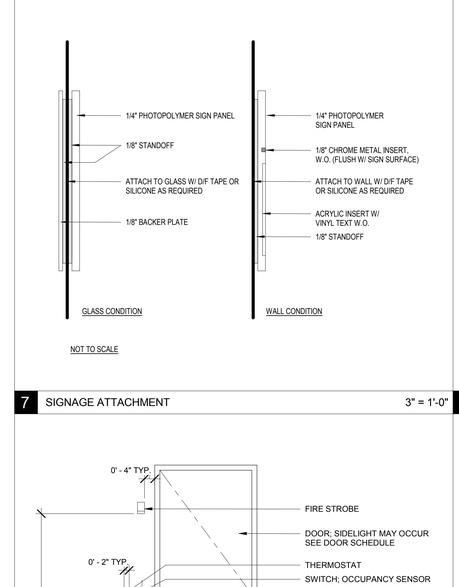
4 TYPICAL BRAILLE NOTES 1/2" = 1'-0"



15 DOOR THRESHOLD DETAIL 3" = 1'-0"

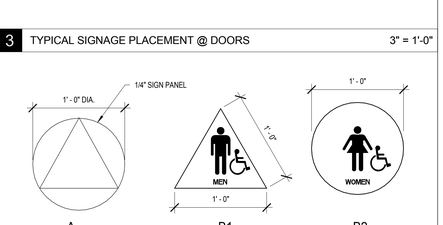


10 TYPICAL ACCESSIBLE DOOR HARDWARE & ELECTRICAL WALL MOUNTING HEIGHTS 1" = 1'-0"



1. ABRUPT CHANGES IN LEVEL, EXCEPT BETWEEN A WALK OR SIDEWALK AND AN ADJACENT STREET OR DRIVEWAY, EXCEEDING 4" IN A VERTICAL DIMENSION, SUCH AS AT PLANTERS OR FOUNTAINS LOCATED IN OR ADJACENT TO WALKS, SIDEWALKS, OR OTHER PEDESTRIAN WAYS, SHALL BE IDENTIFIED BY WARNING CURBS PROJECTING AT LEAST 6" IN HEIGHT ABOVE THE WALK OR SIDEWALK SURFACE TO WARN THE BLIND OF A POTENTIAL DROP OFF.
2. WHEN A GUARDRAIL OR HANDRAIL IS PROVIDED, NO WARNING CURB IS REQUIRED WHEN A GUIDERAIL IS PROVIDED CENTERED 3" ± 1" ABOVE THE SURFACE OF THE WALK OR SIDEWALK, THE WALK IS 5 PERCENT OR LESS GRADIENT, OR NO ADJACENT HAZARD EXISTS.
3. OBJECTS PROJECTING FROM WALLS WITH THEIR LEADING EDGES BETWEEN 27" AND 80" ABOVE THE FINISHED FLOOR SHALL PROTRUDE NO MORE THAN 4" INTO WALKS, HALLS, CORRIDORS, PASSAGEWAYS, OR AISLES.
4. FREE-STANDING OBJECTS MOUNTED ON POSTS OR PYLONS MAY OVERHANG 12" MAXIMUM FROM 27" TO 80" ABOVE THE GROUND OR FINISHED FLOOR.
5. PROTRUDING OBJECTS SHALL NOT REDUCE THE CLEAR WIDTH OF AN ACCESSIBLE ROUTE OR MANEUVERING SPACE.
6. WALKS, HALLS, CORRIDORS, PASSAGEWAYS, AISLES OR OTHER CIRCULATION SPACES SHALL HAVE 80" MIN CLR HEADROOM.
7. ANY OBSTRUCTION, SUCH AS A POST-MOUNTED SIGN, THAT OVERHANGS A PEDESTRIAN WAY SHALL BE AMINIMUM OF 80" ABOVE THE WALKING SURFACE AS MEASURED FROM THE BOTTOM OF THE OBSTRUCTION.

5 PROTRUDING OBJECTS CLEARANCES 3/8" = 1'-0"

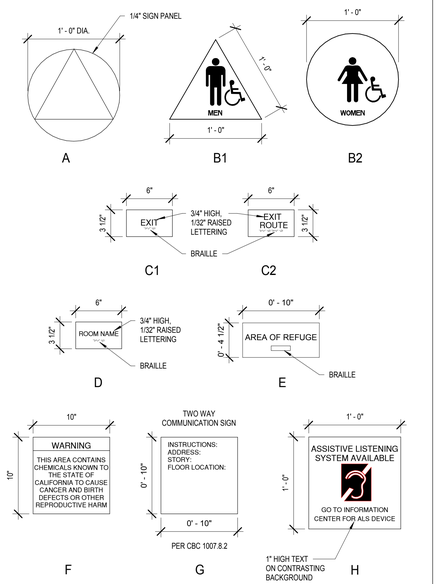


NOT TO SCALE

7 SIGNAGE ATTACHMENT 3" = 1'-0"

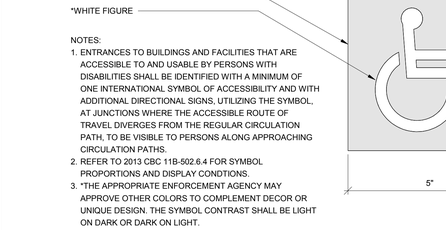
NOTE: SIGNAGE SHALL BE LOCATED SO THAT A CLEAR FLOOR AREA OF 18"X18" MIN. CENTERED ON TACTILE CHARACTER IS PROVIDED BEYOND ARC OF SWING DOOR.
ROOM ID OR EXIT SIGNAGE - MOUNT ON LATCH SIDE OF DOOR. WHERE THERE IS NO WALL SPACE ON THE LATCH SIDE, INCLUDING DOUBLE LEAF DOORS, SIGNS SHALL BE PLACED ON THE NEAREST ADJOINING WALL, PREFERABLY ON THE RIGHT OR, WHEN OCCURS, GLASS SURFACE.

3 TYPICAL SIGNAGE PLACEMENT @ DOORS 3" = 1'-0"

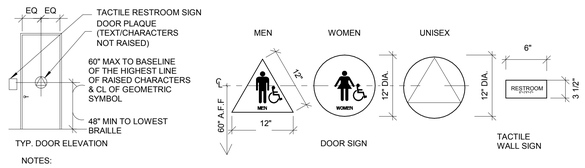


GENERAL NOTES:
1. ALL BRAILLE IS CALIFORNIA CONTRACTED GRADE 2 BRAILLE
2. ALL TEXT AND SYMBOLS SHALL HAVE 70% LRV MIN. CONTRAST W/ BACKGROUND
3. SIGN BACKGROUND COLOR SHALL BE WHITE, TEXT AND SYMBOLS SHALL BE DARK GREY
4. SEE 7- FOR SIGN ATTACHMENT METHODS
5. **RAISED CHARACTERS:**
   CASE: ALL UPPER CASE
   STYLE / TYPE FACE: HELVETICA MEDIUM
   PROPORTION: WIDTH OF UPPERCASE LETTER "O" IS 60% MIN. AND 100% MAX. OF HEIGHT OF UPPERCASE LETTER "I"
   STROKE THICKNESS: UPPERCASE LETTER "I" SHALL BE 15% MAX. OF HEIGHT OF THE CHARACTER
   CHARACTER SPACING: PER CBC 11B-703.2.7
   LINE SPACING: PER CBC 11B-703.2.8
6. **BRAILLE**:
   DIMENSIONS & CAPITALIZATION: PER CBC 11B-703.3.1
   POSITION: PER CBC 11B-703.3.2
   INSTALLATION HEIGHT & LOCATION: PER CBC 11B-703.4

1 SIGNAGE TYPES 1 1/2" = 1'-0"



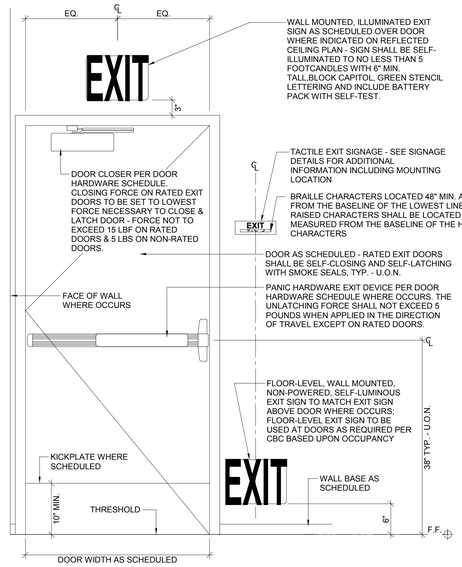
14 ACCESSIBLE DETAIL AT ENTRY 6" = 1'-0"



NOTES:

1. SIGNS PER CALIFORNIA BUILDING CODE
2. ALL ACCESSIBLE TOILET AND BATHING FACILITIES SHALL BE IDENTIFIED BY THE "INTERNATIONAL SYMBOL OF ACCESSIBILITY."
3. DOORWAYS LEADING TO SANITARY FACILITIES SHALL BE IDENTIFIED BY A GEOMETRIC SYMBOL IN COMPLIANCE WITH THIS SECTION. GEOMETRIC SYMBOLS SHALL BE CENTERED HORIZONTALLY ON THE DOOR AT A HEIGHT OF 60" ABOVE THE FINISH FLOOR OR GROUND SURFACE MEASURED TO THE CENTER OF THE SYMBOL. EDGES OF ACCESSIBILITY SIGNAGE SHALL BE ROUNDED, CHAMFERED OR EASED. CORNERS SHALL HAVE A MINIMUM RADIUS OF 1/8". SEE 2013 CBC SECTION 11B-703.4.2 FOR SIGNAGE REQUIREMENTS APPLICABLE TO TACTILE SIGNAGE.
4. MEN'S SANITARY FACILITIES SHALL BE IDENTIFIED BY AN EQUILATERAL TRIANGLE, 1/4 " THICK WITH EDGES 12" LONG AND A VERTEX POINTING UPWARD. THE TRIANGLE SYMBOL SHALL CONTRAST WITH THE DOOR, EITHER LIGHT ON A DARK BACKGROUND OR DARK ON A LIGHT BACKGROUND.
5. WOMEN'S SANITARY FACILITIES SHALL BE IDENTIFIED BY A CIRCLE, 1/4" THICK AND 12" IN DIAMETER. THE CIRCLE SYMBOL SHALL CONTRAST WITH THE DOOR, EITHER LIGHT ON A DARK BACKGROUND OR DARK ON A LIGHT BACKGROUND.
6. UNISEX SANITARY FACILITIES SHALL BE IDENTIFIED BY A CIRCLE, 1/4 " THICK AND 12" IN DIAMETER WITH A 1/4" THICK TRIANGLE SUPERIMPOSED ON THE CIRCLE AND WITHIN THE 12" DIAMETER. THE TRIANGLE SYMBOL SHALL CONTRAST WITH THE CIRCLE SYMBOL, EITHER LIGHT ON A DARK BACKGROUND OR DARK ON A LIGHT BACKGROUND. THE CIRCLE SYMBOL SHALL CONTRAST WITH THE DOOR, EITHER LIGHT ON A DARK BACKGROUND OR DARK ON A LIGHT BACKGROUND.
7. CHARACTERS, SYMBOLS AND THEIR BACKGROUND SHALL HAVE A NONGLARE FINISH. CHARACTERS AND SYMBOLS SHALL CONTRAST WITH THEIR BACKGROUND, EITHER LIGHT ON A DARK BACKGROUND OR DARK ON A LIGHT BACKGROUND. CHARACTERS ON SIGNS SHALL HAVE A WIDTH-TO-HEIGHT RATIO OF BETWEEN 3:5 AND 1:1 AND A STROKE WIDTH-TO-HEIGHT RATIO OF BETWEEN 1:5 AND 1:10. CHARACTERS TO BE SANS SERIF UPPERCASE. LETTTERS AND NUMERALS ON TACTILE SIGNS ARE RAISED 1/32".
8. CHARACTERS TO BE ACCOMPANIED BY GRADE 2 BRAILLE. BRAILLE DOTS ARE 1/10" ON CENTER IN EACH CELL WITH 2/10" SPACE BETWEEN CELLS. BRAILLE DOTS ARE RAISED A MINIMUM OF 1/40" ABOVE THE BACKGROUND.
9. MOUNTING HEIGHT IS 60" FROM THE FINISH FLOOR TO THE CENTERLINE OF THE SIGN.

13 RESTROOM SIGNAGE 1" = 1'-0"



9 TYPICAL EXIT DOOR DETAIL 1" = 1'-0"

NOTES:
1. SEE SECURITY SYSTEM, ELECTRICAL, MECHANICAL DRAWINGS FOR NUMBER OF DEVICES & LOCATIONS. DETAIL INDICATES MOUNTING HEIGHT OF EACH DEVICE WHEN OCCURS.
2. WHERE REACH OVER OBSTRUCTION IS 20" TO 24" (IE KITCHEN COUNTERS), HEIGHT IS REDUCED TO 44" MAX. TO TOP OF BOX FOR FORWARD APROACH OR 46" MAX. FOR SIDE APPROACH

6 TYPICAL DEVICE LOCATIONS 1/2" = 1'-0"

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ACCESSIBILITY DETAILS

G3.0

1. ALL STOREFRONT DOORS, ENTRANCE DOORS, EXIT DOORS, AND DOORS ON AN ACCESSIBLE ROUTE SHALL BE MADE ACCESSIBLE AND FULLY COMPLY WITH ADA & CBC TITLE 24 REQUIREMENTS FOR ACCESSIBILITY UNLESS THEY ARE EXISTING OR OTHERWISE NOTED.

2. THE FOLLOWING APPLIES TO ALL ADA & CBC TITLE 24 COMPLIANT ACCESSIBLE DOORS UNLESS OTHERWISE NOTED:

   A. THE THRESHOLD SHALL NOT BE MORE 1/2" ABOVE THE FINISH FLOOR OR CONCRETE FLATWORK. THE FINISH FLOOR LEVEL IS DEFINED AS THE TOP SURFACE OF THE FINISH FLOORING MATERIAL. SEE "TYPICAL DOOR CLEARANCES & HARDWARE MOUNTING GUIDE" ON THIS SHEET FOR OTHER TYPICAL REQUIREMENTS.

   B. THE BOTTOM 10 INCHES OF ALL DOORS EXCEPT AUTOMATIC AND SLIDING DOORS WILL HAVE A SMOOTH UNINTERRUPTED SURFACE TO ALLOW THE DOOR TO BE OPENED BY A WHEELCHAIR FOOTREST WITHOUT CREATING A TRIP OR HAZARDOUS CONDITION. WHERE NARROW FRAME DOORS ARE USED. A 10 INCH HIGH SMOOTH PANEL SHALL BE INSTALLED ON THE PUSH SIDE OF THE DOOR WHICH WILL ALLOW THE DOOR TO BE OPENED BY A WHEELCHAIR FOOTREST WITHOUT CREATING A TRAP OR HAZARDOUS CONDITION, TYP.

   C. THE DOORWAY SHALL BE OF A SIZE AS TO PERMIT THE INSTALLATION OF A DOOR NOT LESS THAN 3 FEET IN WIDTH AND NOT LESS THAN 6 FEET 8 INCHES IN HEIGHT. DOORS SHALL BE CAPABLE OF OPENING AT LEAST 90 DEGREES AND SHALL BE MOUNTED SO THAT THE CLEAR WIDTH OF THE DOORWAY IS NOT LESS THAN 32 INCHES.

   D. THE MAXIMUM OPENING FORCE OF A DOOR WITH A CLOSER SHALL NOT EXCEED 5 LBS FOR EXTERIOR AND INTERIOR DOORS WHILE FIRE DOORS SHALL NOT EXCEED 15 LBS. THE SWEEP PERIOD OF THE CLOSER SHALL BE ADJUSTED SO THAT FROM AN OPEN POSITION OF 90 DEGREES, THE DOOR WILL TAKE AT LEAST 5 SECONDS TO MOVE TO A POINT 12 DEGREES FROM THE LATCH. AUTOMATIC-CLOSING FIRE OR SMOKE DOORS BY SMOKE DETECTORS SHALL NOT HAVE A CLOSING OR RE-CLOSING DELAY OF MORE THAN 10 SECONDS.

   E. LATCHING AND LOCKING DOORS THAT ARE HAND ACTIVATED AND WHICH ARE IN A PATH OF TRAVEL SHALL BE OPERABLE WITH A SINGLE EFFORT BY LEVER TYPE HARDWARE, PANIC BARS, PUSH-PULL ACTIVATING BARS, OR OTHER HARDWARE DESIGNED TO PROVIDE PASSAGE WITHOUT THE ABILITY TO GRASP THE OPENING HARDWARE AND SHALL NOT REQUIRE TIGHT GRASPING, PINCHING, OR TWISTING OF THE WRIST.

3. **EXIT DOORS:** REGARDLESS OF OCCUPANT LOAD SERVED, EXIT DOORS SHALL BE OPERABLE FROM THE INSIDE WITHOUT THE USE OF A KEY OR ANY SPECIAL KNOWLEDGE OR EFFORT. REVOLVING, SLIDING, AND OVERHEAD DOORS ARE NOT PERMITTED AS REQUIRED EXIT DOORS WHEN SERVING HAZARDOUS AREAS OR AN OCCUPANT LOAD OF 10 OR MORE.

4. **RATED DOORS:** ALL RATED DOORS SHALL BE POSITIVE LATCHING AND INCLUDE A CLOSER. RATED ASSEMBLIES SHALL BE PROVIDED WITH APPROVED GASKETING MATERIAL INSTALLED TO PROVIDE A SEAL WHERE THE DOOR MEETS THE STOP ON BOTH SIDES & THE TOP. THE MANUFACTURER'S INSTALLATION INSTRUCTIONS SHALL BE AVAILABLE ON THE JOB SITE FOR ALL RATED DOOR ASSEMBLIES.

5. **SAFETY GLAZING:** IN THE FOLLOWING LOCATIONS SHOULD BE OF SAFETY GLAZING MATERIAL IN ACCORDANCE WITH SECTION 2406.4 OF CBC TITLE 24:
   A. INGRESS AND EGRESS DOORS EXCEPT JALOUSIES.
   B. FIXED AND SLIDING PANELS OF SLIDING DOOR ASSEMBLIES AND PANELS IN SWINGING DOORS OTHER THAN WARDROBE DOORS.
   C. UNFRAMED SWINGING DOORS

6. **POWERED DOORS**: POWERED DOOR OR GATE OPERATORS MAY SUBSTITUTE FOR AN INTERIOR OR EXTERIOR DOOR OR GATE OPERATING FORCE OF 5 POUND PRESSURE (22.2 N) (11B-404.2.9). WHEN PROVIDED, POWERED DOOR OPERATORS SHALL COMPLY WITH BHMA A156.10, OR LOW ENERGY OPERATED DOORS BHMA156.19.

   A. NUMBER OF ACTUATORS: AT A PAIR OF DOORS, A MINIMUM OF ONE DOOR LEAF SHALL BE AN POWERED DOOR. WHEN AT A SINGLE LOCATION, ONE OF EVERY EIGHT EXTERIOR DOOR LEAFS, OR FRACTION THEREOF. A MINIMUM OF ONE PAIR OF DOORS SHALL BE A POWERED DOOR. OTHER DOORS LEAFS IN THE CLUSTER MAY HAVE A MAXIMUM DOOR OPENING FORCE OF 8 ½ POUNDS (37.8 N).

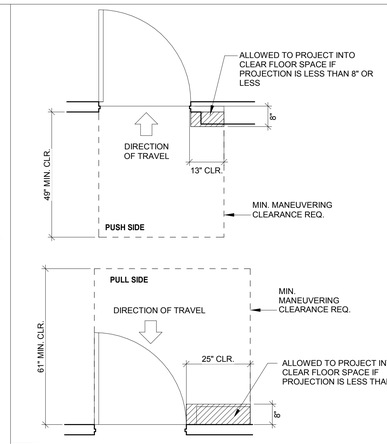
   B. DOOR ACTUATORS, SENSING DEVICES, PUSH PLATES, VERTICAL ACTUATION BARS OR OTHER SIMILAR DEVICES: ACTUATORS SHALL BE PROVIDED WITH LEVEL CLEAR FLOOR AREAS COMPLYING WITH 11B-304 AND 11B-305, AND WITHOUT PROTRUDING OBSTRUCTIONS NOT OTHERWISE IN COMPLIANCE WITH 11B-307. OPERABLE PARTS COMPLYING WITH 11B-308.

   C. POWER DISCONNECT: KEYED OR TOGGLE SWITCH FOR DISCONNECTING POWER TO THE DEVICE SHALL BE PROVIDED IN THE NEAR VICINITY OF THE POWERED DOOR. AN ACTUATOR IS PERMITTED TO CONTAIN INTEGRAL OR BE INTERCONNECTED WITH TIMER, SECURITY SYSTEMS OR OTHER OPERATIONAL CONTROLS.

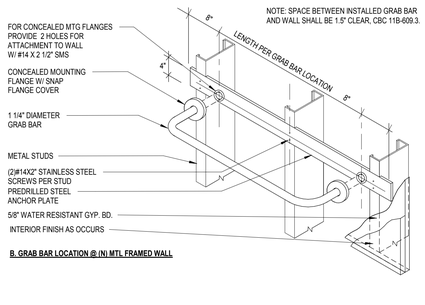
   D. BACK-UP OR EMERGENCY POWER OPERATION: POWERED DOORS SERVING A BUILDING OR FACILITY WITH 150 OR MORE SHALL BE PROVIDED WITH BACKUP POWER OR BACK-UP GENERATOR POWER. THE BACKUP POWER SOURCE SHALL BE ABLE TO CYCLE THE DOOR A MINIMUM OF 100 CYCLES, WHEN THE DEVICE IS IN OPERATIONAL MODE.

   E. ADDITIONAL SIGNAGE REQUIREMENTS:
   a. IN ADDITION TO THE ACCESSIBILITY SYMBOL REQUIRED ON THE DOOR ACTUATORS, 6" BY 6" ACCESSIBILITY SYMBOL SIGN COMPLYING WITH 11B-216.6 SHALL BE PLACED ON, OR IMMEDIATELY ADJACENT TO, EACH POWERED DOOR (LOCATION ON A DOOR SURFACE IS NOT SPECIFIED). THE SIGN SHALL BOTH SIDES OF DOOR.
   b. WHERE A POWERED DOOR IS PROVIDED IN A BUILDING OR FACILITY CONTAINING ASSEMBLY OCCUPANCIES OF 300 OR MORE, AN ACCESSIBILITY SYMBOL SIGN MEASURING 6" BY 6" AND COMPLYING WITH 11B-703.7 SHALL BE PROVIDED ABOVE THE ON BOTH THE INTERIOR AND EXTERIOR SIDES OF EACH POWERED DOOR OR PAIR OF DOORS.
   c. ADDITIONAL SIGNAGE COMPLYING WITH BHMA A156.10 OR BHMA A156.19 SHALL BE PROVIDED.

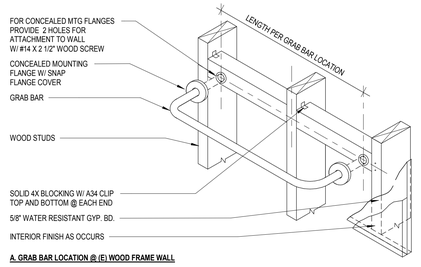
19 TYPICAL DOOR REQUIREMENTS 1 1/2" = 1'-0"



16 CLEAR SPACE AND PROJECTIONS AT DOORS 1/2" = 1'-0"

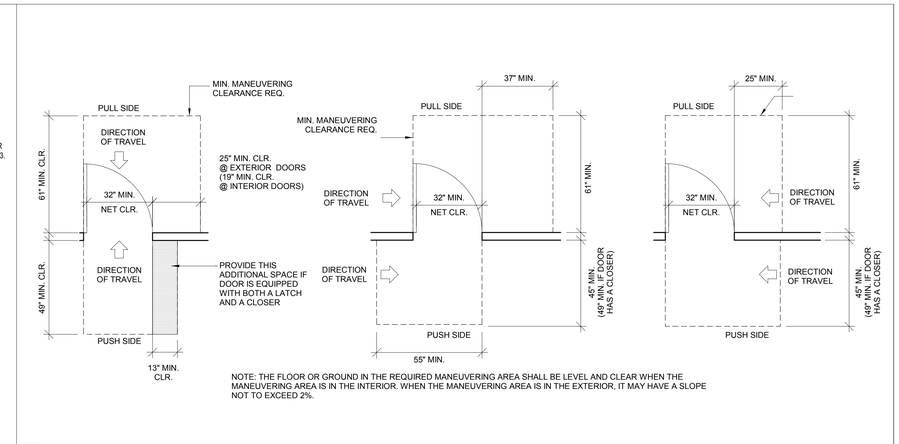


B. GRAB BAR LOCATION @ (N) MTL FRAMED WALL



A. GRAB BAR LOCATION @ (E) WOOD FRAME WALL

11 GRAB BAR ANCHORAGE 3" = 1'-0"

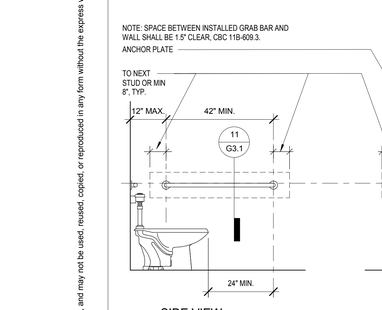


NOTE: THE FLOOR OR GROUND IN THE REQUIRED MANEUVERING AREA SHALL BE LEVEL AND CLEAR WHEN THE MANEUVERING AREA IS IN THE INTERIOR. WHEN THE MANEUVERING AREA IS IN THE EXTERIOR, IT MAY HAVE A SLOPE NOT TO EXCEED 2%.

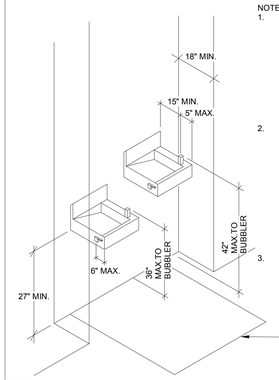
8 CLEAR SPACE AT DOORS 3/8" = 1'-0"

1. THE MINIMUM, MAXIMUM, AND ABSOLUTE DIMENSIONS SHOWN IN THESE STANDARD DETAILS VARY FROM THOSE IN TITLE 24 ADMINISTRATIVE CODE AND/OR AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES (ADAAG). DIMENSIONS THAT ARE NOT STATED AS "MAXIMUM: OR "MAX." OR "MINIMUM" OR "MIN." ARE ABSOLUTE (1101B.4), ALL DIMENSIONS ARE SUBJECT TO CONVENTIONAL INDUSTRY TOLERANCES EXCEPT WHERE THE REQUIREMENT IS STATED AS A RANGE WITH SPECIFIC MINIMUM AND MAXIMUM END POINTS.
2. TOILET ROOMS ARE TO CONTAIN A 60" DIAMETER TURNING SPACE OF EQUIVALENT T-SHAPED SPACE COMPLYING WITH TITLE 24 11B - 304. THE MANEUVERING SPACES ARE PERMITTED TO UNDERLAP SOME OBJECTS. 11B-104.1 PERMITS 11B-306 TOE AND KNEE SPACE OF A CIRCULAR MANEUVERING SPACE OR, TOE AND KNEE SPACE AT ONLY ONE END OF EITHER THE BASE OR ONE ARE OF T-SHAPED SPACE. A DOOR IS PERMITTED TO OVERLAP A TOILET ROOM'S REQUIRED TURNING SPACE BY 12" MAX.
3. TOILET ROOMS ARE TO CONTAIN A CLEAR 45" PATH TO WHEELCHAIR AND ACCESSIBLE TOILET COMPARTMENTS, EXCEPT FOR INTERVENING DOOR WIDTHS. APPROACH FROM THE FRONT OF AN OUT-SWINGING WHEELCHAIR ACCESSIBLE TOILET COMPARTMENT DOOR SHALL COMPLY WITH TITLE 24 11B-404.2.4.1.
4. TRASH CAN IS NOT PERMITTED TO OCCUPY THE CLEAR FLOOR SPACE OF ANY FIXTURE OR DOOR.
5. DOORS ARE NOT PERMITTED TO ENCROACH ON THE REQUIRED CLEAR FLOOR SPACE AT ANY ACCESSIBLE FIXTURE. EXCEPTION: WHERE THE TOILET OR BATHING ROOM IS FOR INDIVIDUAL USE AND A 30" BY 48" CLEAR FLOOR SPACE COMPLYING WITH TITLE 24 11B-305.4 IS PROVIDED WITHIN THE ROOM BEYOND THE ARC OF THE DOOR SWING, DOORS SHALL BE PERMITTED TO SWING INTO THE CLEAR FLOOR SPACE OR CLEARANCE REQUIRED FOR ANY FIXTURE.
6. THE CLEAR FLOOR AREAS OF ANY FIXTURE, ACCESSIBLE ROUTE AND MANEUVERING SPACE ARE PERMITTED TO OVERLAP.
7. AMBULATORY ACCESSIBLE STALL DOOR SHALL OPEN OUTWARD.
8. WHEELCHAIR ACCESSIBLE TOILET COMPARTMENT DOOR SHALL OPEN OUTWARD AND BE PROVIDED WITH 19" STRIKE SIDE CLEARANCE. WHEN STRIKE SIDE CLEARANCE OPENS IN, THE STALL SHALL BE PROVIDED WITH A 61" BY 61" CLEAR FLOOR AREA IN FRONT OF TOILET. IN FRONT OPENING TOILETS, TOILET STALL DOOR SHALL BE ORIENTED DIAGONALLY OPPOSITE FROM TOILET FIXTURE. TOILET COMPARTMENT DOOR SHALL PROVIDE 32" MINIMUM CLEAR, UNLESS THE DOOR IS APPROACHED PARALLEL TO THE SURFACE FROM LATCH SIDE - THEN DOOR IS REQUIRED TO BE 34" CLEAR WHEN OPENED IN THE 90 DEGREE POSITION.
9. MOUNTING HEIGHT OF FIXTURES SHALL TAKE INTO ACCOUNT FLOOR SLOPE TO DRAIN.
10. FLOOR SLOPE TO DRAIN SHALL NOT EXCEED 1.5% IN ANY DIRECTION.
11. FIXTURE AND TOILET COMPARTMENT CLEARANCES ARE TO FACE OF FINISH.
12. TOILET ROOM THRESHOLD SHALL NOT EXCEED 1/2" HEIGHT AND SHALL BE BEVELED 1:2 AT NOSINGS, ON EACH SIDE, OR BE 1/4" TALL EASED WITH EDGES.
13. NO ACCESSORIES ARE TO BE MOUNTED BEHIND GRAB BARS UNLESS THEY ARE COMPLETELY FLUSH TO ADJACENT SURFACE.
14. ACCESSIBLE ACCESSORIES SHALL BE LOCATED ON AN ACCESSIBLE ROUTE AND WITHIN ACCESSIBLE REACH RANGE PROVIDE CLEAR FLOOR SPACE THAT ALLOWS A FORWARD OR PARALLEL APPROACH BY A PERSON USING A WHEELCHAIR. ALL USER OPERABLE PARTS & CONTROLS SHALL BE LOCATED WITHIN 40" FROM THE FINISH FLOOR. CONTROLS AND OPERATING MECHANISMS SHALL BE OPERABLE WITH ONE HAND AND SHALL NOT REQUIRE TIGHT GRASPING, PINCHING OR TWISTING OF THE WRIST. THE FORCE REQUIRED TO ACTIVATE CONTROLS SHALL BE NO GREATER THAN 5 POUNDS (22.2 N) OF FORCE.
15. DOOR TO SINGLE USER ACCESSIBLE RESTROOM MUST BE PROVIDED WITH BY AN ACCESSIBLE PRIVACY LOCK.

7 GENERAL TOILET ROOM ACCESSIBILITY NOTES 1/2" = 1'-0"

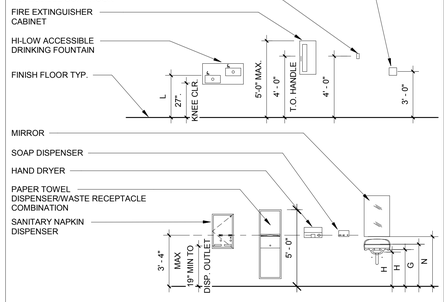


18 TYPICAL GRAB BAR MOUNTING 1/2" = 1'-0"

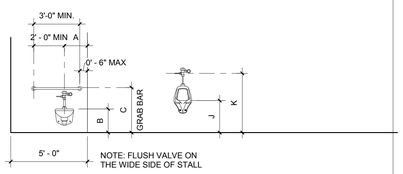


NOTES:
1. DRINKING FOUNTAIN SHALL BE LOCATED ENTIRELY WITHIN ALCOVES, POSITIONED COMPLETELY BETWEEN WING WALLS, OR OTHERWISE POSITIONED SO AS NOT TO ENCROACH INTO PEDESTRIAN WAYS. WING WALLS OR BARRIERS SHALL PROJECT HORIZONTALLY AT LEAST AS FAR AS THE DRINKING FOUNTAIN AND TO WITHIN 6" VERTICALLY FROM THE FLOOR OR GROUND SURFACE.
2. THE SPOUT SHALLL PROVIDE A FLOW OF WATER 4"H. MIN.& SHALL BE LOCATED 5" MAX. FROM FRONT OF UNIT. THE ANGLE OF THE WATER STREAM SHALL BE MEASURED HORIZONTALLY RELATIVE TO THE FACE OF THE UNIT. WHERE SPOUTS ARE LOCATED <3" OF THE FRONT OF THE UNIT, THE ANGLE OF THE WATER STREAM SHALL BE 30° MAX. WHERE SPOUTS ARE LOCATED BETWEEN 3"-5" MAX. FROM FRONT OF THE UNIT, THE ANGLE OF THE WATER STREAM SHALL BE 15° MAX. THERE SHALL BE A DRINKING FOUNTAIN WHICH IS ACCESSIBLE TO INDIVIDUALS WHO USE WHEELCHAIRS AND ONE ACCESSIBLE TO THOSE WHO HAVE DIFFICULTY BENDING AND STOOPING.
3.

17 DRINKING FOUNTAIN REQUIREMENTS 1 1/2" = 1'-0"

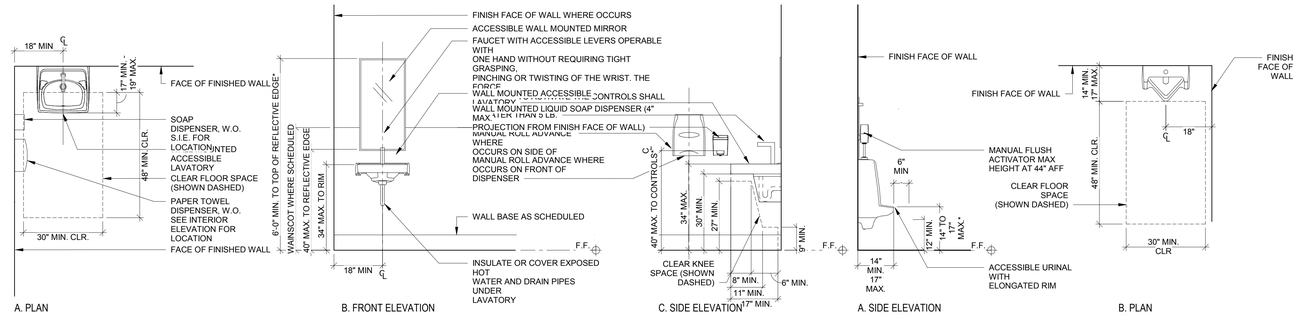


13 TYPICAL ACCESSIBLE MOUNTING HEIGHT 1/4" = 1'-0"

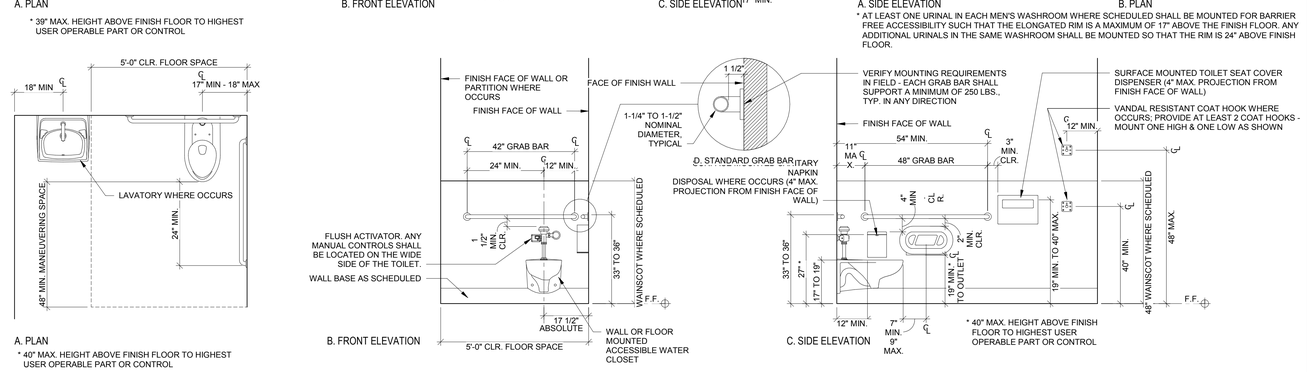


DIMENSIONS FOR ACCESSIBILITY		
	DESCRIPTIONS	DIMENSIONS
A	TOILET CENTER LINE FROM WALL	17" MIN., 18" MAX.
B	TOILET SEAT HEIGHT	17"-19"
C	GRAB BAR HEIGHT	33" - 36"
D	TOILET PAPER IN FRONT OF TOILET	7" - 9"
E	NAPKIN DISPOSAL IN FRONT OF TOILET	12"
F	DISPENSER HEIGHT	40" MAX. A.F.F. TO OPERABLE PART
G	LAVATORY AND SINK TOP HEIGHT	34" MAX. A.F.F.
H	LAVATORY AND SINK KNEE CLEARANCE	29" MAX. AT APRON; 27" MAX. AT BOWL
J	URINAL LIP HEIGHT	17" MAX.
K	URINAL FLUSH HANDLE HEIGHT	44" MAX.
L	DRINKING FOUNTAIN BUBBLER HEIGHT	36" MAX.
M	DRINKING FOUNTAIN KNEE CLEARANCE	27" MAX.
N	BOTTOM OF REFLECTIVE SURFACE (MIRROR)	40" MAX.

9 TYPICAL LAVATORY/TOILET/URINAL/SHOWER CLEARANCES 1/2" = 1'-0"



* AT LEAST ONE URINAL IN EACH MEN'S WASHROOM WHERE SCHEDULED SHALL BE MOUNTED FOR BARRIER FREE ACCESSIBILITY SUCH THAT THE ELONGATED RIM IS A MAXIMUM OF 17" ABOVE THE FINISH FLOOR. ANY ADDITIONAL URINALS IN THE SAME WASHROOM SHALL BE MOUNTED SO THAT THE RIM IS 24" ABOVE FINISH FLOOR.



CBC 11B-604.5.2. GRAB BAR EXCEPTIONS:
1. THE REAR GRAB BAR SHALL BE PERMITTED TO BE 24 INCHES LONG MINIMUM, CENTERED ON THE WATER CLOSET, WHERE WALL SPACE DOES NOT PERMIT A LENGTH OF 36 INCHES MINIMUM DUE TO THE LOCATION OF A RECESSED FIXTURE ADJACENT TO THE WATER CLOSET.
2. WHERE AN ADMINISTRATIVE AUTHORITY REQUIRES FLUSH CONTROLS FOR FLUSH VALVES TO BE LOCATED IN A POSITION THAT CONFLICTS WITH THE LOCATION OF THE REAR GRAB BAR, THE THE REAR BAR SHALL BE PERMITTED TO BE SPLIT OR SHIFTED TO THE OPEN SIDE OF THE TOILET AREA.

brick.

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kentfield, ca 94904

NOT FOR CONSTRUCTION

rev	date	issue
4	11/21/17	100% SD
3	10/06/17	80% SD
2	07/10/17	60% SD
1	06/16/17	50% SD

COLLEGE OF MARIN IVC
JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 12/1/2017 5:03:38 PM

scale: as noted

date:

ACCESSIBILITY DETAILS

G3.1

2016 CALIFORNIA GREEN BUILDING STANDARDS CODE
NONRESIDENTIAL MANDATORY MEASURES, SHEET 1 (INCLUDING JANUARY 1, 2017 ERRATA)

AIA|CC CALIFORNIA COUNCIL

INSPECTOR SIGNOFF

CHAPTER 3
GREEN BUILDING
SECTION 301 GENERAL

301.1 SCOPE. Buildings shall be designed to include the green building measures specified as mandatory in the application checklists contained in this code. Voluntary green building measures are also included in the application checklists and may be included in the design and construction of structures covered by this code, but are not required unless adopted by a city, county, or city and county as specified in Section 101.7.

301.3 NONRESIDENTIAL ADDITIONS AND ALTERATIONS. [BSC] The provisions of individual sections of Chapter 5 apply to newly constructed buildings, building additions of 1,000 square feet or greater, and/or building alterations with a permit valuation of $200,000 or above (for occupancies within the authority of California Building Standards Commission). Code sections relevant to additions and alterations shall only apply to the portions of the building being added or altered within the scope of the permitted work.

A code section will be designated by a banner to indicate where the code section only applies to newly constructed building [N] or to additions and alterations [A]. When the code section applies to both, no banner will be used.

301.3.1 Nonresidential additions and alterations that cause updates to plumbing fixtures only:

Note: On and after January 1, 2014, certain commercial real property, as defined in Civil Code Section 1101.3, shall have its noncompliant plumbing fixtures replaced with appropriate water-conserving plumbing fixtures under specific circumstances. See Civil Code Section 1101.1 *et seq.* for definitions, types of commercial real property affected, effective dates, circumstances necessitating replacement of noncompliant plumbing fixtures, and duties and responsibilities for ensuring compliance.

301.3.2 Waste Diversion. The requirements of Section 5.408 shall be required for additions and alterations whenever a permit is required for work.

301.4 PUBLIC SCHOOLS AND COMMUNITY COLLEGES. (see GBSC)
301.5 HEALTH FACILITIES. (see GBSC)

SECTION 302 MIXED OCCUPANCY BUILDINGS

302.1 MIXED OCCUPANCY BUILDINGS. In mixed occupancy buildings, each portion of a building shall comply with the specific green building measures applicable to each specific occupancy.

SECTION 303 PHASED PROJECTS

303.1 Phased projects. For shell buildings and others constructed for future tenant improvements, only those code measures relevant to the building components and systems considered to be new construction (or newly constructed) shall apply.

303.1.1 Tenant improvements. The provisions of this code shall apply only to the initial tenant or occupant improvements to a project. Subsequent tenant improvements shall comply with the scoping provisions in Section 301.3 non-residential additions and alterations.

ABBREVIATION DEFINITIONS:

HCD	Department of Housing and Community Development
BSC	California Building Standards Commission
DSA-SS	Division of the State Architect, Structural Safety
OSHPD	Office of Statewide Health Planning and Development
LR	Low Rise
HR	High Rise
AA	Additions and Alterations
N	New

CHAPTER 5
NONRESIDENTIAL MANDATORY MEASURES
DIVISION 5.1 PLANNING AND DESIGN
SECTION 5.101 GENERAL

5.101.1 Scope
The provisions of this chapter outline planning, design and development methods that include environmentally responsible site selection, building design, building siting and development to protect, restore and enhance the environmental quality of the site and respect the integrity of adjacent properties.

SECTION 5.102 DEFINITIONS

5.102.1 DEFINITIONS
The following terms are defined in Chapter 2 *(and are included here for reference)*

CUTOFF LUMINAIRES. Luminaires whose light distribution is such that the candela per 1000 lamp lumens does not numerically exceed 25 (2.5 percent) at an angle of 90 degrees above nadir, and 100 (10 percent) at a vertical angle of 80 degrees above nadir. This applies to all lateral angles around the luminaire.

LOW-EMITTING AND FUEL EFFICIENT VEHICLES.
Eligible vehicles are limited to the following:

1. Zero emission vehicle (ZEV), including neighborhood electric vehicles (NEV), partial zero emission vehicle (PZEV), advanced technology PZEV (AT ZEV) or CNG fueled (original equipment manufacturer only) regulated under Health and Safety Code section 43800 and CCR, Title 13, Sections 1961 and 1962.
2. High-efficiency vehicles, regulated by U.S. EPA, bearing High-Occupancy Vehicle (HOV) car pool lane stickers issued by the Department of Motor Vehicles.

NEIGHBORHOOD ELECTRIC VEHICLE (NEV). A motor vehicle that meets the definition of "low-speed vehicle" either in Section 385.5 of the Vehicle Code or in 49CFR571.500 (as it existed on July 1, 2000), and is certified to zero-emission vehicle standards.

TENANT-OCCUPANTS. Building occupants who inhabit a building during its normal hours of operation as permanent occupants, such as employees, as distinguished from customers and other transient visitors.

VANPOOL VEHICLE. Eligible vehicles are limited to any motor vehicle, other than a motortruck or truck tractor, designed for carrying more than 10 but not more than 15 persons including the driver, which is maintained and used primarily for the nonprofit work-related transportation of adults for the purpose of ridesharing.

Note: Source: Vehicle Code, Division 1, Section 668

ZEV. Any vehicle certified to zero-emission standards.

SECTION 5.106 SITE DEVELOPMENT

5.106.1 STORM WATER POLLUTION PREVENTION. Newly constructed projects and additions which disturb less than one acre of land shall prevent the pollution of storm water runoff from the construction activities through one or more of the following measures:

5.106.1.1 Local ordinance. Comply with a lawfully enacted storm water management and/or erosion control ordinance.

5.106.1.2 Best Management Practices (BMP). Prevent the loss of soil through wind or water erosion by implementing an effective combination of erosion and sediment control and good housekeeping BMP.

1. Soil loss BMP that should be considered for each project include, but are not limited to, the following:
   a. Scheduling construction activity.
   b. Preservation of natural features, vegetation and soil.
   c. Drainage swales or lined ditches to control stormwater flow.
   d. Mulching or hydroseeding to stabilize disturbed soils.
   e. Erosion control to protect slopes.
   f. Protection of storm drain inlets (gravel bags or catch basin inserts).
   g. Perimeter sediment control (perimeter silt fence, fiber rolls).
   h. Sediment trap or sediment basin to retain sediment on site.
   i. Stabilized construction exits.
   j. Wind erosion control.
   k. Other soil loss BMP acceptable to the enforcing agency.
2. Good housekeeping BMP to manage construction equipment, materials and wastes that should be considered for implementation as appropriate for each project include, but are not limited to, the following:
   a. Material handling and waste management.
   b. Building materials stockpile management.
   c. Management of washout areas (concrete, paints, stucco, etc.).
   d. Control of vehicle/equipment fueling to contractor's staging area.
   e. Vehicle and equipment cleaning performed off site.
   f. Spill prevention and control.
   g. Other housekeeping BMP acceptable to the enforcing agency.

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5.106.4 BICYCLE PARKING. For buildings within the authority of California Building Standards Commission as specified in Section 103, comply with Section 5.106.4.1. For buildings within the authority of the Division of the State Architect pursuant to Section 105, comply with Section 5.106.4.2

5.106.4.1 Bicycle parking. [BSC-CG] Comply with Sections 5.106.4.1.1 and 5.106.4.1.2; or meet the applicable local ordinance, whichever is stricter.

5.106.4.1.1 Short-term bicycle parking. If the project or an addition or alteration is anticipated to generate visitor traffic, provide permanently anchored bicycle racks within 200 feet of the visitors' entrance, readily visible to passers-by, for 5% of new visitor motorized vehicle parking spaces being added, with a minimum of one two-bike capacity rack.
Exception: Additions or alterations which add nine or less visitor vehicular parking spaces.

5.106.4.1.2 Long-term bicycle parking. For new buildings with 10 or more tenant-occupants or for additions or alterations that add 10 or more tenant-occupants or for additions or alterations that add 10 or more tenant vehicular parking spaces, provide secure bicycle parking for 5 percent of the tenant vehicle parking spaces being added, with a minimum of one space. Acceptable parking facilities shall be convenient from the street and shall meet one of the following:

1. Covered, lockable enclosures with permanently anchored racks for bicycles;
2. Lockable bicycle rooms with permanently anchored racks; or
3. Lockable, permanently anchored bicycle lockers.

Note: Additional information on recommended bicycle accommodations may be obtained from Sacramento Area Bicycle Advocates.

5.106.4.2 Bicycle parking. [DSA-SS] For public schools and community colleges, comply with Sections 5.106.4.2.1 and 5.106.4.2.2

5.106.4.2.1 Student bicycle parking. Provide permanently anchored bicycle racks conveniently accessed with a minimum of four two-bike capacity racks per new building.
5.106.4.2.2 Staff bicycle parking. Provide permanent, secure bicycle parking conveniently accessed with a minimum of two staff bicycle parking spaces per new building. Acceptable bicycle parking facilities shall be convenient from the street or staff parking area and shall meet one of the following:

1. Covered, lockable enclosures with permanently anchored racks for bicycles;
2. Lockable bicycle rooms with permanently anchored racks; or
3. Lockable, permanently anchored bicycle lockers.

5.106.5.2 DESIGNATED PARKING FOR CLEAN AIR VEHICLES. In new projects or additions or alterations that add 10 or more vehicular parking spaces, provide designated parking for any combination of low-emitting, fuel-efficient and carpool/van pool vehicles as follows:

TABLE 5.106.5.2 - PARKING

TOTAL NUMBER OF PARKING SPACES	NUMBER OF REQUIRED SPACES
0-9	0
10-25	1
25-50	3
51-75	6
76-100	8
101-150	11
151-200	16
201 AND OVER	AT LEAST 8% OF TOTAL

5.106.5.2.1 - Parking stall marking. Paint, in the paint used for stall striping, the following characters such that the lower edge of the last word aligns with the end of the stall striping and is visible beneath a parked vehicle: CLEAN AIR / VAN POOL / EV

Note: Vehicles bearing Clean Air Vehicle stickers from expired HOV lane programs may be considered eligible for designated parking spaces.

5.106.5.3 Electric vehicle (EV) charging. [N] Construction shall comply with Section 5.106.5.3.1 or Section 5.106.5.3.2 to facilitate future installation of electric vehicle supply equipment (EVSE). When EVSE(s) is/are installed, it shall be in accordance with the *California Building Code*, the California Energy Commission (CEC) and as follows:

5.106.5.3.1 Single charging space requirements. [N] When only a single charging space is required per Table 5.106.5.3.3, a raceway is required to be installed at the time of construction and shall be installed in accordance with the *California Electrical Code*. Construction plans and specifications shall include, but are not limited to, the following:

1. The type and location of the EVSE.
2. A listed raceway capable of accommodating a 208/240 -volt dedicated branch circuit.
3. The raceway shall not be less than trade size 1.*
4. The raceway shall originate at a service panel or a subpanel serving the area, and shall terminate in close proximity to the proposed location of the charging equipment and listed suitable cabinet, box, enclosure or equivalent.
5. The service panel or subpanel shall have sufficient capacity to accommodate a minimum 40-ampere dedicated branch circuit for the future installation of the EVSE.

5.106.5.3.2 Multiple charging space requirements. [N] When multiple charging spaces are required per Table 5.106.5.3.3 raceway(s) is/are required to be installed at the time of construction and shall be installed in accordance with the *California Electrical Code*. Construction plans and specifications shall include, but are not limited to, the following:

1. The type and location of the EVSE.
2. The raceway(s) shall originate at a service panel or a subpanel(s) serving the area, and shall terminate in close proximity to the proposed location of the charging equipment and into listed suitable cabinet(s), box(es), enclosure(s) or equivalent.
3. Plan design shall be based upon 40-ampere minimum branch circuits.
4. Electrical calculations shall substantiate the design of the electrical system, to include the rating of equipment and any on-site distribution transformers and have sufficient capacity to simultaneously charge all required EVs at its full rated amperage.
5. The service panel or subpanel(s) shall have sufficient capacity to accommodate the required number of dedicated branch circuit(s) for the future installation of the EVSE.

5.106.5.3.3 EV charging space calculations. [N] Table 5.106.5.3.3 shall be used to determine if single or multiple charging space requirements apply for the future installation of EVSE.

Exceptions: On a case-by-case basis where the local enforcing agency has determined EV charging and infrastructure is not feasible based upon one or more of the following conditions:

1. Where there is insufficient electrical supply.
2. Where there is evidence suitable to the local enforcing agency substantiating that additional local utility infrastructure design requirements, directly related to the implementation of Section 5.106.5.3, may adversely impact the construction cost of the project.

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TABLE 5.106.5.3.3

TOTAL NUMBER OF PARKING SPACES	NUMBER OF REQUIRED SPACES
0-9	0
10-25	1
36-50	2
51-75	4
76-100	5
101-200	7
201 AND OVER	6% of total[1]

1. Calculation for spaces shall be rounded up to the nearest whole number.

5.106.5.3.4 [N] Identification. The service panel or subpanel(s) circuit directory shall identify the reserved overcurrent protective device space(s) for future EV charging as "EV CAPABLE". The raceway termination location shall be permanently and visibly marked as "EV CAPABLE".

5.106.5.3.5 [N] Future charging spaces qualify as designated parking as described in Section 5.106.5.2 Designated parking for clean air vehicles.
Notes:

1. The California Department of Transportation adopts and publishes the California Manual on Uniform Traffic Control Devices (California MUTCD) to provide uniform standards and specifications for all official traffic control devices in California. Zero Emission Vehicle Signs and Pavement Markings can be found in the New Policies & Directives number 13-01. www.dot.ca.gov/hq/traffops/policy/13-01.pdf.
2. See Vehicle Code Section 22511 for EV charging spaces signage in off-street parking facilities and for use of EV charging spaces.
3. The Governor's Office of Planning and Research published a Zero-Emission Vehicle Community Readiness Guidebook which provides helpful information for local governments, residents and businesses. www.opr.ca.gov/docs/ZEV_Guidebook.pdf.

5.106.8 LIGHT POLLUTION REDUCTION. [N] Outdoor lighting systems shall be designed and installed to comply with the following:

1. The minimum requirements in the California Energy Code for Lighting Zones 1-4 as defined in Chapter 10 of the California Administrative Code; and
2. Backlight, Uplight and Glare (BUG) ratings as defined in IES TM-15-11; and
3. Allowable BUG ratings not exceeding those shown in Table 5.106.8, or Comply with a local ordinance lawfully enacted pursuant to Section 101.7, whichever is more stringent.

Exceptions: [N]

1. Luminaires that qualify as exceptions in Section 140.7 of the California Energy Code.
2. Emergency lighting.
3. Building facade meeting the requirements in Table 140.7-B of the California Energy Code, Part 6.
4. Custom lighting features as allowed by the local enforcing agency, as permitted by Section 101.8 Alternate materials, designs and methods of construction.

Note: [N] See also California Building Code, Chapter 12, Section 1205.6 for college campus lighting requirements for parking facilities and walkways.

5.106.10 GRADING AND PAVING. Construction plans shall indicate how site grading or a drainage system will manage all surface water flows to keep water from entering buildings. Examples of methods to manage surface water include, but are not limited to, the following:

1. Swales.
2. Water collection and disposal systems.
3. French drains.
4. Water retention gardens.
5. Other water measures which keep surface water away from buildings and aid in groundwater recharge.

Exception: Additions and alterations not altering the drainage path.

TABLE 5.106.8 [N] MAXIMUM ALLOWABLE BACKLIGHT, UPLIGHT AND GLARE (BUG) RATINGS 1,2

ALLOWABLE RATING	LIGHTING ZONE 1	LIGHTING ZONE 2	LIGHTING ZONE 3	LIGHTING ZONE 4
MAXIMUM ALLOWABLE BACKLIGHT RATING 3				
Luminaire greater than 2 mounting heights (MH) from property line	No Limit	No Limit	No Limit	No Limit
Luminaire back hemisphere is 1-2 MH from property line	B2	B3	B4	B4
Luminaire back hemisphere is 0.5-1 MH from property line	B1	B2	B3	B3
Luminaire back hemisphere is less than 0.5 MH from property line	B0	B0	B1	B2
MAXIMUM ALLOWABLE UPLIGHT RATING				
For area lighting 4	U0	U0	U0	U0
For all other outdoor lighting,including decorative luminaires	U1	U2	U3	U4
MAXIMUM ALLOWABLE GLARE RATING 4				
Luminaire greater than 2 MH from property line	G1	G2	G3	G4
Luminaire front hemisphere is 1-2 MH from property line	G0	G1	G1	G2
Luminaire front hemisphere is 0.5-1 MH from property line	G0	G0	G1	G1
Luminaire back hemisphere is less than 0.5 MH from property line	G0	G0	G0	G1

1. IESNA Lighting Zones 0 and 5 are not applicable; refer to Lighting Zones as defined in the *California Energy Code* and Chapter 10 of the *Callifornia Administrative Code*.

2. For property lines that abut public walkways, bikeways, plazas and parking lots, the property line may be considered to be 5 feet beyond the actual property line for purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the centerline of the public roadway or public transit corridor for the purpose of determining compliance with this section.

3. If the nearest property line is less than or equal to two mounting heights from the back hemisphere of the luminaire distribution, the applicable reduced Backlight rating shall be met.

4. General lighting luminaires in areas such as outdoor parking, sales or storage lots shall meet these reduced ratings. Decorative luminaires located in these areas shall meet *U*-value limits for "all other outdoor lighting".

5. If the nearest property line is less than or equal to two mounting heights from the front hemisphere of the luminaire distribution, the applicable reduced Glare rating shall be met.

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DIVISION 5.2 ENERGY EFFICIENCY
SECTION 5.201 GENERAL

5.201.1 Scope [BSC-CG]. ***California Energy Code [DSA-SS].*** For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory building standards.

DIVISION 5.3 WATER EFFICIENCY AND CONSERVATION
SECTION 5.301 GENERAL

5.301.1 Scope. The provisions of this chapter shall establish the means of conserving water use indoors, outdoors and in wastewater conveyance.

SECTION 5.302 DEFINITIONS

5.302.1 Definitions. The following terms are defined in Chapter 2 *(and are included here for reference)*

EVAPOTRANSPIRATION ADJUSTMENT FACTOR (ETAF) [DSA-SS]. An adjustment factor when applied to reference evapotranspiration that adjusts for plant factors and irrigation efficiency, which ae two major influences on the amount of water that needs to be applied to the landscape.

FOOTPRINT AREA [DSA-SS]. The total area of the furthest exterior wall of the structure projected to natural grade, not including exterior areas such as stairs, covered walkways, patios and decks.

METERING FAUCET. A self-closing faucet that dispenses a specific volume of water for each actuation cycle. The volume or cycle duration can be fixed or adjustable.

GRAYWATER. Pursuant to Health and Safety Code Section 17922.12, "graywater" means untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. "Graywater" includes, but is not limited to wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines and laundry tubs, but does not include waste water from kitchen sinks or dishwashers.

MODEL WATER EFFICIENT LANDSCAPE ORDINANCE (MWELO). The California ordinance regulating landscape design, installation and maintenance practices that will ensure commercial, multifamily and other developer installed landscapes greater than 2500 square feet meet an irrigation water budget developed based on landscaped area and climatological parameters.

MODEL WATER EFFICIENT LANDSCAPE ORDINANCE (MWELO). [HCD] The California model ordinance (California Code of Regulations, Title 23, Division 2, Chapter 2.7), regulating landscape design, installation and maintenance practices. Local agencies are required to adopt the updated MWELO, or adopt a local ordinance at least as effective as the MWELO.

POTABLE WATER. Water that is drinkable and meets the U.S. Environmental Protection Agency (EPA) Drinking Water Standards. See definition in the California Plumbing Code, Part 5.

POTABLE WATER. [HCD] Water that is satisfactory for drinking, culinary, and domestic puroses, and meets the U.S. Environmental Protection Agency (EPA) Drinking Water Standards and the requirements of the Health Authority Having Jurisdiction.

RECYCLED WATER. Water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur [Water Code Section 13050 (n)]. Simply put, recycled water is water treated to remove waste matter attaining a quality that is suitable to use the water again.

SUBMETER. A meter installed subordinate to a site meter. Usually used to measure water intended for one purpose, such as landscape irrigation. For the purposes of CALGreen, a dedicated meter may be considered a submeter.

WATER BUDGET. Is the estimated total landscape irrigation water use which shall not exceed the maximum applied water allowance calculated in accordance with the Department of Water Resources Model Efficient Landscape Ordinance (MWELO).

SECTION 5.303 INDOOR WATER USE

5.303.1 METERS. Separate submeters or metering devices shall be installed for the uses described in Sections 503.1.1 and 503.1.2.

5.303.1.1 Buildings in excess of 50,000 square feet. Separate submeters shall be installed as follows:

1. For each individual leased, rented or other tenant space within the building projected to consume more than 100 gal/day (380 L/day), including, but not limited to, spaces used for laundry or cleaners, restaurant or food service, medical or dental office, laboratory, or beauty salon or barber shop.
2. Where separate submeters for individual building tenants are unfeasible, for water supplied to the following subsystems:
   a. Makeup water for cooling towers where flow through is greater than 500 gpm (30 L/s).
   b. Makeup water for evaporative coolers greater than 6 gpm (0.04 L/s).
   c. Steam and hot water boilers with energy input more than 500,000 Btu/h (147 kW).

5.303.1.2 Excess consumption. A separate submeter or metering device shall be provided for any tenant within a new building or within an addition that is projected to consume more than 1,000 gal/day.

5.303.3 WATER CONSERVING PLUMBING FIXTURES AND FITTINGS. Plumbing fixtures (water closets and urinals) and fittings (faucets and showerheads) shall comply with the following:

5.303.3.1 Water Closets. The effective flush volume of all water closets shall not exceed 1.28 gallons per flush. Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type toilets.

Note: The effective flush volume of dual flush toilets is defined as the composite, average flush volume of two reduced flushes and one full flush.

5.303.3.2 Urinals. The effective flush volume of urinals shall not exceed 0.5 gallons per flush.

5.303.3.3 Showerheads.
5.303.3.3.1 Single showerhead. Showerheads shall have a maximum flow rate of not more than 2.0 gallons per minute at 80 psi. Showerheads shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Showerheads.

5.303.3.3.2 Multiple showerheads serving one shower. When a shower is served by more than one showerhead, the combined flow rate of all the showerheads and/or other shower outlets controlled by a single valve shall not exceed 2.0 gallons per minute at 80 psi, or the shower shall be designed to allow only one shower outlet to be in operation at a time.

Note: A hand-held shower shall be considered a showerhead.

5.303.3.4 Faucets and fountains.

5.303.3.4.1 Nonresidential Lavatory faucets. Lavatory faucets shall have a maximum flow rate of not more than 0.5 gallons per minute at 60 psi.

5.303.3.4.2 Kitchen faucets. Kitchen faucets shall have a maximum flow rate of not more than 1.8 gallons per minute at 60 psi. Kitchen faucets may temporarily increase the flow above the maximum rate, but not to exceed 2.2 gallons per minute at 60 psi, and must default to a maximum flow rate of 1.8 gallons per minute at 60 psi.

5.303.3.4.3 Wash fountains. Wash fountains shall have a maximum flow rate of not more than1.8 gallons per minute/20 [rim space (inches) at 60 psi].

5.303.3.4.4 Metering faucets. Metering faucets shall not deliver more than 0.20 gallons per cycle.

5.303.3.4.5 Metering faucets for wash fountains. Metering faucets for wash fountains shall have a maximum flow rate of not more than 0.20 gallons per minute/20 [rim space (inches) at 60 psi].

Note: Where complying faucets are unavailable, aerators or other means may be used to achieve reduction.

5.303.4 COMMERCIAL KITCHEN EQUIPMENT.

5.303.4.1 Food Waste Disposers. Disposers shall either modulate the use of water to no more than 1 gpm when the disposer is not in use (not actively grinding food waste/no-load) or shall automatically shut off after no more than 10 minutes of inactivity. Disposers shall use no more than 8 gpm of water.

Note: This code section does not affect local jurisdiction authority to prohibit or require disposer installation.

5.303.5 AREAS OF ADDITION OR ALTERATION. For those occupancies within the authority of the California Building Standards Commission as specified in Section 103, the provisions of Section 5.303.3 and 5.303.4 shall apply to new fixtures in additions or areas of alteration to the building.

5.303.6 STANDARDS FOR PLUMBING FIXTURES AND FITTINGS. Plumbing fixtures and fittings shall be installed in accordance with the *California Plumbing Code*, and shall meet the applicable standards referenced in Table 1701.1 of the *California Plumbing Code* and in Chapter 6 of this code.

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	06/16/17	50% SD

COLLEGE OF MARIN IVC
JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 12/1/2017 5:03:40 PM

scale: as noted

date:

CAL-GREEN COMPLIANCE FORM

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AIA|CC CALIFORNIA COUNCIL 2016 CALIFORNIA GREEN BUILDING STANDARDS CODE
NONRESIDENTIAL MANDATORY MEASURES, SHEET 2 (INCLUDING JANUARY 1, 2017 ERRATA)

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SECTION 5.304 OUTDOOR WATER USE

5.304.1 SCOPE. The provisions of Section 5.304, Outdoor Water Use reference the mandatory Model Water Efficiency Landscape Ordinance (MWELO) contained within Chapter 2.7, Division 2, Title 23, California Code of Regulations.

5.304.2 OUTDOOR WATER USE IN LANDSCAPE AREAS EQUAL TO OR GREATER THAN 500 SQUARE FEET. When water is used for outdoor irrigation for new construction projects with an aggregate landscape area equal to or greater than 500 square feet requiring a building or landscape permit, plan check or design review, one of the following shall apply:

1. A local water efficient landscape ordinance that is, based on evidence in the record, at least as effective in conserving water as the updated model ordinance adopted by the Department of Water Resouces (DWR) per Government Code Section 65595(c).
2. The California Department of Water Resources Model Water Efficient Landscape Ordinance (MWELO) commencing with Section 490 of Chapter 2.7, Division 2, Title 23, California Code of Regulations.

5.304.3 OUTDOOR WATER USE IN REHABILITATED LANDSCAPE PROJECTS EQUAL TO OR GREATER THAN 2,500 SQUARE FEET. Rehabilitated landscape project with an aggregate landscape area equal to or greater than 2,500 square feet requiring a building or landscape permit, plan check, or design review shall comply with Section 5.304.2, Item 1 or 2.

5.304.4 OUTDOOR WATER USE IN LANDSCAPE AREAS OF 2,500 SQUARE FEET OR LESS. Any project with an aggregate area of 2,500 square feet of less may comply with the performance requirements of MWELO or conform to the prescriptive compliance measures contained in MWELO's Appendix D.

5.304.5 GRAYWATER OR RAINWATER USE IN LANDSCAPE AREAS. For projects using treated or untreated graywater or rainwater captured on site, any lot or parcel within the project that has less than 2,500 square feet of landscape and meets the lot or parcel's landscape water requirement (Estimate Total Water Use) entirely with treated or untreated graywater or through stored rainwater captured on site is subject only to Appendix D Section (5).

Notes:
1. DWR's Model Water Efficient Landscape Ordinance, definitions and supporting documents are available at the following link: http://water.ca.gov/wateruseefficiency/landscapeordinance/
2. A water budget calculator is available at the following link: http://water.ca.gov/wateruseefficiency/landscapeordinance/
3. The MWELO prescriptive compliance measure Appendix D may be found at the following link: http://water.ca.gov/wateruseefficiency/landscapeordinance/ In addition, a copy of MWELO Appendix D may be found in Chapter 8 of this code.

5.304.6 OUTDOOR POTABLE WATER USE IN LANDSCAPE AREAS [DSA-SS]. For public schools and community colleges, landscape projects as described in Sections 5.304.6.1 and 5.304.6.2 shall comply with the California Department of Water Resources Model Water Efficient Landscape Ordinance (MWELO) commencing with Section 490 of Chapter 2.7, Division 2, Title 23, California Code of Regulations, except that the evapotranspiration adjustment factor (ETAF) shall be 0.65 with an additional water allowance for special landscape areas (SLA) of 0.35.

Exception: Any project with an aggregate landscape area of 2,500 square feet or less may comply with the prescriptive measures contained in Appendix D of MWELO.

5.304.6.1 Newly constructed landscapes. [DSA-SS] New construction projects with an aggregate landscape area equal to or greater than 500 square feet.

5.304.6.2 Rehabilitated landscapes. [DSA-SS] Rehabilitated landscape projects with an aggregate landscape area equal to or greater than 1,200 square feet.

5.304.3 IRRIGATION DESIGN. In new nonresidential construction with at least 1,000 but not more than 2,500 square feet of cumulative landscaped area (the level at which the MWELO applies), install irrigation controllers and sensors which include the following criteria, and meet manufacturer's recommendations.

5.304.3.1 Irrigation controllers. Automatic irrigation system controllers installed at the time of final inspection shall comply with the following:

1. Controllers shall be weather- or soil moisture-based controllers that automatically adjust irrigation in response to changes in plants' needs as weather conditions change.
2. Weather-based controllers without integral rain sensors or communication systems that account for local rainfall shall have a separate wired or wireless rain sensor which connects or communicates with the controller(s). Soil moisture-based controllers are not required to have rain sensor input.

Note: More information regarding irrigation controller function and specifications is available from the Irrigation Association.

DIVISION 5.4 MATERIAL CONSERVATION AND RESOURCE EFFICIENCY

SECTION 5.401 GENERAL

5.401.1 SCOPE. The provisions of this chapter shall outline means of achieving material conservation and resource efficiency through protection of buildings from exterior moisture, construction waste diversion, employment of techniques to reduce pollution through recycling of materials, and building commissioning or testing and adjusting.

SECTION 5.402 DEFINITIONS

5.402.1 DEFINITIONS. The following terms are defined in Chapter 2 *(and are included here for reference)*

ADJUST. To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

BALANCE. To proportion flows within the distribution system, including sub-mains, branches and terminals, according to design quantities.

BUILDING COMMISSIONING. A systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements.

ORGANIC WASTE. Food waste, green waste, landscape and pruning wste, nonhazardous wood waste, and food soiled paper waste that is mixed in with food waste.

TEST. A procedure to determine quantitative performance of a system or equipment

SECTION 5.407 WATER RESISTANCE AND MOISTURE MANAGEMENT

5.407.1 WEATHER PROTECTION. Provide a weather-resistant exterior wall and foundation envelope as required by California Building Code Section 1403.2 (Weather Protection) and California Energy Code Section 150, (Mandatory Features and Devices), manufacturer's installation instructions or local ordinance, whichever is more stringent.

5.407.2 MOISTURE CONTROL. Employ moisture control measures by the following methods.

5.407.2.1 Sprinklers. Design and maintain landscape irrigation systems to prevent spray on structures.

5.407.2.2 Entries and openings. Design exterior entries and/or openings subject to foot traffic or wind-driven rain to prevent water intrusion into buildings as follows:

5.407.2.2.1 Exterior door protection. Primary exterior entries shall be covered to prevent water intrusion by using nonabsorbent floor and wall finishes within at least 2 feet around and perpendicular to such openings plus at least one of the following:

1. An installed awning at least 4 feet in depth.
2. The door is protected by a roof overhang at least 4 feet in depth.
3. The door is recessed at least 4 feet.
4. Other methods which provide equivalent protection.

5.407.2.2.2 Flashing. Install flashings integrated with a drainage plane.

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SECTION 5.408 CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING

5.408.1 CONSTRUCTION WASTE MANAGEMENT. Recycle and/or salvage for reuse a minimum of 65% of the non-hazardous construction and demolition waste in accordance with Section 5.408.1.1, 5.408.1.2 or 5.408.1.3; or meet a local construction and demolition waste management ordinance, whichever is more stringent.

5.408.1.1 Construction waste management plan. Where a local jurisdiction does not have a construction and demolition waste management ordinance, submit a construction waste management plan that:

1. Identifies the construction and demolition waste materials to be diverted from disposal by efficient usage, recycling, reuse on the project or salvage for future use or sale.
2. Determines if construction and demolition waste materials will be sorted on-site (source-separated) or bulk mixed (single stream).
3. Identifies diversion facilities where construction and demolition waste material collected will be taken.
4. Specifies that the amount of construction and demolition waste materials diverted shall be calculated by weight or volume, but not by both.

5.408.1.2 Waste Management Company. Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with this section.

Note: The owner or contractor shall make the determination if the construction and demolition waste material will be diverted by a waste management company.

Exceptions to Sections 5.408.1.1 and 5.408.1.2:

1. Excavated soil and land-clearing debris.
2. Alternate waste reduction methods developed by working with local agencies if diversion or recycle facilities capable of compliance with this item do not exist.
3. Demolition waste meeting local ordinance or calculated in consideration of loacl recycleing facilities and markets.

5.408.1.3 Waste stream reduction alternative. The combined weight of new construction disposal that does not exceed two pounds per square foot of building area may be deemed to meet the 65% minimum requirement as approved by the enforcing agency.

5.408.1.4 Documentation. Documentation shall be provided to the enforcing agency which demonstrates compliance with Sections 5.408.1.1, through 5.408.1.3. The waste management plan shall be updated as necessary and shall be accessible during construction for examination by the enforcing agency.

Notes:

1. Sample forms found in "A Guide to the California Green Building Standards Code (Nonresidential)" located at www.bsc.ca.gov/Home/CALGreen.aspx may be used to assist in documenting compliance with the waste management plan.
2. Mixed construction and demolition debris processors can be located at the California Department of Resources Recycling and Recovery (CalRecycle).

5.408.2 UNIVERSAL WASTE. [A] Additions and alterations to a building or tenant space that meet the scoping provisions in Section 301.3 for nonresidential additions and alterations, shall require verification that Universal Waste items such as fluorescent lamps and ballast and mercury containing thermostats as well as other California prohibited Universal Waste materials are disposed of properly and are diverted from landfills. A list of prohibited Universal Waste materials shall be included in the construction documents.

Note: Refer to the Universal Waste Rule link at: http://www.dtsc.ca.gov/LawsRegsPolicies/Regs/upload/OEAR-A_REGS_UWR_FinalText.pdf

5.408.3 EXCAVATED SOIL AND LAND CLEARING DEBRIS. 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. For a phased project, such material may be stockpiled on site until the storage site is developed.

Exception: Reuse, either on or off-site, of vegetation or soil contaminated by disease or pest infestation.

Notes:

1. If contamination by disease or pest infestation is suspected, contact the County Agricultural Commissioner and follow its direction for recycling or disposal of the material.
2. For a map of know pest and/or disease quarantine zones, consult with the California Department of Food and Agriculture. (www.cdfa.ca.gov)

SECTION 5.410 BUILDING MAINTENANCE AND OPERATIONS

5.410.1 RECYCLING BY OCCUPANTS. Provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics, organic waste, and metals or meet a lawfully enacted local recycling ordinance, if more restrictive.

Exception: Rural jurisdictions that meet and apply for the exemption in Public Resources Code 42649.82 (a)(2)(A) et seq. shall also be exempt from the organic waste portion of this section.

5.410.1.1 Additions. All additions conducted within a 12-month period under single or multiple permits, resulting in an increase of 30% or more in floor area, shall provide recycling areas on site.

Exception: Additions within a tenant space resulting in less than a 30% increase in the tenant space floor area.

5.410.1.2 Sample ordinance. Space allocation for recycling areas shall comply with Chapter 18, Part 3, Division 30 of the *Public Resources Code*. Chapter 18 is known as the California Solid Waste Reuse and Recycling Access Act of 1991 (Act).

Note: A sample ordinance for use by local agencies may be found in Appendix A of the document at the CalRecycle's web site.

5.410.2 COMMISSIONING. [N] For new buildings 10,000 square feet and over, building commissioning shall be included in the design and construction processes of the building project to verify that the building systems and components meet the owner's or owner representative's project requirements. Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity. All occupancies other than I-occupancies and L-occupancies shall comply with the California Energy Code as prescribed in California Energy Code Section 120.8. For I-occupancies that are not regulated by OSHPD or for I-occupancies and L-occupancies that are not regulated by the California Energy Code Section 100.0 Scope, all requirements in Sections 5.410.2 through 5.410.2.6 shall apply.

Commissioning requirements shall include:

1. Owner's or Owner representative's project requirements.
2. Basis of design.
3. Commissioning measures shown in the construction documents.
4. Commissioning plan.
5. Functional performance testing.
6. Documentation and training.
7. Commissioning report.

Exceptions:

1. Unconditioned warehouses of any size.
2. Areas less than 10,000 square feet used for offices or other conditioned accessory spaces within unconditioned warehouses.
3. Tenant improvements less than 10,000 square feet as described in Section 303.1.1.
4. Open parking garages of any size, or open parking garage areas, of any size, within a structure.

Note: For the purposes of this section, unconditioned shall mean a building, area, or room which does not provide heating and or air conditioning.

Informational Notes:

1. IAS AC 476 is an accreditation criteria for organizations providing training and/or certification of commissioning personnel. AC 476 is available to the Authority Having Jurisdiction as a reference for qualifications of commissioning personnel. AC 476 does not certify individuals to conduct functional performance tests or to adjust and balance systems.
2. Functional performance testing for heating, ventilation, air conditioning systems and lighting controls must be performed in compliance with the *California Energy Code*.

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5.410.2.1 Owner's or Owner Representative's Project Requirements (OPR). [N] The expectations and requirements of the building appropriate to its phase shall be documented before the design phase of the project begins. This documentation shall include the following:

1. Environmental and sustainability goals.
2. Energy efficiency goals.
3. Indoor environmental quality requirements.
4. Project program, including facility functions and hours of operation, and need for after hours operation.
5. Equipment and systems expectations.
6. Building occupant and operation and maintenance (O&M) personnel expectations.

5.410.2.2 Basis of Design (BOD). [N] A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project. The Basis of Design document shall cover the following systems:

1. Heating, ventilation, air conditioning (HVAC) systems and controls.
2. Indoor lighting system and controls.
3. Water heating system.
4. Renewable energy systems.
5. Water reuse systems.

5.410.2.3 Commissioning plan. [N] Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned. The commissioning plan shall include the following:

1. General project information.
2. Commissioning goals.
3. Systems to be commissioned. Plans to test systems and components shall include:
   a. An explanation of the original design intent.
   b. Equipment and systems to be tested, including the extent of tests.
   c. Functions to be tested.
   d. Conditions under which the test shall be performed.
   e. Measurable criteria for acceptable performance.
4. Commissioning team information.
5. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning shall be included.

5.410.2.4 Functional performance testing. [N] Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the approved plans and specifications. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.

5.410.2.5 Documentation and training. [N] A Systems Manual and Systems Operations Training are required, including Occupational Safety and Health Act (OSHA) requirements in *California Code of Regulations* (CCR), Title 8, Section 5142, and other related regulations.

5.410.2.5.1 Systems manual. [N] Documentation of the operational aspects of the building shall be completed within the systems manual and delivered to the building owner or representative. The systems manual shall include the following:

1. Site information, including facility description, history and current requirements.
2. Site contact information.
3. Basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, site events log.
4. Major systems.
5. Site equipment inventory and maintenance notes.
6. A copy of verifications required by the enforcing agency or this code.
7. Other resources and documentation, if applicable.

5.410.2.5.2 Systems operations training. [N] A program for training of the appropriate maintenance staff for each equipment type and/or system shall be developed and documented in the commissioning report and shall include the following:

1. System/equipment overview (what it is, what it does and with what other systems and/or equipment it interfaces).
2. Review and demonstration of servicing/preventive maintenance.
3. Review of the information in the Systems Manual.
4. Review of the record drawings on the system/equipment.

5.410.2.6 Commissioning report. [N] A report of commissioning process activities undertaken through the design and construction phases of the building project shall be completed and provided to the owner or representative.

5.410.4 TESTING AND ADJUSTING. Testing and adjusting of systems shall be required for buildings less than 10,000 square feet or new systems to serve an addition or alteration subject to Section 303.1.

5.410.4.2 Systems. Develop a written plan of procedures for testing and adjusting systems. Systems to be included for testing and adjusting shall include at a minimum, as applicable to the project:

1. HVAC systems and controls.
2. Indoor and outdoor lighting and controls.
3. Water heating systems.
4. Renewable energy systems.
5. Landscape irrigation systems.
6. Water reuse systems.

5.410.4.3 Procedures. Perform testing and adjusting procedures in accordance with manufacturer's specifications and applicable standards on each system.

5.410.4.3.1 HVAC balancing. In addition to testing and adjusting, before a new space-conditioning system serving a building or space is operated for normal use, the system shall be balanced in accordance with the procedures defined by the Testing Adjusting and Balancing Bureau National Standards; the National Environmental Balancing Bureau Procedural Standards; Associated Air Balance Council National Standards or as approved by the enforcing agency.

5.410.4.4 Reporting. After completion of testing, adjusting and balancing, provide a final report of testing signed by the individual responsible for performing these services.

5.410.4.5 Operation and maintenance (O & M) manual. Provide the building owner or representative with detailed operating and maintenance instructions and copies of guaranties/warranties for each system. O & M instructions shall be consistent with OSHA requirements in CCR, Title 8, Section 5142, and other related regulations.

5.410.4.5.1 Inspections and reports. Include a copy of all inspection verifications and reports required by the enforcing agency.

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DIVISION 5.5 ENVIRONMENTAL QUALITY

SECTION 5.501 GENERAL

5.501.1 SCOPE. The provisions of this chapter shall outline means of reducing the quantity of air contaminants that are odorous, irritating, and/or harmful to the comfort and well-being of a building's installers, occupants and neighbors.

SECTION 5.502 DEFINITIONS

5.502.1 DEFINITIONS. The following terms are defined in Chapter 2 *(and are included here for reference)*

ARTERIAL HIGHWAY. A general term denoting a highway primarily for through traffic usually on a continuous route.

A-WEIGHTED SOUND LEVEL (dBA). The sound pressure level in decibels as measured on a sound level meter using the internationally standardized A-weighting filter or as computed from sound spectral data to which A-weighting adjustments have been made.

1 BTU/HOUR. British thermal units per hour, also referred to as Btu. The amount of heat required to raise one pound of water one degree Fahrenheit per hour, a common measure of heat transfer rate. A ton of refrigeration is 12,000 Btu, the amount of heat required to melt a ton (2,000 pounds) of ice at 32^{0} Fahrenheit.

COMMUNITY NOISE EQUIVALENT LEVEL (CNEL). A metric similar to the day-night average sound level (Ldn), except that a 5 decibel adjustment is added to the equivalent continuous sound exposure level for evening hours (7pm to 10pm) in addition to the 10 dB nighttime adjustment used in the Ldn.

COMPOSITE WOOD PRODUCTS. Composite wood products include hardwood plywood, particleboard and medium density fiberboard. "Composite wood products" does not include hardboard, structural plywood, structural panels, structural composite lumber, oriented strand board, glued laminated timber, timber, prefabricated wood I–joists or finger–jointed lumber, all as specified in California Code of Regulations (CCR), Title 17, Section 93120.1(a).

Note: See CCR, Title 17, Section 93120.1.

DAY-NIGHT AVERAGE SOUND LEVEL (Ldn). The A-weighted equivalent continuous sound exposure level for a 24-hour period with a 10 dB adjustment added to sound levels occurring during nighttime hours (10p.m. to 7 a.m.).

DECIBEL (db). A measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power, sound intensity) with respect to a reference quantity.

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. Plug-in hybrid electric vehicles (PHEV) are considered electric vehicles. For purposes of the *California Electrical Code*, off-road, self-propelled electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats, and the like, are not included.

ELECTRIC VEHICLE CHARGING STATION(S) (EVCS)). One or more spaces intended for charging electric vehicles.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle.

ENERGY EQUIVALENT (NOISE) LEVEL (Leq). The level of a steady noise which would have the same energy as the fluctuating noise level integrated over the time of period of interest.

EXPRESSWAY. An arterial highway for through traffic which may have partial control of access, but which may or may not be divided or have grade separations at intersections.

FREEWAY. A divided arterial highway with full control of access and with grade separations at intersections.

GLOBAL WARMING POTENTIAL (GWP). The radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time. Carbon dioxide is the reference compound with a GWP of one.

GLOBAL WARMING POTENTIAL VALUE (GWP VALUE). A 100-year GWP value published by the Intergovernmental Panel on Climate Change (IPCC) in either its Second Assessment Report (SAR) (IPCC, 1995); or its Fourth Assessment A-3 Report (AR4) (IPCC, 2007). The SAR GWP values are found in column "SAR (100-yr)" of Table 2.14.; the AR4 GWP values are found in column "100 yr" of Table 2.14.

HIGH-GWP REFRIGERANT. A compound used as a heat transfer fluid or gas that is: (a) a chlorofluorocarbon, a hdrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or any compound or blend of compounds, with a GWP value equal to or greater than 150, or (B) any ozone depleting substance as defined in Title 40 of the Code of Federal Regulations, Part 82, sec.82.3 (as amended March 10, 2009).

LONG RADIUS ELBOW. Pipe fitting installed between two lengths of pipe or tubing to allow a change of direction, with a radius 1.5 times the pipe diameter.

LOW-GWP REFRIGERANT. A compound used as a heat transfer fluid or gas that: (A) has a GWP value less than 150, and (B) is not an ozone depleting substance as defined in Title 40 of the Code of Federal Regulations, Part 82, sec.82.3 (as amended March 10, 2009).

MERV. Filter minimum efficiency reporting value, based on ASHRAE 52.2–1999.

MAXIMUM INCREMENTAL REACTIVITY (MIR). The maximum change in weight of ozone formed by adding a compound to the "Base REactive Organic Gas (ROG) Mixture" per weight of compound added, expressed to hundreths of a gram (g O^3/g ROC).

PRODUCT-WEIGHTED MIR (PWMIR). The sum of all weighted-MIR for all ingredients in a product subject to this article. The PWMIR is the total product reactivity expressed to hundredths of a gram of ozone formed per gram of product (excluding container and packaging).

PSIG. Pounds per square inch, guage.

REACTIVE ORGANIC COMPOUND (ROC). Any compound that has the potential, once emitted, to contribute to ozone formation in the troposphere.

SCHRADER ACCESS VALVES. Access fittings with a valve core installed.

SHORT RADIUS ELBOW. Pipe fitting installed between two lengths of pipe or tubing to allow a change of direction, with a radius 1.0 times the pipe diameter.

SUPERMARKET. For the purposes of Section 5.508.2, a supermarket is any retail food facility with 8,000 square feet or more conditioned area, and that utilizes either refrigerated display cases, or walk-in coolers or freezers connected to remote compressor units or condensing units.

VOC. A volatile organic compound broadly defined as a chemical compound based on carbon chains or rings with vapor pressures greater than 0.1 millimeters of mercury at room temperature. These compounds typically contain hydrogen and may contain oxygen, nitrogen and other elements. See CCR Title 17, Section 94508(a)

Note: Where specific regulations are cited from different agencies such as SCAQMD, ARB, etc., the VOC definition included in that specific regulation is the one that prevails for the specific measure in question.

SECTION 5.503 FIREPLACES

5.503.1 FIREPLACES. Install only a direct-vent sealed-combustion gas or sealed wood-burning fireplace, or a sealed woodstove or pellet stove, and refer to residential requirements in the California Energy Code, Title 24, Part 6, Subchapter 7, Section 150. Woodstoves, pellet stoves and fireplaces shall comply with applicable local ordinances.

5.503.1.1 Woodstoves. Woodstoves and pellet stoves shall comply with U.S. EPA New Source Performance Standards (NSPS) emission limits as applicable, and shall have a permanent label indicating they are certified to meet the emission limits.

SECTION 5.504 POLLUTANT CONTROL

5.504.1 TEMPORARY VENTILATION. The permanent HVAC system shall only be used during construction if necessary to condition the building or areas of addition or alteration within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.2-1999, or an average efficiency of 30% based on ASHRAE 52.1-1992 Replace all filters immediately prior to occupancy, or, if the building is occupied during alteration, at the conclusion of construction.

5.504.3 Covering of duct openings and protection of mechanical equipment during construction. At the time of rough installation, or during storage on the construction site and until final startup of the heating, cooling and ventilating equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal or other methods acceptable to the enforcing agency to reduce the amount of dust, water and debris which may collect in the system.

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	11/21/17	100% SD
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	07/10/17	60% SD
	06/16/17	50% SD

COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 12/1/2017 5:03:41 PM

scale: as noted

date:

CAL-GREEN COMPLIANCE FORM

G4.1

2016 CALIFORNIA GREEN BUILDING STANDARDS CODE
NONRESIDENTIAL MANDATORY MEASURES, SHEET 3 (INCLUDING JANUARY 1, 2017 ERRATA)

AIA|CC CALIFORNIA COUNCIL

INSPECTOR SIGNOFF

5.504.4 FINISH MATERIAL POLLUTANT CONTROL. Finish materials shall comply with Sections 5.504.4.1 through 5.504.4.6.

5.504.4.1 Adhesives, sealants and caulks. Adhesives, sealants, and caulks used on the project shall meet the requirements of the following standards:

1. Adhesives, adhesive bonding primers adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products as specified in subsection 2, below.

2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of *California Code of Regulations*, Title 17, commencing with Section 94507.

TABLE 5.504.4.1 - ADHESIVE VOC LIMIT[1,2]

Less Water and Less Exempt Compounds in Grams per Liter

ARCHITECTURAL APPLICATIONS	CURRENT VOC LIMIT
INDOOR CARPET ADHESIVES	50
CARPET PAD ADHESIVES	50
OUTDOOR CARPET ADHESIVES	150
WOOD FLOORING ADHESIVES	100
RUBBER FLOOR ADHESIVES	60
SUBFLOOR ADHESIVES	50
CERAMIC TILE ADHESIVES	65
VCT & ASPHALT TILE ADHESIVES	50
DRYWALL & PANEL ADHESIVES	50
COVE BASE ADHESIVES	50
MULTIPURPOSE CONSTRUCTION ADHESIVES	70
STRUCTURAL GLAZING ADHESIVES	100
SINGLE-PLY ROOF MEMBRANE ADHESIVES	250
OTHER ADHESIVES NOT SPECIFICALLY LISTED	50
SPECIALTY APPLICATIONS	
PVC WELDING	510
CPVC WELDING	490
ABS WELDING	325
PLASTIC CEMENT WELDING	250
ADHESIVE PRIMER FOR PLASTIC	550
CONTACT ADHESIVE	80
SPECIAL PURPOSE CONTACT ADHESIVE	250
STRUCTURAL WOOD MEMBER ADHESIVE	140
TOP & TRIM ADHESIVE	250
SUBSTRATE SPECIFIC APPLICATIONS	
METAL TO METAL	30
PLASTIC FOAMS	50
POROUS MATERIAL (EXCEPT WOOD)	50
WOOD	30
FIBERGLASS	80

1. IF AN ADHESIVE IS USED TO BOND DISSIMILAR SUBSTRATES TOGETHER, THE ADHESIVE WITH THE HIGHEST VOC CONTENT SHALL BE ALLOWED.

2. FOR ADDITIONAL INFORMATION REGARDING METHODS TO MEASURE THE VOC CONTENT SPECIFIED IN THIS TABLE, SEE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT RULE 1168, www.arb.ca.gov/DRDB/SC/CURHTML/R1168.PDF

TABLE 5.504.4.2 - SEALANT VOC LIMIT

Less Water and Less Exempt Compounds in Grams per Liter

SEALANTS	CURRENT VOC LIMIT
ARCHITECTURAL	250
MARINE DECK	760
NONMEMBRANE ROOF	300
ROADWAY	250
SINGLE-PLY ROOF MEMBRANE	450
OTHER	420
SEALANT PRIMERS	
ARCHITECTURAL	
NONPOROUS	250
POROUS	775
MODIFIED BITUMINOUS	500
MARINE DECK	760
OTHER	750

NOTE: FOR ADDITIONAL INFORMATION REGARDING METHODS TO MEASURE THE VOC CONTENT SPECIFIED IN THESE TABLES, SEE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT RULE 1168.

5.504.4.3 Paints and coatings. Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Table 5.504.4.3 shall be determined by classifying the coating as a Flat, Nonflat or Nonflat-High Gloss coating, based on its gloss, as defined in Subsections 4.21, 4.36 and 4.37 of the 2007 California Air Resources Board Suggested Control Measure, and the corresponding Flat, Nonflat or Nonflat-High Gloss VOC limit in Table 5.504.4.3 shall apply.

5.504.4.3.1 Aerosol Paints and coatings. Aerosol paints and coatings shall meet the PWMIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Sections 94522(c)(2) and (d)(2) of *California Code of Regulations*, Title 17, commencing with Section 94520; and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8 Rule 49.

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TABLE 5.504.4.3 - VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS[2,3]

GRAMS OF VOC PER LITER OF COATING, LESS WATER & LESS EXEMPT COMPOUNDS

COATING CATEGORY	CURRENT VOC LIMIT
FLAT COATINGS	50
NONFLAT COATINGS	100
NONFLAT HIGH GLOSS COATINGS	150
SPECIALTY COATINGS	
ALUMINUM ROOF COATINGS	400
BASEMENT SPECIALTY COATINGS	400
BITUMINOUS ROOF COATINGS	50
BITUMINOUS ROOF PRIMERS	350
BOND BREAKERS	350
CONCRETE CURING COMPOUNDS	350
CONCRETE/MASONRY SEALERS	100
DRIVEWAY SEALERS	50
DRY FOG COATINGS	150
FAUX FINISHING COATINGS	350
FIRE RESISTIVE COATINGS	350
FLOOR COATINGS	100
FORM-RELEASE COMPOUNDS	250
GRAPHIC ARTS COATINGS (SIGN PAINTS)	500
HIGH-TEMPERATURE COATINGS	420
INDUSTRIAL MAINTENANCE COATINGS	250
LOW SOLIDS COATINGS[1]	120
MAGNESITE CEMENT COATINGS	450
MASTIC TEXTURE COATINGS	100
METALLIC PIGMENTED COATINGS	500
MULTICOLOR COATINGS	250
PRETREATMENT WASH PRIMERS	420
PRIMERS, SEALERS, & UNDERCOATERS	100
REACTIVE PENETRATING SEALERS	350
RECYCLED COATINGS	250
ROOF COATINGS	50
RUST PREVENTATIVE COATINGS	250
SHELLACS:	
CLEAR	730
OPAQUE	550
SPECIALTY PRIMERS, SEALERS & UNDERCOATERS	100
STAINS	250
STONE CONSOLIDANTS	450
SWIMMING POOL COATINGS	340
TRAFFIC MARKING COATINGS	100
TUB & TILE REFINISH COATINGS	420
WATERPROOFING MEMBRANES	250
WOOD COATINGS	275
WOOD PRESERVATIVES	350
ZINC-RICH PRIMERS	340

1. GRAMS OF VOC PER LITER OF COATING, INCLUDING WATER & EXEMPT COMPOUNDS

2. THE SPECIFIED LIMITS REMAIN IN EFFECT UNLESS REVISED LIMITS ARE LISTED IN SUBSEQUENT COLUMNS IN THE TABLE.

3. VALUES IN THIS TABLE ARE DERIVED FROM THOSE SPECIFIED BY THE CALIFORNIA AIR RESOURCES BOARD, ARCHITECTURAL COATINGS SUGGESTED CONTROL MEASURE, FEB. 1, 2008. MORE INFORMATION IS AVAILABLE FROM THE AIR RESOURCES BOARD.

5.504.4.3.2 Verification. Verification of compliance with this section shall be provided at the request of the enforcing agency. Documentation may include, but is not limited to, the following:

1. Manufacturer's product specification
2. Field verification of on-site product containers

5.504.4.4 Carpet Systems. All carpet installed in the building interior shall meet at least one of the testing and product requirements:

1. Carpet and Rug Institute's Green Label Plus Program.
2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as CDPH Standard Method V1.1 or Specification 01350).
3. NSF/ANSI 140 at the Gold level or higher;
4. Scientific Certifications Systems Sustainable Choice; or
5. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database.

5.504.4.4.1 Carpet cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.

5.504.4.4.2 Carpet adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.

5.504.4.5 Composite wood products. Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the buildings shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et seq.). Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Table 5.504.4.5.

5.504.4.5.3 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following:

1. Product certifications and specifications.
2. Chain of custody certifications.
3. Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.).
4. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards.
5. Other methods acceptable to the enforcing agency.

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TABLE 5.504.4.5 - FORMALDEHYDE LIMITS[1]

MAXIMUM FORMALDEHYDE EMISSIONS IN PARTS PER MILLION

PRODUCT	CURRENT LIMIT
HARDWOOD PLYWOOD VENEER CORE	0.05
HARDWOOD PLYWOOD COMPOSITE CORE	0.05
PARTICLE BOARD	0.09
MEDIUM DENSITY FIBERBOARD	0.11
THIN MEDIUM DENSITY FIBERBOARD[2]	0.13

1. VALUES IN THIS TABLE ARE DERIVED FROM THOSE SPECIFIED BY THE CALIFORNIA AIR RESOURCES BOARD, AIR TOXICS CONTROL MEASURE FOR COMPOSITE WOOD AS TESTED IN ACCORDANCE WITH ASTM E 1333. FOR ADDITIONAL INFORMATION, SEE CALIFORNIA CODE OF REGULATIONS, TITLE 17, SECTIONS 93120 THROUGH 93120.12.

2. THIN MEDIUM DENSITY FIBERBOARD HAS A MAXIMUM THICKNESS OF 5/16 INCHES (8 MM).

5.504.4.6 Resilient flooring systems. For 80 percent of floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:

1. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
3. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7. and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product DataBase; or
4. Products certified under UL GREENGUARD Gold (formerly the Greenguard Children's & Schools Program).

5.504.4.6.1 Verification of compliance. Documentation shall be provided verifying that resilient flooring materials meet the pollutant emission limits.

5.504.5.3 Filters. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 8. MERV 8 filters shall be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

Exceptions:

1. An ASHRAE 10% to 15% efficiency filter shall be permitted for an HVAC unit meeting the 2013 California Energy Code having 60,000 Btu/h or less capacity per fan coil, if the energy use of the air delivery system is 0.4 W/cfm or less at design air flow.
2. Existing mechanical equipment.

5.504.7 ENVIRONMENTAL TOBACCO SMOKE (ETS) CONTROL. Where outdoor areas are provided for smoking, prohibit smoking within 25 feet of building entries, outdoor air intakes and operable windows and within the building as already prohibited by other laws or regulations; or as enforced by ordinances, regulations or policies of any city, county, city and county, California Community College, campus of the California State University, or campus of the University of California, whichever are more stringent. When ordinances, regulations or policies are not in place, post signage to inform building occupants of the prohibitions.

SECTION 5.505 INDOOR MOISTURE CONTROL

5.505.1 INDOOR MOISTURE CONTROL. Buildings shall meet or exceed the provisions of *California Building Code*, CCR, Title 24, Part 2, Sections 1203 (Ventilation) and Chapter 14 (Exterior Walls). For additional measures not applicable to low-rise residential occupancies, see Section 5.407.2 of this code.

SECTION 5.506 INDOOR AIR QUALITY

5.506.1 OUTSIDE AIR DELIVERY. For mechanically or naturally ventilated spaces in buildings, meet the minimum requirements of Section 120.1 (Requirements For Ventilation) of the *California Energy Code*, or the applicable local code, whichever is more stringent, and Division 1, Chapter 4 of CCR, Title 8.

5.506.2 CARBON DIOXIDE (CO_2) MONITORING. For buildings or additions equipped with demand control ventilation, CO_2 sensors and ventilation controls shall be specified and installed in accordance with the requirements of the California Energy Code, Section 120(c)(4).

SECTION 5.507 ENVIRONMENTAL COMFORT

5.507.4 ACOUSTICAL CONTROL. Employ building assemblies and components with Sound Transmission Class (STC) values determined in accordance with ASTM E 90 and ASTM E 413, or Outdoor-Indoor Sound Transmission Class (OITC) determined in accordance with ASTM E 1332, using either the prescriptive or performance method in Section 5.507.4.1 or 5.507.4.2.

Exception: Buildings with few or no occupants or where occupants are not likely to be affected by exterior noise, as determined by the enforcement authority, such as factories, stadiums, storage, enclosed parking structures and utility buildings.

Exception: [DSA-SS] For public schools and community colleges, the requirements of this section and all subsections apply only to new construction.

5.507.4.1 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following locations:

1. Within the 65 CNEL noise contour of an airport.

   Exceptions:

   a. L_{dn} or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.
   b. L_{dn} or CNEL for other airports and heliports for which a land use plan has not been developed shall be determined by the local general plan noise element.

2. Within the 65 CNEL or L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway source as determined by the Noise Element of the General Plan.

5.507.4.1.1. Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB L_{eq} - 1-hr during any hour of operation shall have building, addition or alteration exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC 30).

5.507.4.2 Performance Method. For buildings located as defined in Section 5.507.4.1 or 5.507.4.1.1, wall and roof-ceiling assemblies exposed to the noise source making up the building or addition envelope or altered envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (Leq-1Hr) of 50 dBA in occupied areas during any hour of operation.

5.507.4.2.1 Site Features. Exterior features such as sound walls or earth berms may be utilized as appropriate to the building, addition or alteration project to mitigate sound migration to the interior.

5.507.4.2.2 Documentation of Compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the architect or engineer of record.

5.507.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places shall have an STC of at least 40.

Note: Examples of assemblies and their various STC ratings may be found at the California Office of Noise Control: www.toolbase.org/PDF/CaseStudies/stc_icc_ratings.pdf.

SECTION 5.508 OUTDOOR AIR QUALITY

5.508.1 Ozone depletion and greenhouse gas reductions. Installations of HVAC, refrigeration and fire suppression equipment shall comply with Sections 5.508.1.1 and 5.508.1.2.

5.508.1.1 Chlorofluorocarbons (CFCs). Install HVAC, refrigeration and fire suppression equipment that do not contain CFCs.

5.508.1.2 Halons. Install HVAC, refrigeration and fire suppression equipment that do not contain Halons.

5.508.2 Supermarket refrigerant leak reduction. New commercial refrigeration systems shall comply with the provisions of this section when installed in retail food stores 8,000 square feet or more conditioned area, and that utilize either refrigerated display cases, or walk-in coolers or freezers connected to remote compressor units or condensing units. The leak reduction measures apply to refrigeration systems containing high-global-warming potential (high-GWP) refrigerants with a GWP of 150 or greater. New refrigeration systems include both new facilities and the replacement of existing refrigeration systems in existing facilities.

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Exception: Refrigeration systems containing low-global warming potential (low-GWP) refrigerant with a GWP value less than 150 are not subject to this section. Low-GWP refrigerants are nonozone-depleting refrigerants that include ammonia, carbon dioxide (CO_2), and potentially other refrigerants.

5.508.2.1 Refrigerant piping. Piping compliant with the California Mechanical Code shall be installed to be accessible for leak protection and repairs. Piping runs using threaded pipe, copper tubing with an outside diameter (OD) less than 1/4 inch, flared tubing connections and short radius elbows shall not be used in refrigerant systems except as noted below.

5.508.2.1.1 Threaded pipe. Threaded connections are permitted at the compressor rack.

5.508.2.1.2 Copper pipe. Copper tubing with an OD less than 1/4 inch may be used in systems with a refrigerant charge of 5 pounds or less.

5.508.2.1.2.1 Anchorage. One-fouth-inch OD tubing shall be securely clamped to a rigid base to keep vibration levels below 8 mils.

5.508.2.1.3 Flared tubing connections. Double-flared tubing connections may be used for pressure controls, valve pilot lines and oil.

Exception: Single-flared tubing connections may be used with a multiring seal coated with industrial sealant suitable for use with refrigerants and tightened in accordance with manufacturer's recommendations.

5.508.2.1.4 Elbows. Short radius elbows are only permitted where space limitations prohibit use of long radius elbows.

5.508.2.2 Valves. Valves Valves and fittings shall comply with the *California Mechanical Code* and as follows.

5.508.2.2.1 Pressure relief valves. For vessels containing high-GWP refrigerant, a rupture disc shall be installed between the outlet of the vessel and the inlet of the pressure relief valve.

5.508.2.2.1.1 Pressure detection. A pressure gauge, pressure transducer or other device shall be installed in the space between the rupture disc and the relief valve inlet to indicate a disc rupture or discharge of the relief valve.

5.508.2.2.2 Access valves. Only Schrader access valves with a brass or steel body are permitted for use.

5.508.2.2.2.1 Valve caps. For systems with a refrigerant charge of 5 pounds or more, valve caps shall be brass or steel and not plastic.

5.508.2.2.2.2 Seal caps. If designed for it, the cap shall have a neoprene O-ring in place.

5.508.2.2.2.2.1 Chain tethers. Chain tethers to fit ovr the stem are required for valves designed to have seal caps.

Exception: Valves with seal caps that are not removed from the valve during stem operation.

5.508.2.3 Refrigerated service cases. Refrigerated service cases holding food products containing vinegar and salt shall have evaporator coils of corrosion-reistant material, such as stainless steel; or be coated to prevent corrosion from these substances.

5.508.2.3.1 Coil coating. Consideration shall be given to the heat transfer efficiency of coil coating to maximize energy efficiency.

5.508.2.4 Refrigerant receivers. Refrigerant receivers with capacities greater than 200 pounds shall be fitted with a device tha indicates the level of refrigerant in the receiver.

5.508.2.5 Pressure testing. The system shall be pressure tested during installation prior to evacuation and charging.

5.508.2.5.1 Minimum pressure. The system shall be charged with regulated dry nitrogen and appropriate tracer gas to bring system pressure up to 300 psig minimum.

5.508.2.5.2 Leaks. Check the system for leaks, repair any leaks, and retest for pressure using the same gauge.

5.508.2.5.3 Allowable pressure change. The system shall stand, unaltered, for 24 hours with no more than a +/- one pound pressure change from 300 psig, measured with the same gauge.

5.508.2.6 Evacuation. The system shall be evacuated after pressure testing and prior to charging.

5.508.2.6.1 First vacuum. Pull a system vacuum down to at least 1000 microns (+/- 50 microns), and hold for 30 minutes.

5.508.2.6.2 Second vacuum. Pull a second system vacuum to a minimum of 500 microns and hold for 30 minutes.

5.508.2.6.3 Third vacuum. Pull a third vacuum down to a minimum of 300 microns, and hold for 24 hours with a maximum drift of 100 microns over a 24-hour period.

CHAPTER 7
INSTALLER & SPECIAL INSPECTOR QUALIFICATIONS

702 QUALIFICATIONS

702.1 INSTALLER TRAINING. HVAC system installers shall be trained and certified in the proper installation of HVAC systems including ducts and equipment by a nationally or regionally recognized training or certification program. Uncertified persons may perform HVAC installations when under the direct supervision and responsibility of a person trained and certified to install HVAC systems or contractor licensed to install HVAC systems. Examples of acceptable HVAC training and certification programs include but are not limited to the following:

1. State certified apprenticeship programs.
2. Public utility training programs.
3. Training programs sponsored by trade, labor or statewide energy consulting or verification organizations.
4. Programs sponsored by manufacturing organizations.
5. Other programs acceptable to the enforcing agency.

702.2 SPECIAL INSPECTION [HCD]. When required by the enforcing agency, the owner or the responsible entity acting as the owner's agent shall employ one or more special inspectors to provide inspection or other duties necessary to substantiate compliance with this code. Special inspectors shall demonstrate competence to the satisfaction of the enforcing agency for the particular type of inspection or task to be performed. In addition to other certifications or qualifications acceptable to the enforcing agency, the following certifications or education may be considered by the enforcing agency when evaluating the qualifications of a special inspector:

1. Certification by a national or regional green building program or standard publisher.
2. Certification by a statewide energy consulting or verification organization, such as HERS raters, building performance contractors, and home energy auditors.
3. Successful completion of a third party apprentice training program in the appropriate trade.
4. Other programs acceptable to the enforcing agency.

Notes:

1. Special inspectors shall be independent entities with no financial interest in the materials or the project they are inspecting for compliance with this code.
2. HERS raters are special inspectors certified by the California Energy Commission (CEC) to rate homes in California according to the Home Energy Rating System (HERS).

[BSC-CG] When required by the enforcing agency, the owner or the responsible entity acting as the owner's agent shall employ one or more special inspectors to provide inspection or other duties necessary to substantiate compliance with this code. Special inspectors shall demonstrate competence to the satisfaction of the enforcing agency for the particular type of inspection or task to be performed. In addition, the special inspector shall have a certification from a recognized state, national or international association, as determined by the local agency. The area of certification shall be closely related to the primary job function, as determined by the local agency.

Note: Special inspectors shall be independent entities with no financial interest in the materials or the project they are inspecting for compliance with this code.

703 VERIFICATIONS

703.1 DOCUMENTATION. Documentation used to show compliance with this code shall include but is not limited to, construction documents, plans, specifications, builder or installer certification, inspection reports, or other methods acceptable to the enforcing agency which demonstrate substantial conformance. When specific documentation or special inspection is necessary to verify compliance, that method of compliance will be specified in the appropriate section or identified applicable checklist.

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NOT FOR CONSTRUCTION

rev	date	issue
1	11/21/17	100% SD
2	10/06/17	80% SD
3	07/10/17	60% SD
4	06/16/17	50% SD

COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

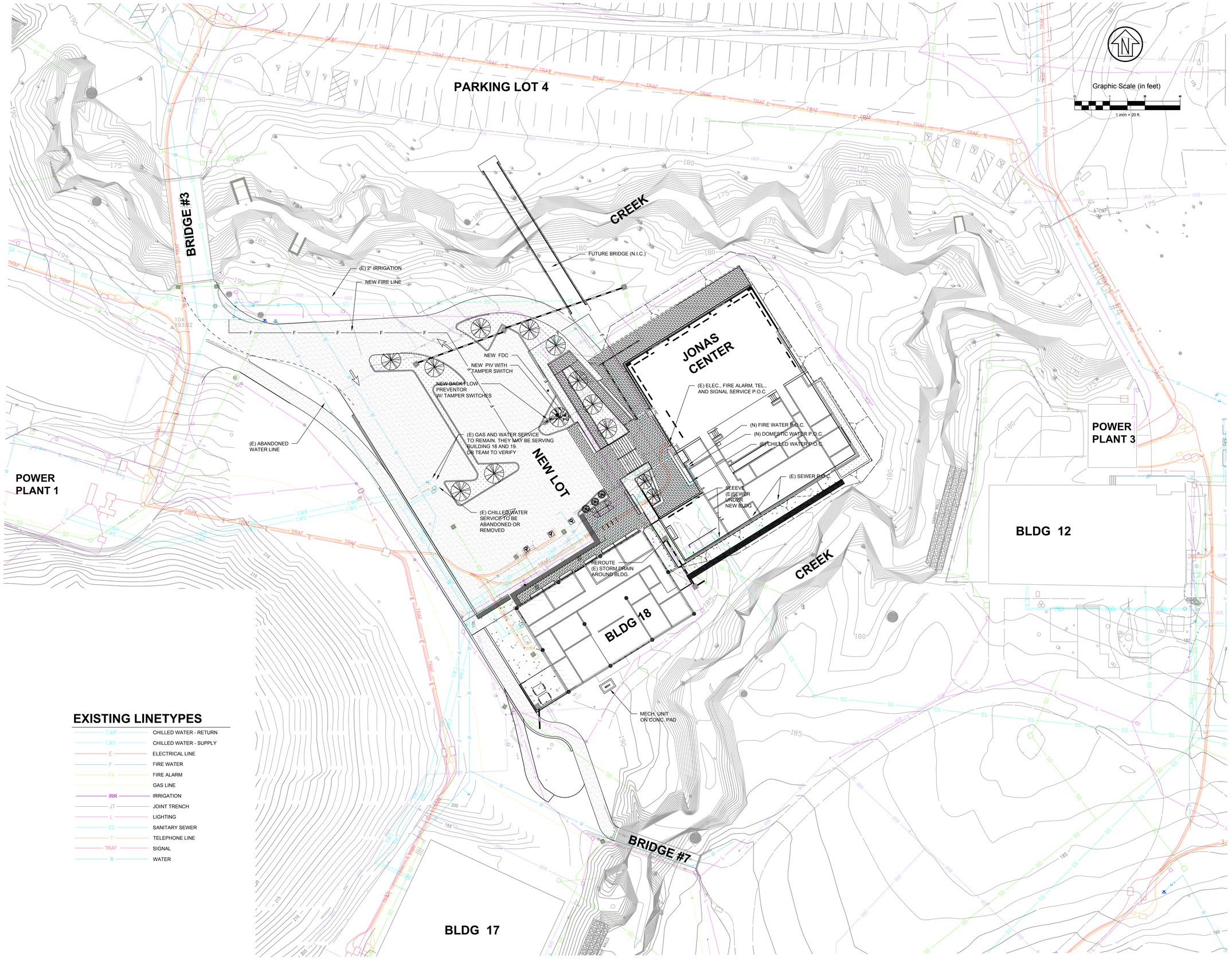
project number: 16-148.04

plot date: 12/1/2017 5:03:42 PM

scale: as noted

date:

CAL-GREEN COMPLIANCE FORM



EXISTING LINETYPES

CWR	CHILLED WATER - RETURN
CWS	CHILLED WATER - SUPPLY
E	ELECTRICAL LINE
F	FIRE WATER
FA	FIRE ALARM
G	GAS LINE
IRR	IRRIGATION
JT	JOINT TRENCH
L	LIGHTING
SS	SANITARY SEWER
T	TELEPHONE LINE
TRAF	SIGNAL
W	WATER

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rev	date	issue
	06/16/17	50% SD
	10/06/17	80% SD
	11/21/17	100% SD

IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 6/12/2017 10:51:05 AM

scale: as noted

date: 06/16/17

Utility Plan

C2.0

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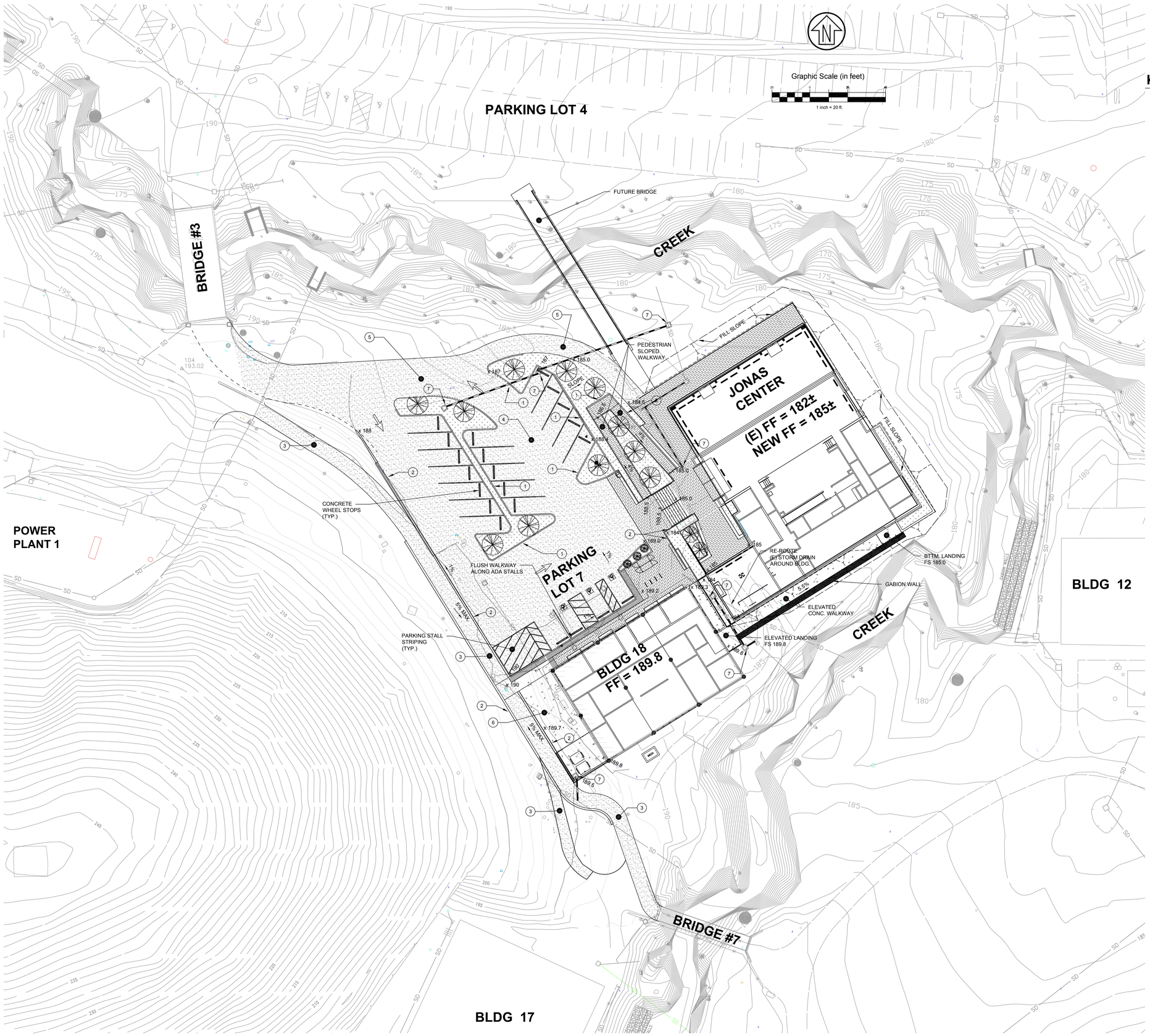

KEYNOTES

1. CONCRETE CURB
2. CONCRETE RETAINING WALL
3. AC PATHWAY
4. AC PARKING LOT
5. REMOVE, REGRADE, AND REPAVE AC DRIVEWAY
6. CONCRETE PAVEMENT
7. DRAINAGE INLET

PRELIMINARY GRADING QUANTITIES

1,000 CY CUT
1,800 CY FILL

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IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

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plot date: 6/12/2017 10:51:05 AM

scale: as noted

date: 06/16/17

Grading Plan

C3.0

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PROJECT ABBREVIATIONS

AC	ASPHALTIC CONCRETE	LSJ	LONGITUDINAL SHRINKAGE JOINT
AB	AGGREGATE BASE	MAX	MAXIMUM
AD	AREA DRAIN	MFR	MANUFACTURER
ARCH	ARCHITECT	MH	MANHOLE
AVG	AVERAGE	MIN	MINIMUM
B&B	BALL AND BURLAP	MM	MILLIMETERS
BC	BACK OF CURB	NIC	NOT IN CONTRACT
BF	BOTTOM OF FENCE	NTS	NOT TO SCALE
BLDG	BUILDING	OC	ON CENTER
BOR	BACK OF RAMP	OCEW	ON CENTER EACH WAY
BOS	BOTTOM OF SLOPE	OD	OUTSIDE DIAMTER
BR	BIKE RACK	OPP	OPPOSITE
BS	BOTTOM OF STEP (STAIR)	PA	PIPE ANCHOR
BSW	BACK OF SIDEWALK	PLA	PLANTING AREA
BW	BOTTOM OF WALL	PED	PEDESTAL
CAL	CALIPER	PDSN	PEDESTRIAN
CB	CATCH BASIN OR CEMENT BASE	PERF	PERFORATED
CH	CHANNEL OR CHILLER	PIP	POURED-IN-PLACE
CHD	CONCRETE HEADER	POC	POINT OF CONNECTION
CIP	CAST-IN-PLACE	PT	POINT OF TANGENCY
CJ	CONTROL JOINT	R	RADIUS
CL	CENTER LINE	RB	ROOT BARRIER
CLR	CLEARANCE	RGB	ROUNDED FRADE BREAK
CMU	CONCRETE MASONRY UNIT	RIM	RIM ELEVATION
CO	CLEAN OUT	ROW	RIGHT OF WAY
COJ	CONSTRUCTION JOINT	SAD	SEE ARCHITECTURAL DRAWINGS
CONC	CONCRETE	SB	SPLASH BLOCK
CONT	CONTINUOUS	SBSD	SEE BUILDING STRUCTURAL DRAWINGS
CP	CENTER POINT	SCD	SEE CIVIL DRAWINGS
CTR	CENTER	SD	STORM DRAIN
D/B	DESIGN/BUILD	SED	SEE ELECTRICAL DRAWINGS
DI	DRAIN INLET	SG	SUBGRADE
DIA	DIAMETER	SF	SQUARE FEET
DIM	DIMENSION	SHP	SWALE FLOWLINE HIGH POINT
DN	DOWN	SIM	SIMILAR
EA	EACH	SJ	SCORE JOINT
EF	EACH FACE	SLD	SEE LIGHTING DRAWINGS
EJ	EXPANSION JOINT	SPECS	SPECIFICATIONS
EJS	EXPANSION JOINT W/ SEALANT	SSL	STRAIGHT SLOPE
EL	ELEVATION	SSD	SEE STRUCTURAL DRAWINGS
ENGR	ENGINEER	SSGD	SEE SIGN DRAWINGS
EP	EDGE OF PAVEMENT	SWPPP	STORMWATER POLLUTION PREVENTION PLAN
EQ	EQUAL		
EW	EACH WAY	TBD	TO BE DETERMINED
(E)	EXISTING	TD	TOP OF DRAIN
FDC	FIRE DEPARTMENT CONNECTION	TOC	TOP OF CURB
FFE	FINISHED FLOOR ELEVATION	TOR	TOP OF RAMP
FG	FINISHED GRADE	TPTL	TREE PLANTING TRENCH LIMIT
FH	FIRE HYDRANT	TOBR	TOP OF BERM
FL	FLOW LINE	TOF	TOP OF FENCE
FOW	FACE OF WALL	TOFG	TOP OF FOOTING
FS	FINISHED SURFACE	TOFN	TOP OF FOUNDATION
GC	GENERAL CONTRACTOR	T&B	TOP AND BOTTOM
GB	GRADE BREAK	TOP	TOP OF POST
GJ	GROUT JOINT	TOS	TOP OF SLOPE
H	HANDICAP PARKING STALL	TS	TOP OF STEP (STAIR)
HC	HANDICAP	TSS	TOP OF STRUCTURAL SLAB
HDR	HEADER	TW	TOP OF WALL
HH	HANDHOLE	TWL	TREE WELL
HP	HIGH POINT	TYP	TYPICAL
HV	HOSE VALVE	UFC	UNIFORM FIRE CODE
HVP	HANDICAP VAN PARKING STALL	VEH	VEHICULAR
ID	INSIDE DIAMETER	WPM	WATER PROOF MEMBRANE
IE	INVERT ELEVATION	WWF	WELDED WIRE FABRIC
INV	INVERTED		
LOW	LIMIT OF WORK		
LPT	LOW POINT		

GENERAL LANDSCAPE PROJECT NOTES

1. ALL NOTES APPEARING ON THESE PLANS SHALL BE CONSIDERED AS INCIDENTAL WORK AND AS A PART OF THIS CONTRACT.
2. ALL WORK SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF TITLE 8 (CAL/OSHA) AND THE GENERAL CONDITIONS OF THE PROJECT SPECIFICATIONS.
3. CONTRACTOR TO VERIFY LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION INCLUDING LOCATIONS OF FIBER OPTIC LINES, PROPOSED UTILITIES, AREA DRAINS, MANHOLES, AND VAULTS AS INDICATED ON THE PROJECT SURVEY AND ANY CIVIL UTILITY PLANS. OBTAIN COPIES OF UTILITY PLANS FROM OWNERS ARCHIVES PRIOR TO CONSTRUCTION.
4. CONTRACTOR SHALL FIELD MARK ALL UTILITY LINES AND POT HOLE TO DETERMINE DEPTH OF BURIED UTILITIES PRIOR TO CONSTRUCTION. CONTRACTOR SHALL RECORD & MONITOR WORK IN THESE AREAS AND POTHOLE AS NEEDED TO IDENTIFY OBJECTS.
5. FOR MARKING UNDERGROUND FACILITIES, CALL UNDERGROUND SERVICE ALERT MINIMUM TWO DAYS PRIOR TO DIGGING: 1-800-227-2600, BETWEEN 6:00 AM- 7:00 PM, MONDAY- FRIDAY, EXCEPT HOLIDAYS.
6. PROTECT EXISTING UNDERGROUND UTILITIES, VAULTS AND CONNECTIONS AND REPAIR ANY DAMAGE TO FULL OPERATIONS TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE.
7. ELEVATIONS AND LOCATIONS OF ALL EXISTING UTILITIES WHICH CROSS THE LINE OF CONSTRUCTION SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO START OF ANY CONSTRUCTION AFFECTING SAID LINES.
8. CONTRACTOR SHALL COORDINATE UTILITY SHUTDOWN WITH DISTRICT REPRESENTATIVE.
9. REFER TO CIVIL DRAWINGS FOR ALL STORM DRAIN LINE CONNECTIONS IN LANDSCAPE PLANTING AREAS.
10. REFER TO CIVIL DRAWINGS FOR IRRIGATION POINT OF CONNECTION AND SEPARATE IRRIGATION SERVICE METER.
11. REFER TO CIVIL DRAWINGS FOR HORIZONTAL AND VERTICAL CONTROL OF DRIVE AISLES, CURBS, AND GUTTERS.
12. REFER TO CIVIL DRAWINGS FOR ALL UTILITIY CONNECTIONS, ADJUSTED UTILITY ELEVATIONS AND RIM ELEVATIONS.
13. REFER TO ELECTRICAL PLANS FOR LIGHTING AND IRRIGATION CONTROLLER CONNECTIONS.
14. EXISTING ELEVATION INFORMATION BASED ON TOPOGRAPHICAL SURVEY BY PROVIDED BY THE OWNER'S REPRESENTATIVE. VERIFY GRADES PRIOR TO CONSTRUCTION AND NOTIFY OWNER'S REPRESENTATIVE IF EXISTING CONDITIONS VARY FROM PLANS.
15. STORM INLET BOXES SHALL NOT BE LEFT UNCOVERED AT ANY TIME.
16. THE CONTRACTOR SHALL PROCEED WITH DUE CAUTION DURING UNDERGROUND OPERATIONS AND SHALL REPAIR OR REPLACE ALL UTILITIES AND SERVICES, EITHER MARKED IN THE FIELD OR INDICATED ON THE PLANS, WHICH ARE DAMAGED DURING CONSTRUCTION, AT HIS OWN EXPENSE. TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE.
17. THE CONTRACTOR SHALL BE RESPONSIBLE UNDER THIS CONTRACT FOR REPAIRING AND REPLACING AT THE CONTRACTOR'S OWN EXPENSE ANY DRAINAGE STRUCTURES, UTILITIES, WALLS, EXISTING PLANTS, FURNITURE, LIGHTS, WALKWAYS, PAVING, SIGNAGE, OR OTHER EXISTING IMPROVEMENTS TO REMAIN WHICH ARE DAMAGED OR DESTROYED BY OPERATION OF THIS CONTRACT. LIKEWISE, THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING OR REPLACING ANY AND ALL DAMAGES OCCURRING AS A RESULT OF THE CONTRACTOR'S OPERATION, ONSITE, ON ADJACENT PROPERTIES AND ANYWHERE OUTSIDE THE CONTRACT LIMIT LINES. THE DAMAGED ITEMS SHALL BE RESTORED TO THEIR ORIGINAL CONDITION AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE.
18. CONTRACTOR SHALL VERIFY EXISTING CONDITIONS IN THE FIELD. ANY DISCREPANCIES BETWEEN THE EXISTING CONDITIONS IN THE FIELD AND THE INFORMATION SHOWN ON THESE PLANS SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER'S REPRESENTATIVE PRIOR TO THE START OF CONSTRUCTION.
19. WORK SHALL NOT BEGIN UNTIL ADEQUATE TEMPORARY BARRICADES, BARRIERS, FENCES, WARNING SIGNS, LIGHTS, OR OTHER SUCH TRAFFIC AND PEDESTRIAN WARNING AND CONTROL DEVICES AS REQUIRED ARE IN PLACE.
20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DUST CONTROL AT ALL TIMES.
21. ADJUST LIDS OF ALL (E) IN-GRADE UTILITY BOXES AND VAULTS TO MEET NEW GRADES.
22. THE CONTRACTOR SHALL BE RESPONSIBLE FOR WATERING ALL EXISTING PLANT MATERIAL TO REMAIN THROUGHOUT THE DURATION OF THE CONTRACT TO ENSURE HEALTH OF PLANT MATERIAL TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE, SEE SPEC. SECTIONS 32-93-00, PLANTING.
23. KEEP ALL PLANTING AND PAVING AREAS FREE FROM WEEDS, DEBRIS AND TRASH THROUGHOUT THE DURATION OF THE CONTRACT.

CAL GREEN NOTES

1. THIS LANDSCAPE PROJECT AREA COMPLIES WITH CAL GREEN SECTION 5.304 OUTDOOR WATER USE
2. THIS LANDSCAPE PROJECT AREA COMPLIES WITH CAL GREEN SECTION A5.304.4 POTABLE WATER REDUCTION
3. THIS LANDSCAPE PROJECT AREA COMPLIES WITH THE MODEL WATER EFFICIENT LANDSCAPE ORDINANCE

LANDSCAPE FINISH GRADING NOTES

1. REFER TO GENERAL PROJECT NOTES AND SPECIFICATIONS FOR ADDITIONAL INFORMATION
2. EXISTING GRADING INFORMATION BASED ON AERIAL SURVEY PROVIDED BY OWNER. VERIFY GRADES PRIOR TO CONSTRUCTION AND NOTIFY OWNER'S REPRESENTATIVE IF EXISTING CONDITIONS VARY FROM PLANS, AND WAIT FOR WRITTEN AUTHORIZATION PRIOR TO PROCEEDING.
3. REFER TO ARCHITECTURAL PLANS FOR BUILDING FINISH FLOOR ELEVATION, BLDG. PERIMETER WALL ELEVATIONS AND BLDG. COLUMN ELEVATIONS.
4. REFER TO CIVIL DRAWINGS FOR TOP OF CURB AND ROADWAY ELEVATIONS, ADJUSTED UTILITY ELEVATIONS AND RIM ELEVATIONS.
5. REFER TO CIVIL PLANS FOR RIM ELEVATIONS AND STORM LINE CONNECTIONS IN LANDSCAPE PLANTING AREAS. COORDINATE FINISHED GRADES WITH STORM DRAINAGE SYSTEM ON CIVIL DRAWINGS. COORDINATE FINISHED GRADES WITH STORM DRAINAGE SYSTEM ON CIVIL DRAWINGS. NOTIFY OWNER'S REPRESENTATIVE OF ANY DISCREPANCIES AND WAIT FOR WRITTEN DIRECTION BEFORE PROCEEDING.
6. EXPORTATION AND IMPORTATION OF SOIL, WHICH MAY BE NECESSARY TO MEET THE GRADES SHOWN ON THIS PLAN, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE PART OF THIS CONTRACT.
7. PLANTING AREAS SHALL RECEIVE 6" IMPORT TOPSOIL/ 6" AMENDED EXISTING TOPSOIL/ AND OR AMENDMENTS. SEE PLAN
8. SET ROUGH GRADING ELEVATIONS IN PLANTING AREAS AND SOIL AMENDMENTS BELOW FINISH GRADES SHOWN TO ALLOW INSTALLATION OF 6" IMPORT TOPSOIL/ 6" AMENDED EXISTING TOPSOIL/ AND OR AMENDMENTS AS INDICATED ON PLAN AND SPECIFICATIONS, EXCEPT WITHIN DRIP LINE OF EXISTING TREES TO REMAIN, WHERE GRADES WITHIN THE DRIP LINE OF THE TREE SHALL NOT BE CHANGED UNLESS OTHERWISE SPECIFIED ON THE PLANS. UNNECESSARY COMPACTION OF THE AREA WITHIN THE DRIP LINE SHALL BE AVOIDED.
9. NOTIFY THE OWNER'S REPRESENTATIVE IF ROUGH GRADES HAVE NOT BEEN SET BELOW FINISH GRADES SHOWN AS REQUIRED, AND WAIT FOR WRITTEN AUTHORIZATION PRIOR TO PROCEEDING.
10. EXPOSE AND CHECK INVERTS ON EXISTING STORM MANHOLES OR INLETS BEFORE CONSTRUCTING NEW STORM LINES.
11. ALL HIGH POINTS, LOW POINTS, OR GRADE BREAKS ON CONCRETE SURFACE SHALL HAVE A SMOOTH CURVE. CONCRETE SHALL NOT BE BUILT TO A POINT.
12. THE CONTRACTOR SHALL MATCH THE NEW GRADES WITHIN THE LIMITS OF WORK TO THE EXISTING GRADES WITHOUT DAMAGING THE EXISTING FENCE LINES, TREES OR EXISTING PAVING TO REMAIN, ALONG THE LIMIT LINE. ANY DAMAGE TO THESE AREAS SHALL BE REPAIRED AT THE CONTRACTORS OWN EXPENSE.
13. WHERE CONTOUR LINES FALL ON AREAS TO BE PAVED, AS PART OF THIS CONTRACT, CONTOURS APPROXIMATE THE FINISH GRADE. HENCE, EARTHWORK ELEVATIONS AT THESE LOCATIONS SHALL TAKE INTO ACCOUNT THE THICKNESS OF PAVING AND BASE MATERIALS.
14. THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE PRIOR TO MAKING CONNECTIONS TO THE EXISTING FACILITIES AND PRIOR TO BACKFILLING ANY TRENCH. ALL BACKFILL MATERIAL SHALL BE APPROVED BY DISTRICT REPRESENTATIVE.

LANDSCAPE MATERIAL & DIMENSION NOTES

1. REFER TO GENERAL PROJECT NOTES AND SPECIFICATIONS FOR ADDITIONAL INFORMATION
2. DIMENSIONS ARE MEASURED TO FACE OF BLDG., FACE OF CURB, EDGE OF PAVING, FACE OF HEADER, CENTERLINE OF POST, CENTERLINE OF FIXTURE, CENTERLINE OF COLUMN/BLDG. GRIDLINE, CENTERLINE OF PAVING BAND, OR CENTERLINE OF DOOR UNLESS NOTED OTHERWISE.
3. STAKE LOCATION OF LANDSCAPE ELEMENTS INCLUDING FENCING, WALLS, PAVING, BENCHES, POTS, ETC. FOR APPROVAL BY OWNER'S REPRESENTATIVE PRIOR TO CONSTRUCTION.
4. SPACING OF SCORE MARKS EQUALS WIDTH OF WALK, EXCEPT WHERE DRAWN OTHERWISE. ALIGN WITH OBVIOUS PAVING EDGES, AND PERPENDICULAR TO EDGE OF CURVED WALKWAYS UNLESS SHOWN OTHERWISE.
5. PROVIDE EXPANSION JOINTS WITH SEALANT WHERE CONCRETE PAVING MEETS EXISTING PAVING. AT NEW CONCRETE PAVING, SPACING OF EXPANSION JOINTS IS TYPICALLY 20' MIN. O.C., OR WHERE SHOWN. REFER TO SPECIFICATIONS. PROVIDE DOWELS INTO BACK OF CURB, FACE OF WALL, BOTTOM OF STAIRS, ETC. TO PREVENT DIFFERENTIAL SETTLEMENT AS SHOWN ON DETAILS.
6. ALL CURVES SHALL BE CONSTRUCTED SMOOTH AND TANGENT WITH OTHER CURVES OR STRAIGHT LINES WHEREVER POSSIBLE. TRANSITIONS BETWEEN CHANGES IN VERTICAL CURVATURE OF PAVING SHALL BE SMOOTH AND GRADUAL WITH NO ABRUPT CHANGES.
7. LIGHTING SHOWN FOR POSITION ONLY, REFER TO ELECTRICAL DRAWINGS FOR FIXTURE TYPE, INSTALLATION AND LIGHTING REQUIREMENTS.
8. SET LIGHT POLE BASES 18" ABOVE FINISH GRADE PER DISTRICT STANDARDS. REFER TO DETAIL 9, SHEET L7.00 FOR RELATIONSHIP BETWEEN TOP OF LIGHTPOLE BASES TO FINISH GRADE.
9. REFER TO LANDSCAPE SPECIFICATIONS FOR ALL WALL FINISHES
10. REFER TO LANDSCAPE SPECIFICATIONS FOR ALL PAVEMENT TYPES & FINISHES
11. REFER TO LANDSCAPE SPECIFICATIONS FOR ALL METAL FINISHES
12. REFER TO LANDSCAPE SPECIFICATIONS FOR FURNISHINGS
13. FOR ALL ITEMS INDICATED AS 'PROVIDED BY OWNER', THE CONTRACTOR WILL PROVIDE FOR PLACEMENT AND INSTALLATION ONLY.

LANDSCAPE PLANTING NOTES

1. REFER TO GENERAL PROJECT NOTES AND SPECIFICATIONS FOR ADDITIONAL INFORMATION
2. ALL GRADES SHALL BE APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO PLANTING OF ANY PLANT MATERIALS.
3. REFER TO SPECIFICATIONS FOR PLACEMENT OF TOPSOIL, SOIL AMENDMENTS, FERTILIZERS AND ADDITIONAL PLANTING INFORMATION.
4. A COPY OF THE NURSERY INVOICE SHALL BE SUBMITTED TO THE OWNER'S REPRESENTATIVE TO VERIFY COMPLIANCE WITH DRAWINGS AND SPECS.
5. ALL PLANTS SHALL BE OF THE GENUS, SPECIES, VARIETY, CULTIVAR, AND SIZES AS SHOWN ON THE PLANS. UNDER NO CONDITION WILL THERE BE ANY SUBSTITUTION OF PLANTS OR SIZES FOR THOSE LISTED ON THE PLANS, EXCEPT WITH THE EXPRESS WRITTEN CONSENT OF THE OWNER'S REPRESENTATIVE
6. ALL PLANTS SHALL BE TRUE TO NAME, AND SHALL BE TAGGED WITH THE NAME AND SIZE OF THE PLANT, IN ACCORDANCE WITH THE STANDARDS OF PRACTICE RECOMMENDED BY THE AMERICAN ASSOCIATION OF NURSERYMEN.
7. IMPORT/ OR AMENDED TOPSOIL MEETING SPECIFICATIONS SHALL BE INSTALLED IN ALL ON GRADE PLANTING AREAS. A SAMPLE OF IMPORT TOPSOIL, ALONG WITH A COMPLETE SOIL ANALYSIS REPORT AS SPECIFIED, SHALL BE APPROVED BY THE PROJECT ARCHITECT PRIOR TO DELIVERY OF IMPORT TOPSOIL TO THE SITE.
8. CALIPER OF TREES SHALL BE MEASURED 6" ABOVE FINISH GRADE.
9. PROVIDE 4" MULCH OVER ALL NEW SHRUB AND GROUNDCOVER AREAS EXCEPT AT HYDROSEED AREAS.
10. PLANT TREES A MINIMUM OF 4'-0" FROM EDGE OF PAVING, UTILITY STRUCTURES, WALLS AND BUILDINGS UNLESS RESTRICTED BY SIZE OF PLANTER. NOTIFY OWNER'S REPRESENTATIVE OF CONFLICTS PRIOR TO PLANTING.
11. ALL TREES 36" BOX AND LARGER SHALL BE GUYED. REFER TO DETAILS.
12. ALL 15" GALLON AND 24" BOX SIZED TREES SHALL BE DOUBLE STAKED. REFER TO DETAILS.
13. ALL SHRUBS AND GROUNDCOVERS SHALL BE SET 1/2 THE DIMENSION OF THE SPACING FROM ADJACENT WALKS, CURBS AND WALLS UNLESS OTHERWISE SHOWN.
14. ALL SHRUB AND GROUNDCOVER SPACING SHALL BE EITHER LINEAR OR TRIANGULAR UNLESS DRAWN OTHERWISE. REFER TO PLANS AND DETAILS FOR PATTERNS.
15. WHERE CIRCLES SHOW PLANTS, TRUNK OF PLANT EQUALS CENTER POINT OF CIRCLE.
16. FOR DESCRIPTION OF PREFABRICATED PLANTERS SEE LANDSCAPE SPECIFICATIONS.
17. PROVIDE HEALTHY, VIGOROUS PLANTS TYPICAL OF THE SPECIES, FREE OF PESTS OR INJURIES.
18. ORIENT PLANTS IN PLANTERS SO THAT THEIR BEST APPEARANCE IS MOST VISIBLE.
19. FOR HYDROZONES, SEE IRRIGATION PLANS.
20. ALL PLANTING AREAS SCHEDULED TO RECEIVE HYDROSEED SHALL BE PREPPED AS OUTLINED IN THE SPECIFICATIONS OR AS REQUIRED BY THE SEED MANUFACTURER. VERIFY W/ OWNER'S REPRESENTATIVE.
21. ALL PROPOSED TREES SHALL BE PRUNED FOR STRUCTURAL SOUNDNESS AND THINNED TO REDUCE WIND SAIL AT THE DIRECTION OF THE OWNER'S REPRESENTATIVE.
22. HYDROSEED MIX IS AVAILABLE FROM PACIFIC COAST SEED, 533 HAWTHORNE PLACE, LIVERMORE, CA 94550, PHONE: 925-373-4417

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IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca
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LANDSCAPE NOTES

L1.00

GENERAL LANDSCAPE PROJECT LEGEND

KEY	DESCRIPTION	DETAIL
	LIMIT OF WORK	
	PROPERTY LINE	
	CONSTRUCTION FENCING	
	BREAK LINE	
	EXISTING TREE TO REMAIN	
	EXISTING TREE REMOVAL	
SS	(E) SANITARY LINE	
SD	(E) STORM DRAIN LINE	
W	(E) WATER LINE	
E	(E) WATER LINE	
G	(E) GAS LINE	
	(E) POLE LIGHT LUMINAIRE	
	(E) BOLLARD LIGHT LUMINAIRE	
	PARKING LOT LUMINAIRE, DOUBLE. SED.	
	PEDESTRIAN POLE LIGHT LUMINAIRE, SED.	
XX / XX	DETAIL CALLOUT	
XX / XX	ELEVATION INDICATOR	
XX / XX	SECTION / ELEVATION DETAIL	
	WALL: TYPE 1	#X/LX.XX
	STAIR	#X/LX.XX
	GUARDRAIL	SAD
	TREE, REFER TO PLANTING PLAN	
MTL	METAL HEADER	SEE SPECS
	GABION WALL	SSD

LANDSCAPE GRADING LEGEND

KEY	DESCRIPTION	DETAIL# / SHEET #
	LIMIT OF GRADING LINE	
89	EXISTING CONTOUR	
89	PROPOSED CONTOUR	
XXX.XX	EXISTING ELEVATION	
FG. XXX.XX	PROPOSED ELEVATION	
FFE	FINISH FLOOR ELEVATION (S.A.D.)	
FG.	FINISH GRADE	
FG. XXX.XX	SLOPE	
	LANDSCAPE SWALE	
GB.	GRADE BREAK	
RIDGE	RIDGE	
	FLUSH	
HP/+	HIGH POINT	
TW.	TOP OF WALL	
BW.	BOTTOM OF WALL	
TC.	TOP OF CURB	
BC.	BOTTOM OF CURB	
TR.	TOP OF RAMP	
BR.	BOTTOM OF RAMP	
SCD	SEE CIVIL DRAWINGS	
SAD.	SEE ARCHITECTURAL DRAWINGS	
(E), EX.	EXISTING	
INVERT	INVERT ELEVATION (SCD.)	
RIM.	RIM ELEVATION	
VIF.	VERIFY IN FIELD	
AD	LANDSCAPE AREA DRAIN, CONNECT TO STORM DRAIN SYSTEM. SCD.	#X/LX.XX

SITE FURNISHING LEGEND

KEY	DESCRIPTION	DETAIL# / SHEET #
	FIBERGLASS PLANTERS	SEE SPECS
	CUSTOM COMPOSITE BENCH	7/L7.00
	PICNIC TABLES W/ BENCHES	N.I.C.
	BAR HEIGHT TABLES + STOOLS	N.I.C.
	BIKE RACK	N.I.C.
	BIKE STORAGE LOCKERS	N.I.C.
LU	LITTER UNIT	N.I.C.

LANDSCAPE MATERIAL & DIMENSION LEGEND

KEY	DESCRIPTION	DETAIL# / SHEET #
	CONCRETE PAVING W/ SANDBLAST FINISH	1/L7.00
EJS	EXPANSION JOINT W/ SEALANT (EJS)	2/L7.00
	SCORE JOINT (SAWCUT)	2/L7.00
	ASPHALT PAVING	3/L7.00
	UNIT PAVERS	4/L7.00
	TACTILE WARNING DOMES	5/L7.00
	CONCRETE WALL	SCD
	CENTERLINE	
	POINT OF BEGINNING	
S	BUILDING GRIDLINE, SAD.	
	ALIGN	
VIF.	VERIFY IN FIELD	
4'-5"	DIMENSION	
38°	ANGULAR DIMENSION	

PLANTING LEGEND

KEY	DESCRIPTION	DETAIL# / SHEET #
	TREE PLANTING HOLE	#X/LX.XX
00 | XXX XXX / X GAL	PLANT CALLOUT	
FG.	FLAT GROWN	
GAL	GALLON SIZED PLANT	
BOX	BOXED SIZE TREE	
O.C.	ON CENTER SPACING	
TYP.	TYPICAL	

POTENTIAL PLANT LIST

	BOTANICAL NAME	COMMON NAME	EXPOSURE	SIZE	WATER	NATIVE
TREES						
	CERCIS OCCIDENTALIS	WESTERN REDBUD	ALL	36" BOX	LOW	Y
	COTINUS COGGYGRIA	SMOKE TREE	ALL	24" BOX	LOW	N
	QUERCUS SUBER	CORK OAK	SUN	36" BOX	LOW	N
	SCHINUS MOLLE	CALIFORNIA PEPPER TREE	SUN	24" BOX	LOW	Y
BIORETENTION						
	CAREX DIVULSA	BERKELEY SEDGE	ALL	1GAL	LOW	Y
	NA					
	ACHILLEA MILLEFOLIUM 'ROSEA'	YARROW	SUN	1GAL	LOW	Y
	ESCHSCHOLZIA CALIFORNICA	CALIFORNIA POPPY	ALL	1GAL	LOW	Y
	IRIS DOUGLASIANA	PACIFIC COAST IRIS	PSHADE/SHADE	1GAL	LOW	Y
	MIMULUS AURANTIACUS	STICKY MONKEY FLOWER	ALL	1GAL	LOW	Y
ENTRY PLANTING						
	ARCTOSTAPHYLOS DENSIFLORA 'HOWARD MCMINN'	HOWARD MCMINN MANZANITA	ALL	1GAL	LOW	Y
	NA					
	CEANOTHUS 'CONCHA'	CALIFORNIA LILAC 'CONCHA'	ALL	5GAL	LOW	Y
	LUPINUS ALBIFRONS	SILVER BUSH LUPINE	SUN	5GAL	LOW	Y
	STIPA ICHU	PERUVIAN FEATHER GRASS	SUN	1GAL	LOW	N
	MONARDELLA VILLOSA 'RUSSIAN RIVER'	COYOTE MINT	SUN	1GAL	LOW	Y
	ARCTOSTAPHYLOS DENSIFLORA 'EMERALD CARPET'	EMERALD CARPET MANZANITA	ALL	5GAL	LOW	Y
	CEANOTHUS GRISEUS HORIZONTALIS 'YANKEE POINT'	YANKEE POINT CALIFORNIA LILAC	ALL	5GAL	LOW	Y
	NA					
	POLYPODIUM CALIFORNICUM	CALIFORNIA GROUND FERN	PSHADE/SHADE	1GAL	LOW	Y
HEDGE PLANTING						
	CARPENTERIA CALIFORNICA	BUSH ANEMONE	ALL	15GAL	LOW	Y
	FREMONTODENDRON CALIFORNICUM 'PACIFIC SUNSET'	PACIFIC SUNSET FLANNEL BUSH	SUN	15GAL	LOW	Y
	HETEROMELES ARBUTIFOLIA	TOYON	ALL	15GAL	LOW	Y
	RHAMNUS CALIFORNICA	CALIFORNIA COFFEE BERRY	ALL	15GAL	LOW	Y
	RHAMNUS ALATERNUS	ITALIAN BUCKTHORN	ALL	15GAL	LOW	N
PLANTER POTS						
	MUHLENBERGIA CAPILLARIS	PINK MUHLY GRASS	SUN	1GAL	LOW	N
	SALVIA APIANA	WHITE SAGE	SUN	1GAL	LOW	Y
	SALVIA CLEVELANDII 'WINIFRED GILMAN'	CHAPARRAL SAGE	SUN	1GAL	LOW	Y
HYDROSEED MIX						
	BROMUS CARINATUS	CALIFORNIA BROME				
	ELYMUS GLAUCUS	BLUE WILDRYE				
	FESTUCA MICROSTACHYS	THREE WEEKS FESCUE				
	TRIFOLIUM WILDENOVII	TOMCAT CLOVER				

PLANTING HOLE SCHEDULE

TREES	WIDTH	DEPTH
15 GALLON	3'-0" SQUARE	AS DETAILED
36" BOX	6'-0" SQUARE	AS DETAILED
48" BOX	8'-0" SQUARE	AS DETAILED
SHRUBS		
1 GALLON	1'-6" ROUND	AS DETAILED
5 GALLON	2'-0" ROUND	AS DETAILED

HYDROSEED SCHEDULE

BOTANICAL NAME	COMMON NAME	LBS/ACRE
BROMUS CARINATUS	CALIFORNIA BROME	45(TOTAL)
ELYMUS GLAUCUS	BLUE WILDRYE	45(TOTAL)
FESTUCA MICROSTACHYS	THREE WEEKS FESCUE	45(TOTAL)
TRIFOLIUM WILDENOVII	TOMCAT CLOVER	45(TOTAL)

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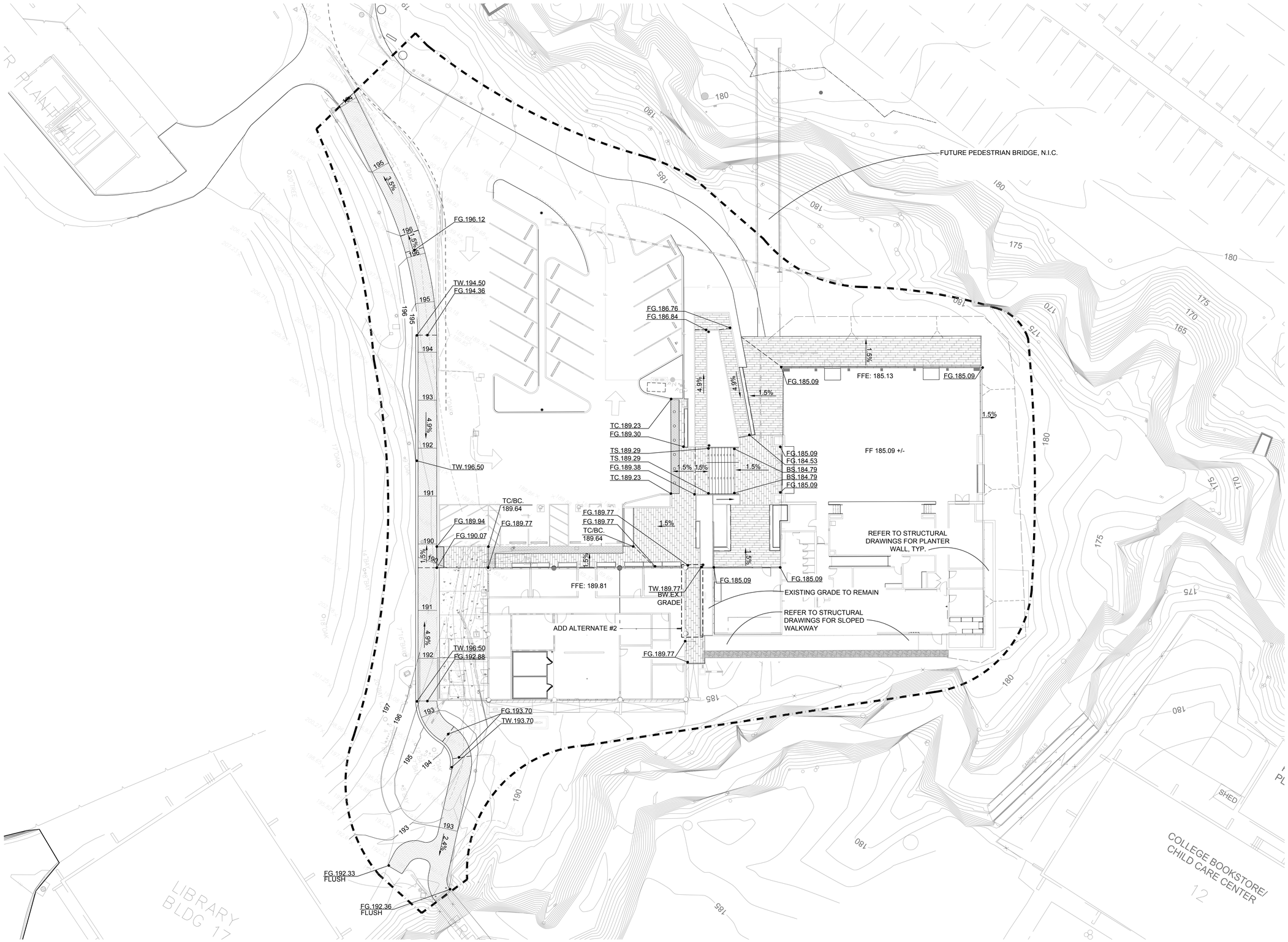
LANDSCAPE LEGENDS & SCHEDULES

L1.01



PLAN

REFER TO SHEET L1.00 AND L1.01 FOR ADDITIONAL NOTES, LEGENDS, AND SCHEDULES

NORTH

SCALE: 1/16 "=1'-0"

0' 4' 8' 16' 32'

file: C:\Users\jbrand.BRICK\Documents\16-148.04 ivc jonas center - CENTRAL_jbrand.rvt

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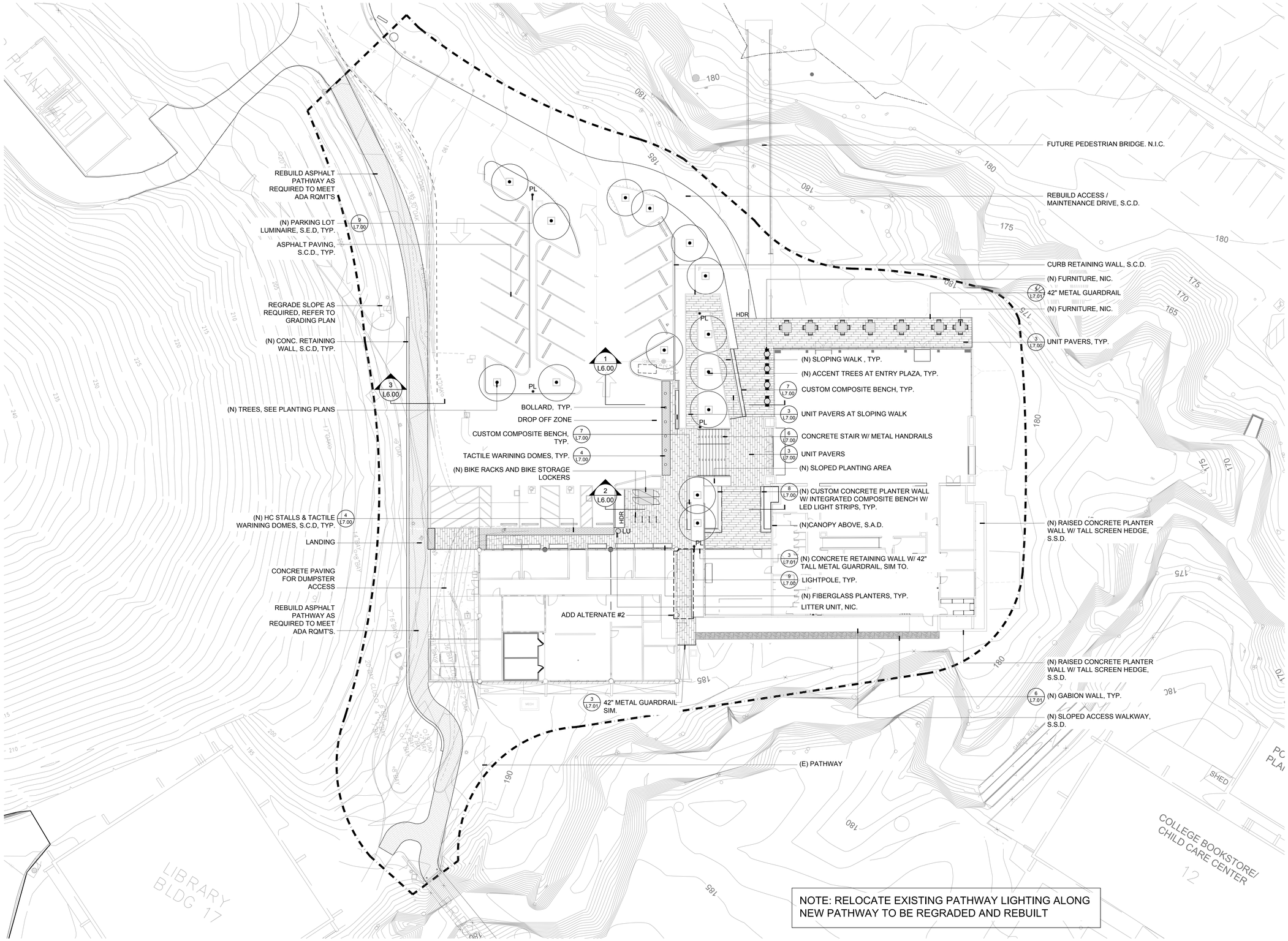
LANDSCAPE GRADING PLAN

L2.00



NOTE: RELOCATE EXISTING PATHWAY LIGHTING ALONG NEW PATHWAY TO BE REGRADED AND REBUILT

REFER TO SHEET L1.00 AND L1.01 FOR ADDITIONAL NOTES, LEGENDS, AND SCHEDULES

NORTH

SCALE: 1/16 "=1'-0"

0' 4' 8' 16' 32'

PLAN

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LANDSCAPE MATERIALS PLAN

L3.00

DICKSON & ASSOCIATES, INC.
LANDSCAPE IRRIGATION
MARTY DICKSON, ASIC-PIC
TEL(530) 547-5515 www.dicksoninc.net
P.O. BOX 415
PALO CEDRO, CALIFORNIA 96073

CONNECT NEW IRRIGATION MAINLINE TO EXISTING REDUCED PRESSURE BACKFLOW ASSEMBLY.

IRRIGATION CONTROLLER 'C' – INSTALL SiteOne GREEN TECH CONTROLLER ASSEMBLY AS DETAILED AND AS SPECIFIED IN IRRIGATION LEGEND. CONTACT JIM WELLER, SiteOne GREEN TECH REPRESENTATIVE, FOR ORDER, PURCHASE, AND WARRANTY. (925.451.1610) OR DISTRICT APPROVED EQUAL. SERVICE WITH 120 VOLT A.C. ELECTRICAL. ELECTRICAL STUB-OUT TO THIS LOCATION SHALL BE PROVIDED UNDER ELECTRICAL CONTRACT. SOLAR SYNC WEATHER SENSOR IS PART OF CONTROLLER ASSEMBLY. CONTROLLER SHALL BE LOCATED WHERE UNOBSTRUCTED RAINFALL AND SOLAR RADIATION WILL COLLECT IN DEVICE.

FUTURE PEDESTRIAN BRIDGE, N.I.C.

SCHEDULE 80 PVC PIPE PER DISTRICT STANDARDS. ROUTING AND INSTALLATION SHALL BE PROVIDED UNDER IRRIGATION CONTRACT.

IRRIGATION METHOD LEGEND

- NON-IRRIGATED
- SUB-SURFACE DRIP EMITTER
- SUB-SURFACE DRIP EMITTER
- MULTI-OUTLET DRIP EMITTER
- SUB-SURFACE DRIP EMITTER

ALL PRODUCTS THIS PAGE AS SPECIFIED OR DISTRICT APPROVED EQUAL

BRIDGE #4
POWER PLANT 3
SHED
COLLEGE BOOKSTORE/ CHILD CARE CENTER
LIBRARY BUILDING 1

NORTH
SCALE: 1/16 "=1'-0"
0' 4' 8' 16' 32'

PLAN

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LANDSCAPE IRRIGATION PLAN

L4.00

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IRRIGATION NOTES

1. THESE IRRIGATION DRAWINGS ARE DIAGRAMMATIC AND INDICATIVE OF THE WORK TO BE INSTALLED. ALL PIPING, VALVES, ETC. SHOWN WITHIN PAVED AREAS IS FOR CLARITY ONLY AND ARE TO BE INSTALLED WITHIN PLANTING AREAS WHERE POSSIBLE. DUE TO THE SCALE OF THE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE ALL OFFSETS, FITTINGS, SLEEVES, ETC., WHICH MAY BE REQUIRED. THE CONTRACTOR IS REQUIRED TO INVESTIGATE THE STRUCTURAL AND FINISHED CONDITIONS AFFECTING ALL OF THE CONTRACT WORK INCLUDING OBSTRUCTIONS, GRADE DIFFERENCES OR AREA DIMENSIONAL DIFFERENCES WHICH MAY NOT HAVE BEEN CONSIDERED IN THE ENGINEERING. IN THE EVENT OF FIELD DIFFERENCES, THE CONTRACTOR IS REQUIRED TO PLAN THE INSTALLATION WORK ACCORDINGLY BY NOTIFICATION AND APPROVAL OF THE OWNER'S AUTHORIZED REPRESENTATIVE AND ACCORDING TO THE CONTRACT SPECIFICATION. THE CONTRACTOR IS ALSO REQUIRED TO NOTIFY AND COORDINATE IRRIGATION CONTRACT WORK WITH ALL APPLICABLE CONTRACTORS FOR THE LOCATION AND INSTALLATION OF PIPE, CONDUIT OR SLEEVES THROUGH OR UNDER WALLS, ROADWAYS, PAVING, STRUCTURE, ETC., BEFORE CONSTRUCTION. IN THE EVENT THESE NOTIFICATIONS ARE NOT PERFORMED, THE CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR ALL REQUIRED REVISIONS.

2. THE CONTRACTOR SHALL EXERCISE CARE IN LOCATING PIPING AS TO NOT CONFLICT WITH OTHER UTILITIES. DO NOT INSTALL IRRIGATION PIPING PARALLEL TO AND DIRECTLY OVER OTHER UTILITIES.

3. THE INTENT OF THIS IRRIGATION SYSTEM IS TO PROVIDE THE MINIMUM AMOUNT OF WATER REQUIRED TO SUSTAIN GOOD PLANT HEALTH.

4. IT IS THE RESPONSIBILITY OF THE LANDSCAPE MAINTENANCE CONTRACTOR AND/OR OWNER TO PROGRAM THE IRRIGATION CONTROLLERS TO PROVIDE THE MINIMUM AMOUNT OF WATER NEEDED TO SUSTAIN GOOD PLANT HEALTH. THIS INCLUDES MAKING ADJUSTMENTS TO THE PROGRAM FOR SEASONAL WEATHER CHANGES, PLANT MATERIAL, WATER REQUIREMENTS, MOUNDS AND SLOPES, SUN, SHADE, AND WIND EXPOSURES.

5. AT THE END OF THE REQUIRED MAINTENANCE PERIOD OF THE CONTRACTOR, THE OWNER SHALL PROVIDE REGULAR MAINTENANCE OF THE IRRIGATION SYSTEM TO ENSURE THE EFFICIENT USE OF WATER. MAINTENANCE SHALL INCLUDE, BUT NOT BE LIMITED TO CHECKING, ADJUSTING, AND REPAIRING IRRIGATION EQUIPMENT AND CONTROL SYSTEM.

6. 120 VOLT A.C. (2.5 AMP DEMAND) ELECTRICAL SERVICE TO IRRIGATION CONTROLLER LOCATION TO BE PROVIDED UNDER ELECTRICAL CONTRACT WORK. IRRIGATION CONTRACTOR TO MAKE FINAL CONNECTION FROM ELECTRICAL STUB-OUT TO CONTROLLER AND PROVIDE PROPER GROUNDING PER CONTROLLER MANUFACTURER'S INSTRUCTIONS.

7. CONTROLLER SHALL HAVE ITS OWN GROUND ROD. THE GROUND ROD SHALL BE AN EIGHT FOOT LONG BY 5/8" DIAMETER U.L. APPROVED COPPER CLAD ROD. NO MORE THAN 6" OF THE GROUND ROD TO BE ABOVE GRADE. CONNECT #6 GAUGE WIRE WITH A U.L. APPROVED GROUND ROD CLAMP TO ROD AND BACK TO GROUND SCREW AT BASE OF CONTROLLER WITH APPROPRIATE CONNECTOR. THIS WIRE SHOULD BE AS SHORT AS POSSIBLE, AVOIDING ANY KINKS OR BENDING. GROUND ROD SHALL BE A MINIMUM OF EIGHT FEET (8') FROM IRRIGATION CONTROL WIRE BUNDLE.

8. IRRIGATION CONTROLLER TO HAVE ITS OWN INDEPENDENT 24 VOLT COMMON GROUND WIRE.

9. CONTRACTOR SHALL PROGRAM THE IRRIGATION CONTROLLER TO PROVIDE IRRIGATION TO ALL PLANTING WITHIN THE ALLOWED WATERING WINDOW OF TIME AS REQUIRED. THE CONTRACTOR SHALL CREATE CONTROLLER PROGRAMING THAT WILL NOT EXCEED THE MAXIMUM GALLONS PER MINUTE FLOW RATE STATED ON THE DRAWINGS, AND NOT EXCEED THE CAPACITY OF ANY MAINLINE PIPING.

10. IRRIGATION CONTROL WIRES SHALL BE COPPER WITH U.L. APPROVAL FOR DIRECT BURIAL IN GROUND, SIZE #14-1. COMMON GROUND WIRE SHALL HAVE WHITE INSULATING JACKET. CONTROL WIRE SHALL HAVE INSULATING JACKET OF COLOR OTHER THAN WHITE. SPLICE SHALL BE MADE WITH 3M-DBR/Y-6 SEAL PACKS.

11. FLOW SENSOR CABLE SHALL BE A SOLID COPPER SHIELDED PAIR CABLE, SIZE #16. NO SPLICES ALLOWED.

12. INSTALL SPARE CONTROL WIRE OF A DIFFERENT COLOR ALONG THE ENTIRE MAINLINE. LOOP 36" EXCESS WIRE INTO EACH SINGLE VALVE BOX AND INTO ONE VALVE BOX IN EACH GROUP OF VALVES. MINIMUM OF ONE SPARE WIRE PER CONTROLLER.

13. SPLICING OF 24 VOLT WIRES IS NOT PERMITTED EXCEPT IN VALVE BOXES. SEAL WIRE SPLICES WITH 3M-DBR/Y-6 SPLICE SEALING DEVICES OF SIZE COMPATIBLE WITH WIRE SIZE. LEAVE A 36" LONG, 1" DIAMETER COIL OF EXCESS WIRE AT EACH SPLICE AND A 36" LONG EXPANSION LOOP EVERY 100 FEET ALONG WIRE RUN. TAPE WIRES TOGETHER EVERY TEN FEET. TAPING WIRES IS NOT REQUIRED INSIDE SLEEVES.

14. PLASTIC VALVE BOXES ARE TO BE BLACK IN COLOR WITH BOLT DOWN, NON-HINGED COVER MARKED "IRRIGATION". BOX BODY SHALL HAVE KNOCK OUTS. MANUFACTURER SHALL BE CARSON INDUSTRIES.

15. INSTALL REMOTE CONTROL VALVE BOXES 12" FROM WALK, CURB, LAWN, HEADER BOARD, BUILDING, OR LANDSCAPE FEATURE. AT MULTIPLE VALVE BOX GROUPS, EACH BOX SHALL BE AN EQUAL DISTANCE FROM THE WALK, CURB, LAWN, ETC. AND EACH BOX SHALL BE 12" APART. SHORT SIDE OF RECTANGULAR VALVE BOXES SHALL BE PARALLEL TO WALK, CURB, ETC.

16. VALVE LOCATIONS SHOWN ARE DIAGRAMMATIC. INSTALL IN GROUND COVER/SHRUB AREAS WHERE POSSIBLE (NOT IN LAWN AREA).

17. THE IRRIGATION CONTRACTOR SHALL FLUSH ALL SYSTEMS FOR OPTIMUM PERFORMANCE AND COVERAGE OF THE LANDSCAPE AREA. THIS SHALL INCLUDE ADJUSTING THE FLOW CONTROL AT EACH VALVE TO OBTAIN THE OPTIMUM OPERATING PRESSURE FOR EACH SYSTEM.

18. ALL IRRIGATION PIPING THAT IS NOT A DIRECT LINE TO TREES SHALL BE A MINIMUM FIVE (5) FEET FROM CENTER OF TREE.

19. LOCATE BUBBLERS ON UP-HILL SIDE OF TREE.

20. INSTALL A FLO CONTROL (NDS) 1002 SERIES SPRING LOADED CHECK VALVE BELOW THOSE BUBBLERS WHERE LOW HEAD DRAINAGE WILL CAUSE EROSION AND/OR EXCESS WATER.

21. WHERE IT IS NECESSARY TO EXCAVATE ADJACENT TO EXISTING TREES, THE CONTRACTOR SHALL USE ALL POSSIBLE CARE TO AVOID INJURY TO TREES AND TREE ROOTS. EXCAVATION IN AREAS WHERE TWO (2) INCH AND LARGER ROOTS OCCUR SHALL BE DONE BY HAND. TRENCHES ADJACENT TO TREE SHOULD BE CLOSED WITHIN TWENTY-FOUR (24) HOURS; AND WHERE THIS IS NOT POSSIBLE, THE SIDE OF THE TRENCH ADJACENT TO THE TREE SHALL BE KEPT SHADED WITH BURLAP OR CANVAS.

22. IRRIGATION CONTRACTOR TO NOTIFY ALL LOCAL JURISDICTIONS FOR INSPECTION AND TESTING OF EXISTING BACKFLOW PREVENTION DEVICE. REPAIR OR REPLACE AS TEST RESULTS INDICATE.

23. PRESSURE TEST PROCEDURE. THE CONTRACTOR SHALL:
   A. NOTIFY ARCHITECT AT LEAST THREE (3) DAY IN ADVANCE OF TESTING.
   B. PERFORM TESTING AT HIS OWN EXPENSE.
   C. CENTER LOAD PIPING WITH SMALL AMOUNT OF BACKFILL TO PREVENT ARCHING OR SLIPPING UNDER PRESSURE. NO FITTING SHALL BE COVERED.
   D. APPLY THE FOLLOWING TESTS AFTER WELD PLASTIC PIPE JOINTS HAVE CURED AT LEAST 24 HOURS.
      1. TEST LIVE (CONSTANT PRESSURE) AND QUICK COUPLER LINE HYDROSTATICALLY AT 125 PSI MINIMUM. LINES WILL BE APPROVED IF TEST PRESSURE IS MAINTAINED FOR SIX (6) HOURS. THE LINE WILL BE APPROVED OR NOT APPROVED AS SUCH RESULTS MAY INDICATE. THE CONTRACTOR SHALL MAKE TESTS AND REPAIRS AS NECESSARY UNTIL TEST CONDITIONS ARE MET.
      2. TEST RCV CONTROLLED LATERAL LINES WITH WATER AT LINE PRESSURE AND VISUALLY INSPECT FOR LEAKS. RETEST AFTER CORRECTING DEFECTS.

24. THE SPRINKLER SYSTEM DESIGN IS BASED ON THE MINIMUM OPERATING PRESSURE SHOWN ON THE IRRIGATION DRAWINGS. THE IRRIGATION CONTRACTOR SHALL VERIFY WATER PRESSURE PRIOR TO CONSTRUCTION. REPORT ANY DIFFERENCE BETWEEN THE WATER PRESSURE INDICATED ON THE DRAWINGS AND THE ACTUAL PRESSURE READING AT THE IRRIGATION POINT OF CONNECTION TO THE OWNER'S AUTHORIZED REPRESENTATIVE.

25. IRRIGATION DEMAND: ___ GPM AT ___ PSI STATIC PRESSURE AT IRRIGATION POINT OF CONNECTION. FIELD VERIFY WATER PRESSURE PRIOR TO CONSTRUCTION. IF ACTUAL WATER PRESSURE DIFFERS FROM THE STATED PRESSURE CONTACT ARCHITECT FOR DIRECTION AND POSSIBLE REVISION.

26. PIPE THREAD SEALANT COMPOUND SHALL BE RECTOR SEAL T+2, CHRISTY'S ULTRA SEAL, OR APPROVED EQUAL.

27. SUB-SURFACE DRIP IRRIGATION AREAS MUST BE HAND WATERED TO INCREASE SOIL MOISTURE PRIOR TO PLANTING. AFTER PLANTING, THE SUB-SURFACE DRIP SYSTEMS MUST BE OPERATED ON A FREQUENT BASIS TO MAINTAIN SOIL MOISTURE CONTENT. DO NOT ALLOW SOIL TO DRY OUT. MAINTENANCE ROUTINE SHALL INCLUDE PROBING SOIL TO MONITOR MOISTURE CONTENT. USE CAUTION WHEN PROBING SOIL. DO NOT DAMAGE SUB-SURFACE DRIP TUBING.

28. RECORD DRAWINGS:
   A. THE CONTRACTOR SHALL MAINTAIN IN GOOD ORDER IN THE FIELD OFFICE ONE COMPLETE SET OF BLACK LINE PRINTS OF ALL SPRINKLER DRAWINGS WHICH FORM A PART OF THE CONTRACT, SHOWING ALL WATER LINES, SPRINKLERS, VALVES, CONTROLLERS AND STUB-OUTS. IN THE EVENT ANY WORK IS NOT INSTALLED AS INDICATED ON THE DRAWINGS, SUCH WORK SHALL BE CORRECTED AND DIMENSIONED ACCURATELY FROM THE BUILDING WALLS.
   B. ALL UNDERGROUND STUB-OUTS FOR FUTURE CONNECTIONS AND VALVES SHALL BE LOCATED AND DIMENSIONED ACCURATELY FROM BUILDING WALLS ON ALL RECORD DRAWINGS.
   C. UPON COMPLETION OF THE WORK, OBTAIN REPRODUCIBLE PRINTS FROM ARCHITECT AND NEATLY CORRECT THE PRINTS TO SHOW THE AS-BUILT CONDITIONS.

IRRIGATION LEGEND

SYMBOL	MODEL NUMBER	DESCRIPTION
▲	ML210	BOWSMITH MULTI-OUTLET EMITTER (1 GPH PER OUTLET)
■	PCB-25	HUNTER BUBBLER (TREE)
▫	RZWS-36-25-CV	HUNTER ROOT ZONE BUBBLER ASSEMBLY AND CHECK VALVE (TREE)
⊠	1½" COMPACT & 500XL-1½"	AMIAD FILTER W/155 MESH SCREEN AND WILKINS PRESSURE REDUCING VALVE – INSTALL IN CARSON 1730 VALVE BOX
Ⓜ	2030-2"	GRISWOLD NORMALLY CLOSED MASTER CONTROL VALVE
F	FSI-T15-001-1½"/P7162D-A (PART OF CONTROLLER EQUIPMENT PACKAGE)	CREATIVE SENSOR TECHNOLOGY FLOW SENSOR WITH PAIGE SHIELDED COMMUNICATION CABLE (SEE CONTROLLER DESCRIPTION)
◕	DWS SERIES	GRISWOLD REMOTE CONTROL VALVE
◆	HQ-33DRC	HUNTER QUICK COUPLING VALVE
⋈	T-113	NIBCO GATE VALVE (LINE SIZE)
⚠	LT-S	FLUSH VALVE (SEE DETAIL) – KBI SCHEDULE 80 PVC FULL PORT BALL VALVE (SLIP X SLIP) (LINE SIZE)
⊙	ARV050	RAIN BIRD AIR RELEASE & VACUUM RELIEF VALVE
	OPERIND – (SEE SUB-SURFACE DRIP LAYOUT DETAILS)	RAIN BIRD DRIP SYSTEM OPERATION INDICATOR
Ⓒ SSN	CA6-HU4-24/HSSE/LPP/EMP-16/FAN-16/CTFS-150B/P7162D-A	SiteOne GREEN TECH CONTROLLER ASSEMBLY WITH HUNTER ACC2 CONTROLLER, PRIMARY LINE PROTECTION, (HOUSED IN A STAINLESS STEEL STRONG BOX ENCLOSURE), CST FLOW SENSOR, SENSOR CABLE (P7162D-A), ENCLOSURE MOUNTING PAD, ENCLOSURE FAN, AND SOLAR SYNC SENSOR ASSEMBLY. CONTACT JIM WELLER SiteOne GREEN TECH REPRESENTATIVE FOR ORDER, PURCHASE, WARRANTY AND PRE-CONSTRUCTION MEETING. (925.451.1610)
		PRECIPITATION RATE
		CONTROLLER & STATION NUMBER
		APPROXIMATE FLOW (GPM)
		REMOTE CONTROL VALVE SIZE
		PLANT TYPE/WATER REQUIREMENT/HYDROZONE LH – LAWN/HIGH WATER LM – LAWN/MODERATE WATER LL – LAWN/LOW WATER SH – SHRUB & GROUNDCOVER/HIGH WATER SM – SHRUB & GROUNDCOVER/MODERATE WATER SL – SHRUB & GROUNDCOVER/LOW WATER TH – TREE/HIGH WATER TM – TREE/MODERATE WATER TL – TREE/LOW WATER
———	MAINLINE:	1120-SCHEDULE 40 PVC PLASTIC PIPE WITH SCHEDULE 40 PVC SOLVENT-WELD FITTINGS. 18" COVER. 24" COVER UNDER VEHICULAR PAVING.
———	LATERAL LINE:	1120-SCHEDULE 40 PVC PLASTIC PIPE WITH SCHEDULE 40 PVC SOLVENT-WELD FITTINGS. 12" COVER. 24" COVER UNDER VEHICULAR PAVING.
- - - -	COPPER PIPE:	TYPE 'K' COPPER PIPE WITH WROUGHT COPPER SOLDER JOINT FITTINGS. ROUTING AND INSTALLATION SHALL BE PROVIDED UNDER IRRIGATION CONTRACT. 12" COVER.
▭	SUB-SURFACE DRIP BOUNDARY:	RAIN BIRD XFS-CV SUB-SURFACE DRIPLINE (XFS-CV-09-12) WITH COPPER SHIELD TECHNOLOGY AND HEAVY DUTY CHECK VALVE. INSTALL AS DETAILED 12" O.C. SEE DRIP IRRIGATION DETAILS FOR TUBING LAYOUT AND INSTALLATION METHODS. BOUNDARIES DEFINE AREAS FOR DRIPLINE TO BE CONNECTED TO ASSOCIATED REMOTE CONTROL VALVES AS DEPICTED IN THE DRAWING. 4" COVER.
— — — —	SLEEVING:	1120-SCHEDULE 40 PVC PLASTIC PIPE. 18" COVER. 24" COVER UNDER VEHICULAR PAVING.

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IRRIGATION LEGEND & NOTES

L4.01

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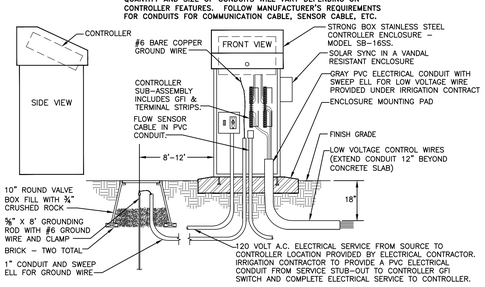
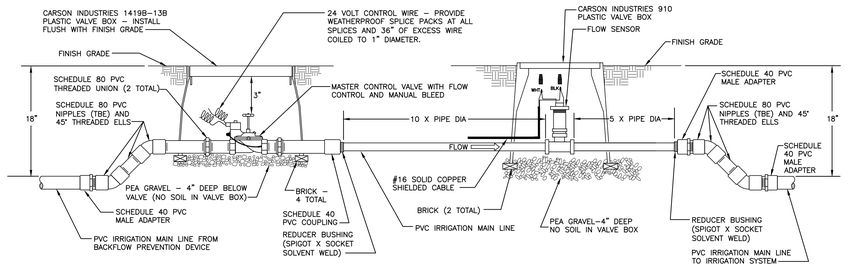
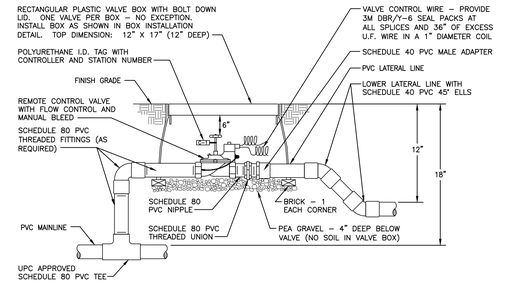


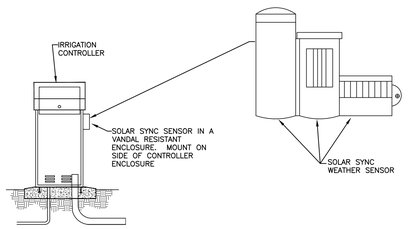
13 CONTROLLER ENCLOSURE TOP OPENING — NOT TO SCALE



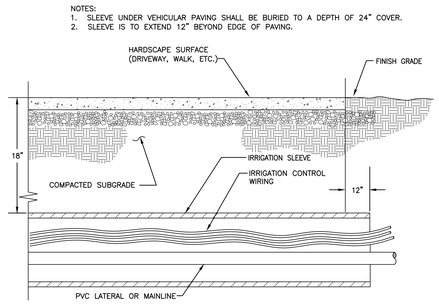
9 MASTER VALVE / FLOW SENSOR — NOT TO SCALE



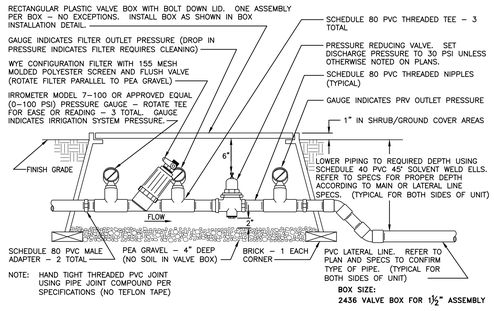
1 REMOTE CONTROL VALVE — NOT TO SCALE



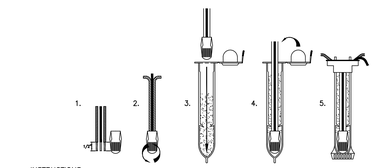
14 SOLAR SYNC SENSOR — NOT TO SCALE



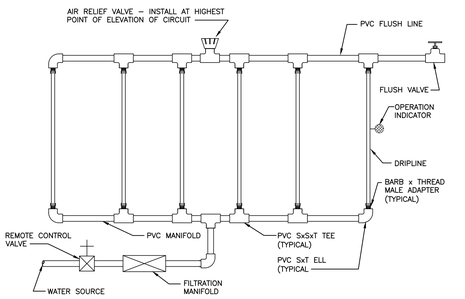
10 SLEEVING INSTALLATION — NOT TO SCALE



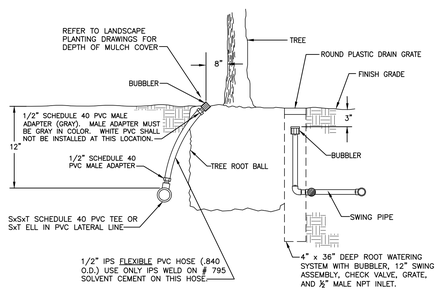
6 EMITTER MANIFOLD — NOT TO SCALE



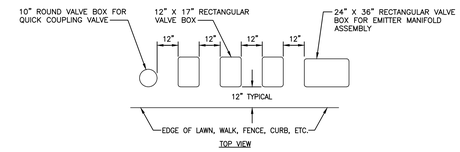
2 WEATHERPROOF SPLICE ASSEMBLY — NOT TO SCALE



15 SUB–SURFACE INSTALLATION LAYOUT–CENTER FEED — NOT TO SCALE

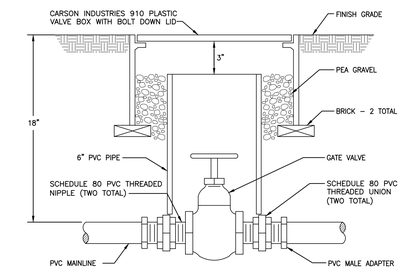


11 TREE BUBBLER INSTALLATION — NOT TO SCALE

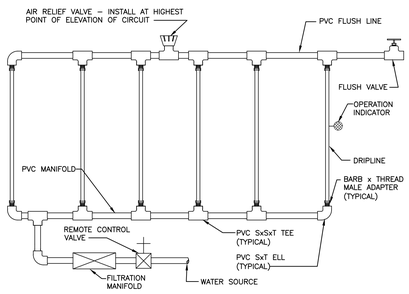


1. CENTER VALVE BOX OVER REMOTE CONTROL VALVE TO FACILITATE SERVICING VALVE.
2. SET BOXES 1" ABOVE FINISH GRADE OR MULCH COVER IN GROUND COVER/SHRUB AREA AND FINISH GRADE IN TURF AREA.
3. SET RCV AND VALVE BOX ASSEMBLY IN GROUND COVER/SHRUB AREA WHERE POSSIBLE. INSTALL IN LAWN ONLY IF GROUND COVER DOES NOT EXIST ADJACENT TO LAWN.
4. SET BOXES PARALLEL TO EACH OTHER AND PERPENDICULAR TO EDGE OF LAWN, WALK, FENCE, CURB, ETC.
5. AVOID HEAVILY COMPACTING SOIL AROUND VALVE BOXES TO PREVENT COLLAPSE AND DEFORMATION OF VALVE BOX SIDES.
6. INSTALL EXTENSION BY VALVE BOX MANUFACTURER AS REQUIRED TO COMPLETELY ENCLOSE ASSEMBLY FOR EASY ACCESS.

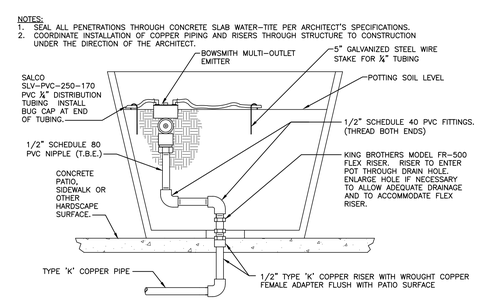
7 VALVE BOX INSTALLATION — NOT TO SCALE



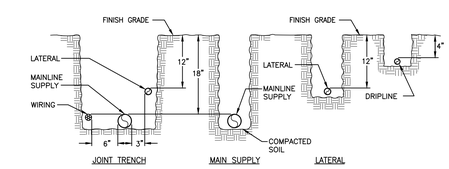
3 GATE VALVE — NOT TO SCALE



16 SUB–SURFACE INSTALLATION LAYOUT–END FEED — NOT TO SCALE

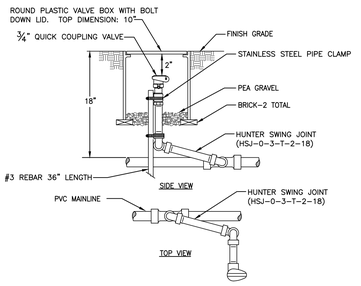


12 PLANTER POT IRRIGATION — NOT TO SCALE



NOTES:
1. ALL PLASTIC PIPING SHALL BE INSTALLED IN THE TRENCH IN A SERPENTINE MANNER AS PER THE MANUFACTURER'S SPECIFICATIONS.
2. ALL SUPPLY LINES TO BE INSTALLED AS PER MANUFACTURER'S SPECIFICATIONS.
3. TAPE AND BUNDLE TUBING OR WIRING AT 10 FEET INTERVALS.
4. ALL 120 VOLT WIRING IN CONDUIT TO BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE CODES.
5. BACKFILL MATERIAL SHALL BE THE EARTH EXCAVATED FROM THE TRENCHES, FREE FROM ROCKS, CONCRETE CHUNKS, AND OTHER FOREIGN OR COARSE MATERIALS. CAREFULLY SELECT BACKFILL THAT IS TO BE PLACED NEXT TO PLASTIC PIPE TO AVOID ANY SHARP OBJECTS WHICH MAY DAMAGE THE PIPE.

8 TRENCHING DETAIL — NOT TO SCALE



4 QUICK COUPLING VALVE — NOT TO SCALE

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IRRIGATION DETAILS

L4.02

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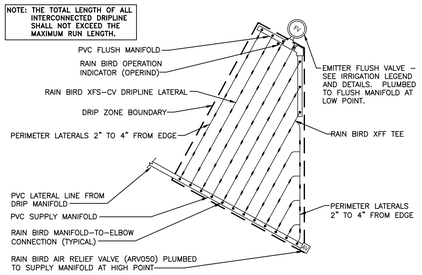
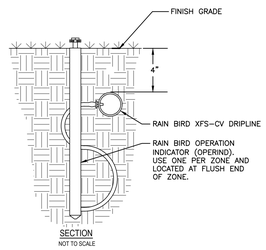
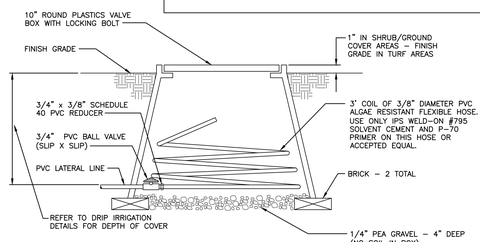


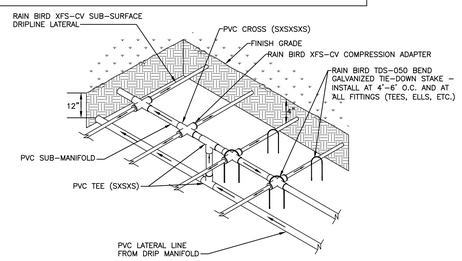
13 TRIANGULAR LAYOUT FOR SUB-SURFACE DRIP — NOT TO SCALE



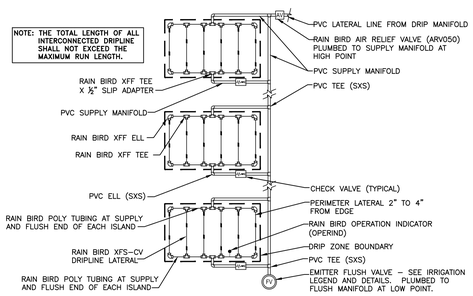
9 POP-UP OPERATION INDICATOR — NOT TO SCALE



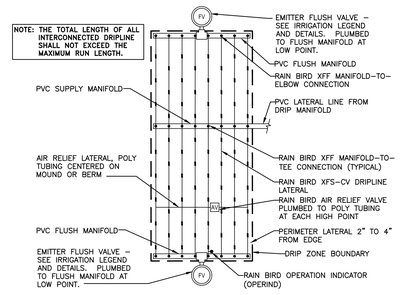
5 DRIP LINE FLUSH VALVE — NOT TO SCALE



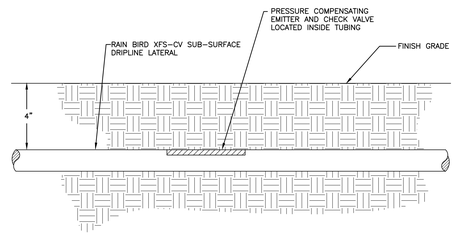
1 SUB-MANIFOLD CENTER FEED — NOT TO SCALE



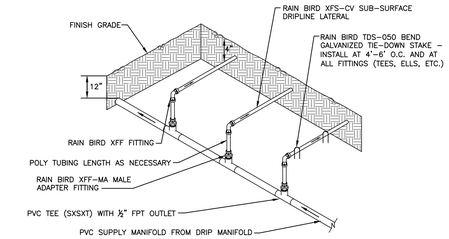
14 ISLAND LAYOUT FOR SUB-SURFACE DRIP — NOT TO SCALE



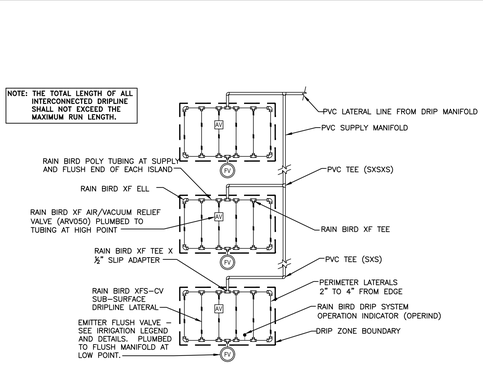
10 CENTER FEED LAYOUT FOR SUB-SURFACE DRIP — NOT TO SCALE



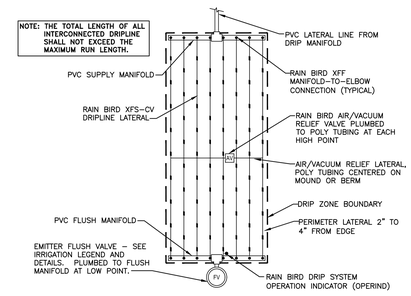
6 DRIPLINE DETAIL — NOT TO SCALE



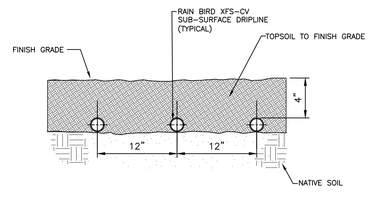
2 SUB-MANIFOLD END FEED — NOT TO SCALE



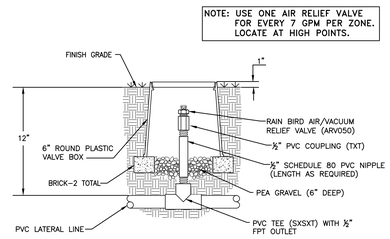
15 ISLAND LAYOUT FOR SUB-SURFACE DRIP — NOT TO SCALE



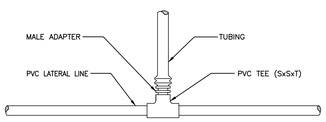
11 END FEED LAYOUT FOR SUB-SURFACE DRIP — NOT TO SCALE



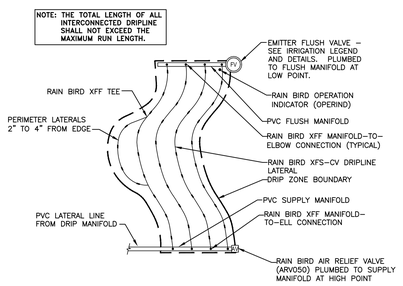
7 DRIPLINE SUB-SURFACE INSTALLATION 12" O.C. — NOT TO SCALE



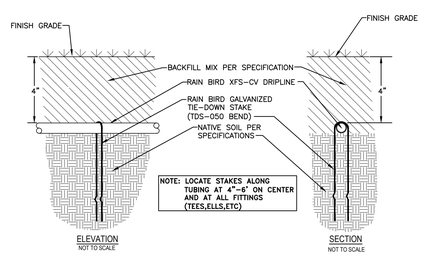
3 AIR/VACUUM RELIEF VALVE AT PVC LATERAL — NOT TO SCALE



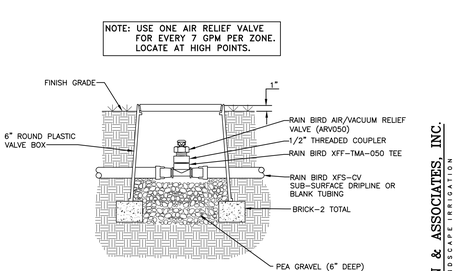
16 TUBING TO PVC CONNECTION — NOT TO SCALE



12 ODD CURVES LAYOUT FOR SUB-SURFACE DRIP — NOT TO SCALE



8 GALVANIZED TIE-DOWN STAKE — NOT TO SCALE



4 AIR RELIEF VALVE AT DRIPLINE PIPE — NOT TO SCALE

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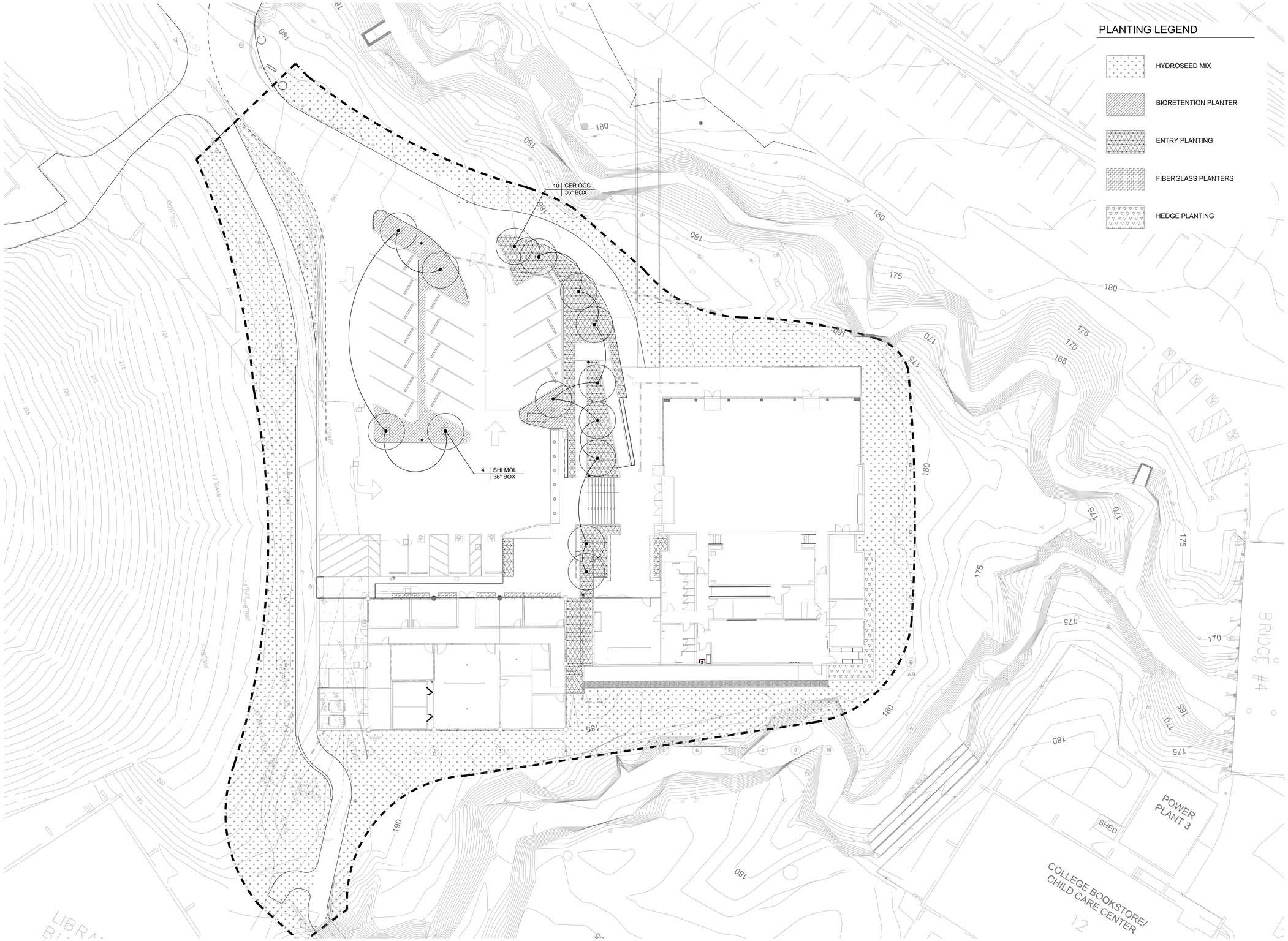

PLAN

REFER TO SHEET L1.00 AND L1.01 FOR ADDITIONAL NOTES, LEGENDS, AND SCHEDULES

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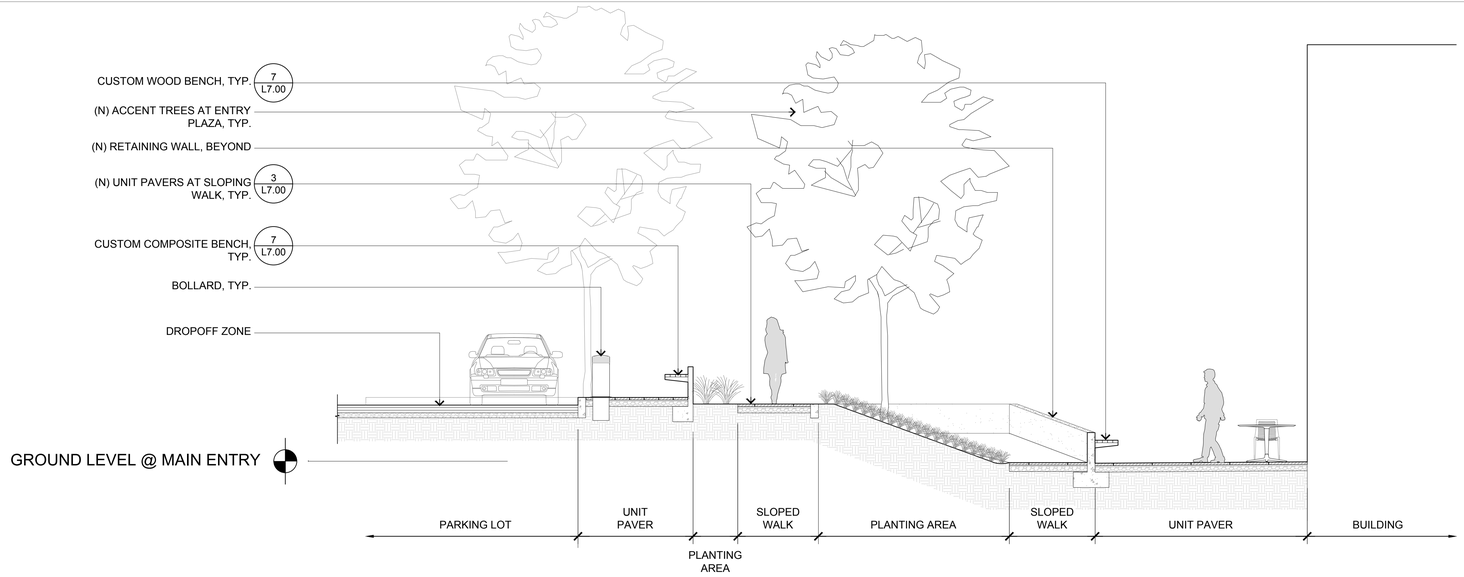
LANDSCAPE PLANTING PLAN

L5.00



1) SECTION THROUGH SLOPED WALK

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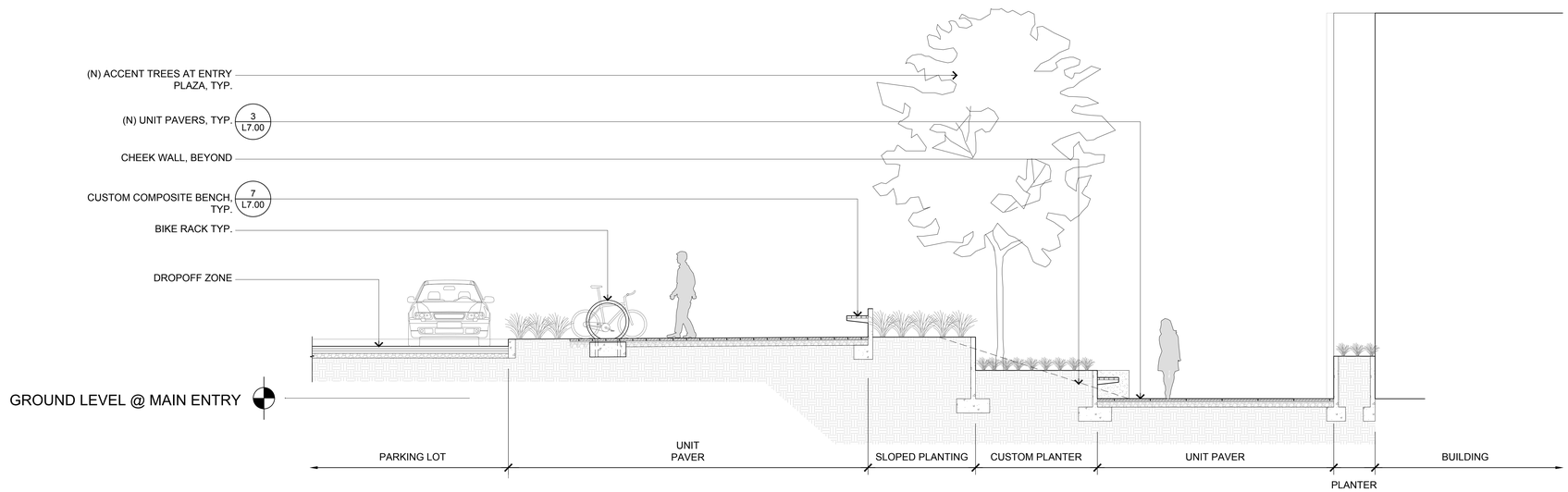

2) SECTION THROUGH CUSTOM PLANTER

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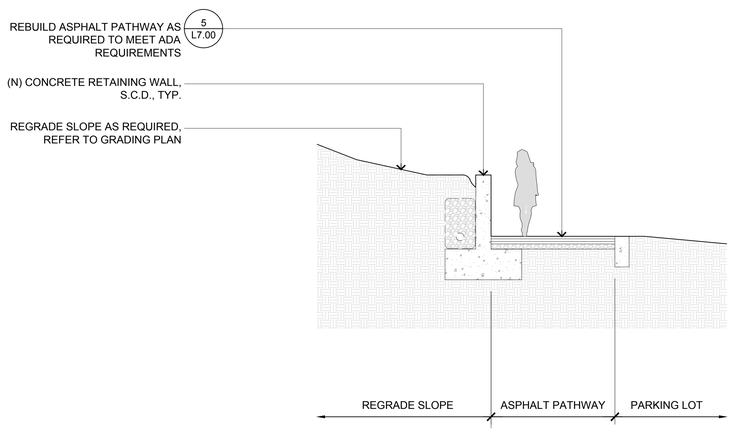
0 2' 4' 8'



3) SECTION THROUGH ASPHALT PATHWAY

SCALE 1/4"=1'-0"
0 2' 4' 8'

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rev	date	issue
	11/21/17	100% SD
	10/06/17	80% SD
	07/10/17	60% SD
	06/16/17	50% SD

IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

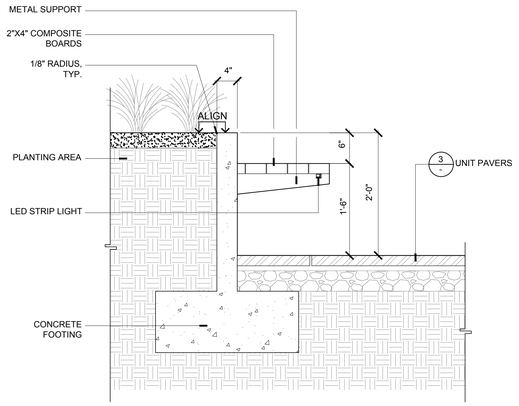
plot date: 11/20/2017 5:46:58 PM

scale: as noted

date: 11/21/17

LANDSCAPE SECTIONS

L6.00



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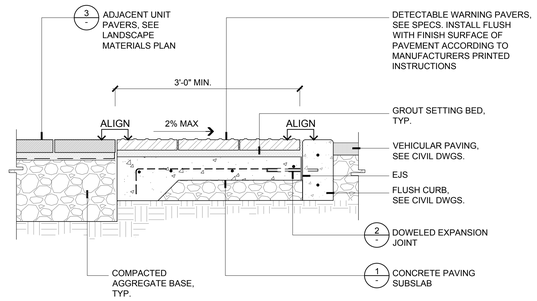
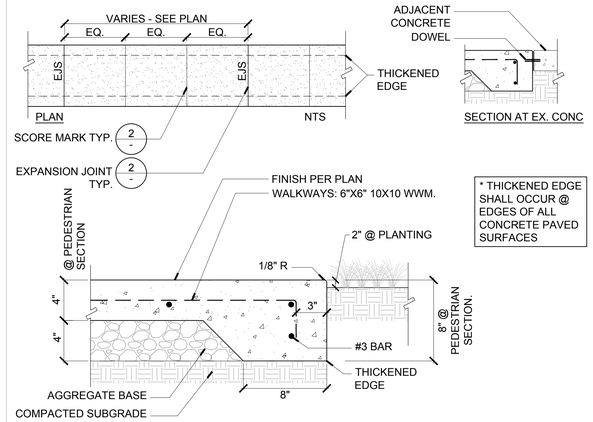


4 TACTILE WARNING DOMES NTS



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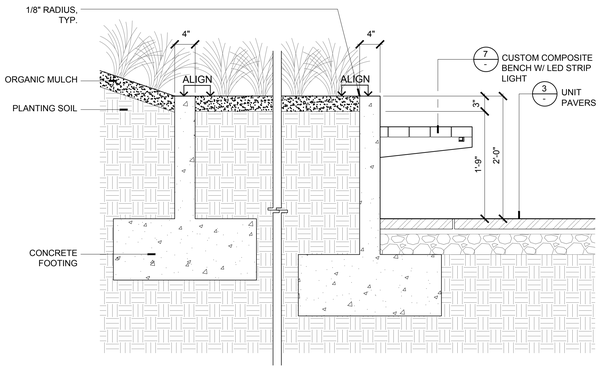
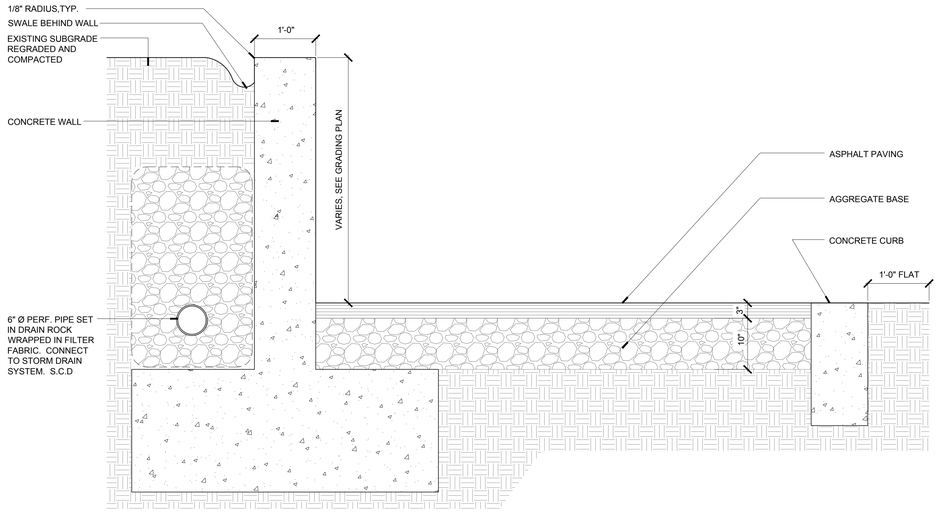
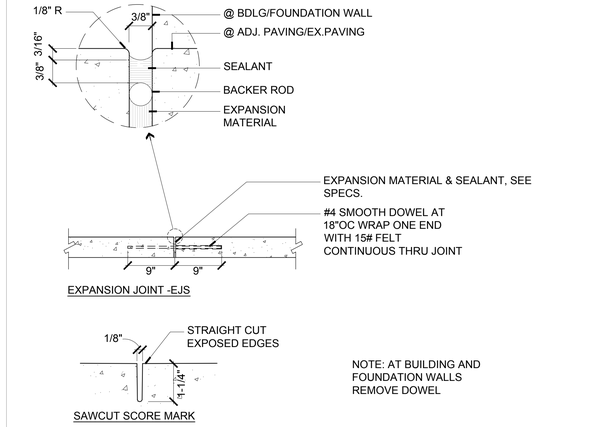


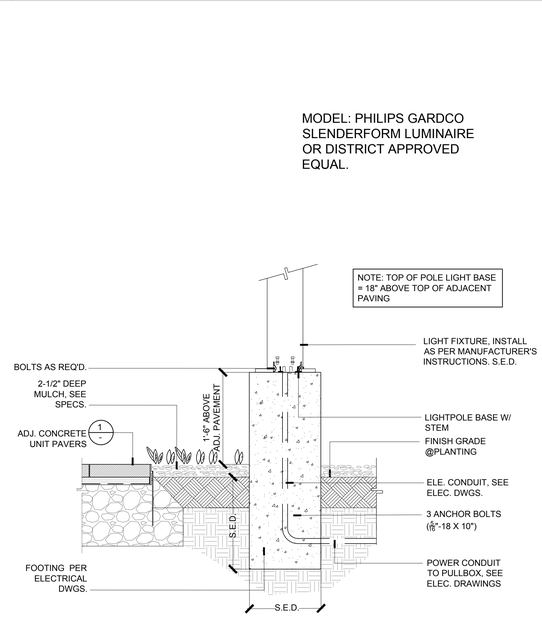
8 PLANTER WALL NTS



5 ASPHALT PATHWAY WITH RETAINING WALL NTS



2 EXPANSION JOINT NTS



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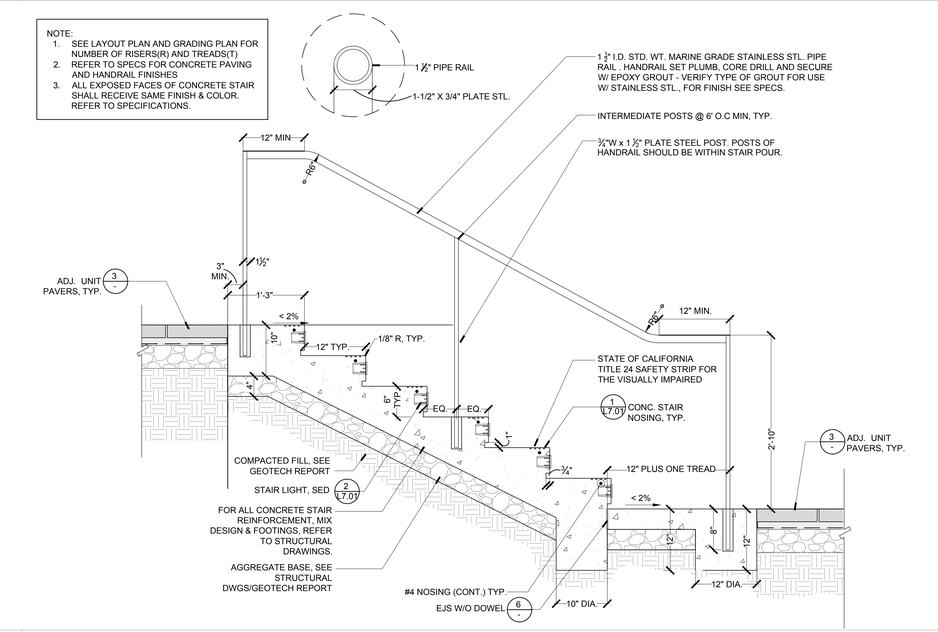
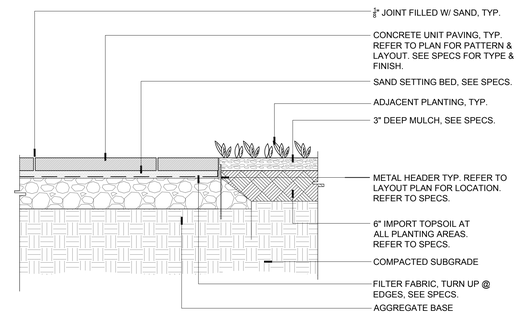


6 CONCRETE STAIR WITH HANDRAIL NTS



3 UNIT PAVERS NTS

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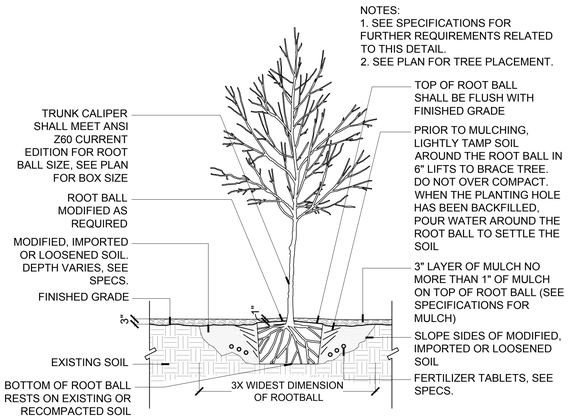
IVC JONAS CENTER & BLDG 18 ALTERATIONS

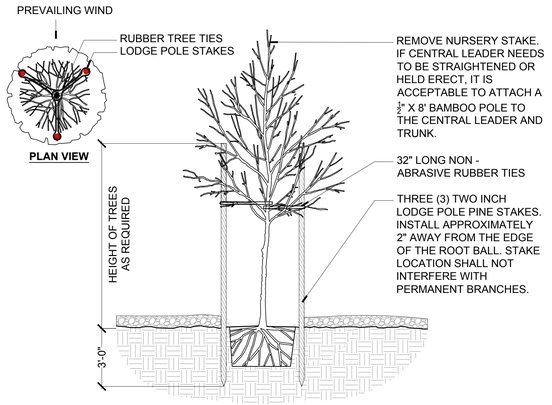
indian valley campus, novato ca
project number: 16-148.04
plot date: 11/20/2017 5:46:58 PM
scale: as noted
date: 11/21/17

LANDSCAPE DETAILS

L7.00



7 TREE PLANTING HOLE NTS



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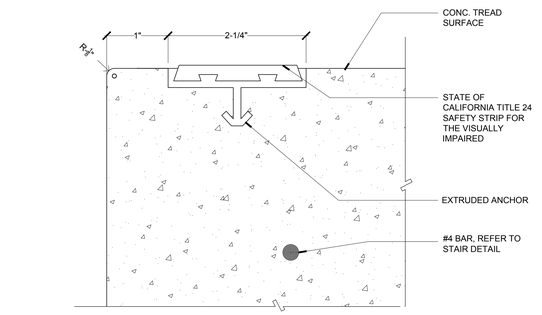

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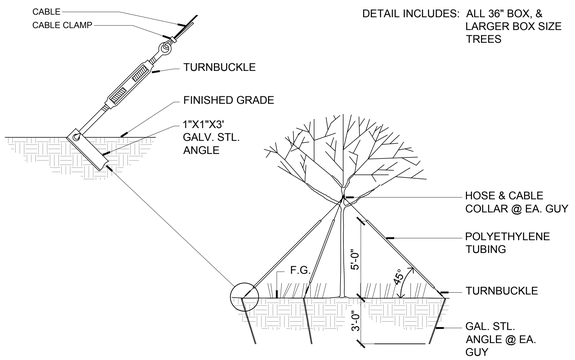
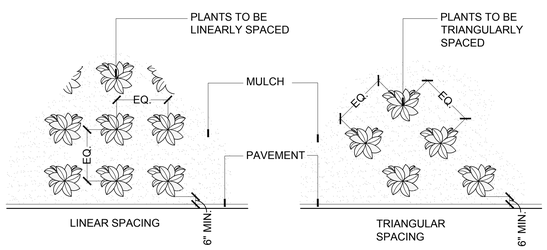


8 TREE GUYING NTS



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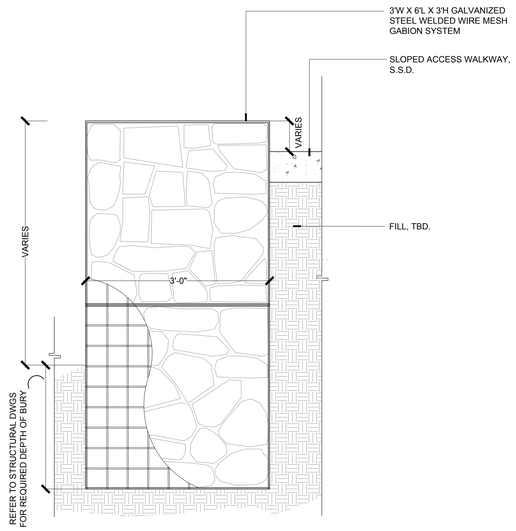
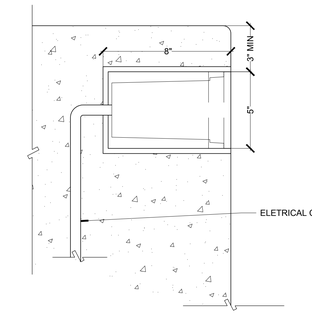
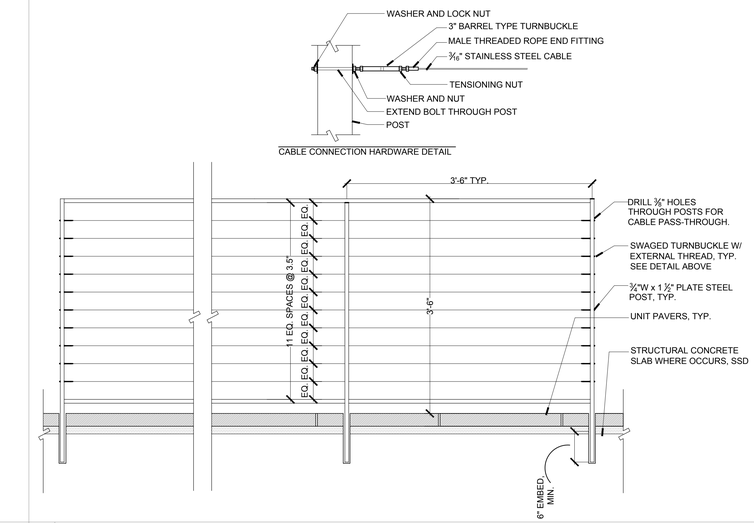


6 GABION RETAINING WALL AT SLOPED DECK



2 STEP LIGHT NTS



3 METAL GUARDRAIL NTS

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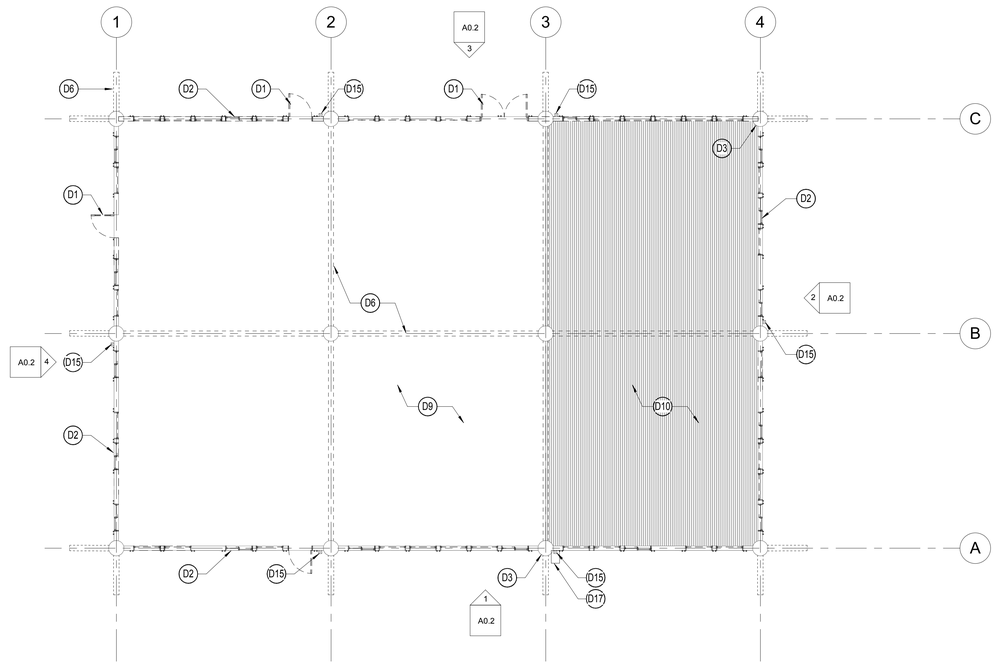
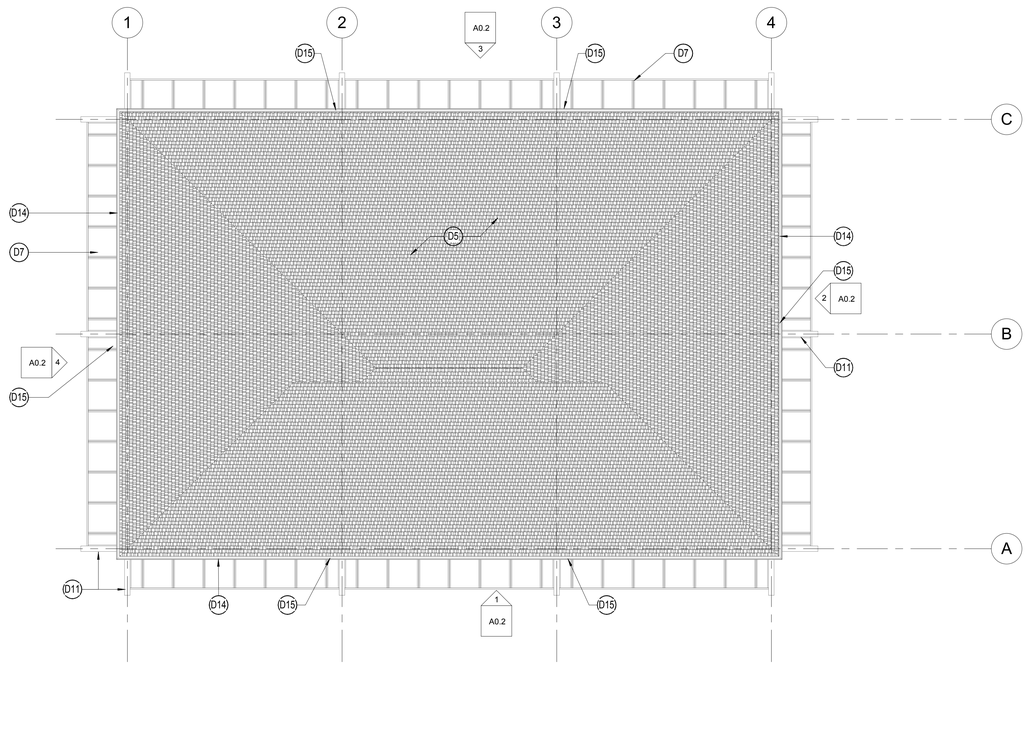
LANDSCAPE DETAILS

L7.01



1 BLDG 18 DEMO FLOOR PLAN 1/8" = 1'-0"



2 BLDG 18 DEMO ROOF PLAN 1/8" = 1'-0"

- D1 REMOVE (E) DOOR, TYP.
- D2 REMOVE ALL (E) WINDOW, TYP.
- D3 (E) CONC. COLUMN, TYP.
- D4 (E) CRAWL SPACE
- D5 (E) ASPHALT SHINGLE ROOF
- D6 (E) GLULAM BEAM ABOVE, TYP., TO REMAIN (SHOWN DASHED FOR CLARITY)
- D7 (E) EXTERIOR MTL. TRELLIS FRAME, TYP.
- D8 REMOVE (E) EXTERIOR WOOD FINISH & WOOD BATTENS, TYP.
- D9 (E) CONC. FLOOR SLAB
- D10 (E) WOOD FRAME FLOOR ASSEMBLY
- D11 (E) GLULAM BEAM METAL CAP, TYP.
- D12 (E) WOOD FRAMING, TYP.
- D13 (E) METAL LOUVER, TYP.
- D14 (E) ROOF GUTTER
- D15 (E) DOWNSPOUT
- D16 REMOVE (E) BLDG. SIGNAGE
- D17 (E) SPLASH BLOCK
- D18 (E) CONC. WALL
- D19 REMOVE (E) CEMENT PNL. SIDING

EXISTING TO REMAIN

EXISTING TO BE DEMOLISHED, U.O.N.

DEMOLITION KEYNOTES

DEMOLITION NOTES

1. NOT EVERY ITEM OF (E) WORK TO BE DEMOLISHED IS INDICATED ON THE DRAWINGS. DEMOLITION WORK INCLUDES THE REMOVAL OF (E) CONSTRUCTION TO THE EXTENT REQUIRED TO ACCOMMODATE THE NEW CONSTRUCTION WHETHER PARTICULARLY INDICATED OR NOT. VISIT THE PROJECT SITE AND REVIEW DRAWINGS SHOWING NEW CONSTRUCTION TO DETERMINE THE EXTENT OF DEMOLITION WORK REQUIRED BEFORE PRICING.
2. IF MATERIALS SUSPECTED OF CONTAINING HAZARDOUS MATERIALS ARE ENCOUNTERED, DO NOT DISTURB; IMMEDIATELY NOTIFY ARCHITECT & OWNER.
3. CONDUCT A PRE-DEMOLITION MEETING AT THE PROJECT SITE BEFORE COMMENCING WITH DEMOLITION WORK. INSPECT AND DISCUSS CONDITION OF CONSTRUCTION TO BE SELECTIVELY DEMOLISHED. REVIEW DEMOLITION DOCUMENTS AND REPORT UNRESOLVED ISSUES OR CONFLICTS TO THE ARCHITECT.
4. PROTECT WALLS, CEILINGS, FLOORS AND OTHER EXISTING FINISH WORK TO REMAIN. COVER AND PROTECT FURNITURE, FURNISHINGS AND EQUIPMENT NOT TO BE REMOVED.
5. DO NOT CLOSE OR OBSTRUCT WALKWAYS, CORRIDORS, OR OTHER OCCUPIED OR USED FACILITIES WITHOUT WRITTEN PERMISSION FROM AUTHORITIES HAVING JURISDICTION. MAINTAIN FIRE-PROTECTION, LIFE SAFETY, AND BUILDING SECURITY SYSTEM IN SERVICE DURING DEMOLITION OPERATIONS.
6. MAINTAIN (E) UTILITIES INDICATED TO REMAIN IN SERVICE AND PROTECT THEM AGAINST DAMAGE. DO NOT REMOVE UTILITY LINES SERVING OTHER PARTS OF THE BUILDING UNTIL NEW REPLACEMENT LINES ARE INSTALLED. REMOVE & CAP UTILITIES CONCEALED BY NEW FINISHED SURFACES WHERE FIXTURES ARE DEMOLISHED.
7. REPAIR DAMAGE CAUSED BY SELECTIVE DEMOLITION TO ADJACENT CONSTRUCTION AND (E) COLUMNS AND RESTORE SURFACES INTENDED TO REMAIN. UON, USE REPAIR MATERIALS IDENTICAL TO (E) MATERIALS. PATCH WITH DURABLE SEAMS THAT ARE AS INVISIBLE AS POSSIBLE. WHERE PATCHING OCCURS IN A PAINTED SURFACE, APPLY PRIMER & INTERMEDIATE PAINT COATS OVER PATCH AND APPLY FINAL PAINT COAT OVER ENTIRE UNBROKEN SURFACE CONTAINING PATCH. PROVIDE ADDITIONAL COATS UNTIL PATCH BLENDS WITH ADJACENT SURFACES.
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COLLEGE OF MARIN IVC
JONAS CENTER
& BLDG 18
ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

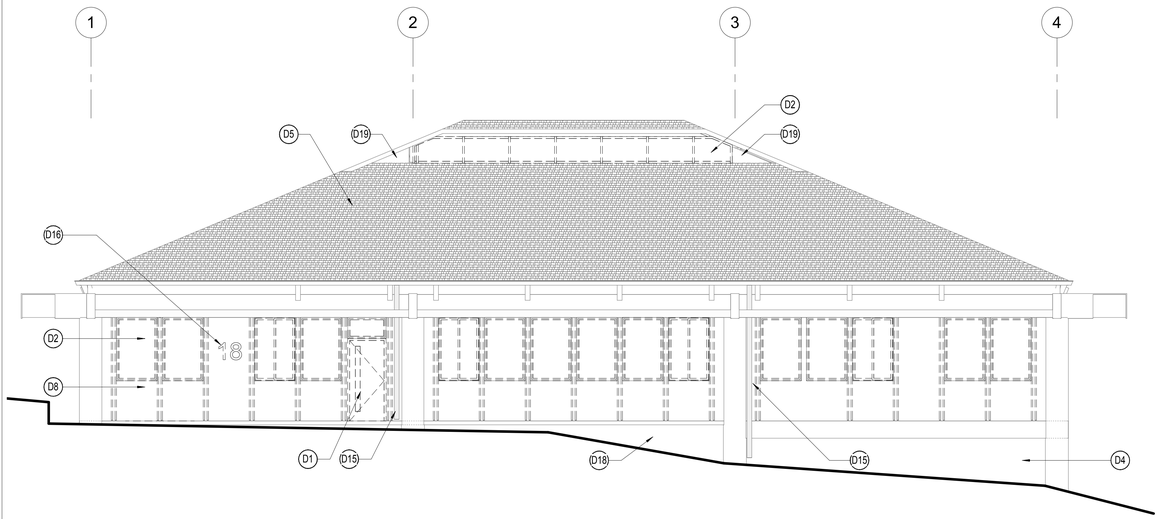
plot date: 12/1/2017 5:02:14 PM

scale: as noted

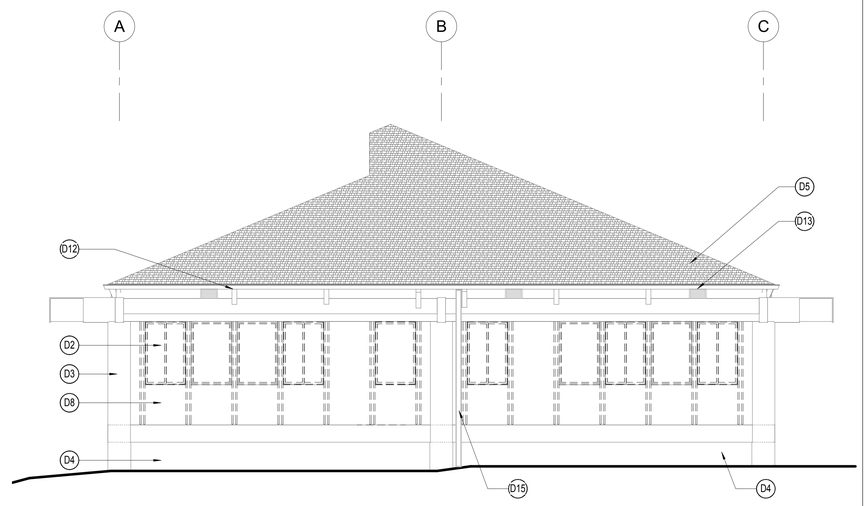
date:

DEMO PLAN
BLDG 18

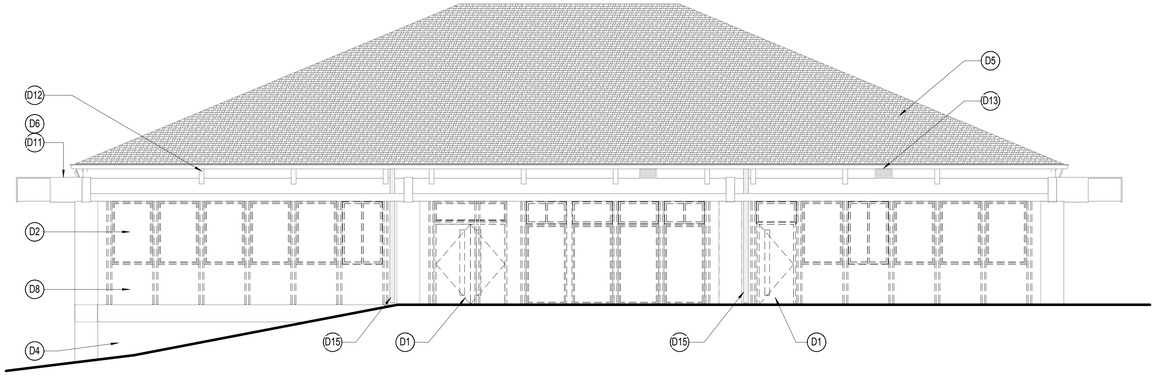
A0.1



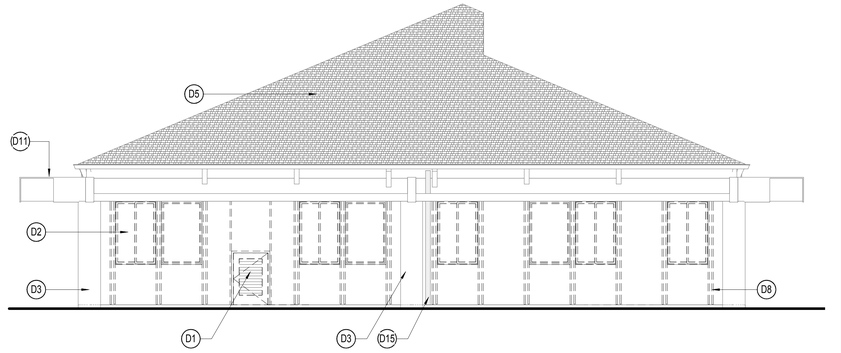
1 BLDG 18 DEMO SOUTH ELEVATION 3/16" = 1'-0"



2 BLDG 18 DEMO EAST ELEVATION 3/16" = 1'-0"



3 BLDG 18 DEMO NORTH ELEVATION 3/16" = 1'-0"



4 BLDG 18 DEMO WEST ELEVATION 3/16" = 1'-0"

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- D8 REMOVE (E) EXTERIOR WOOD FINISH & WOOD BATTENS, TYP.
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- D10 (E) WOOD FRAME FLOOR ASSEMBLY
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- D12 (E) WOOD FRAMING, TYP.
- D13 (E) METAL LOUVER, TYP.
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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

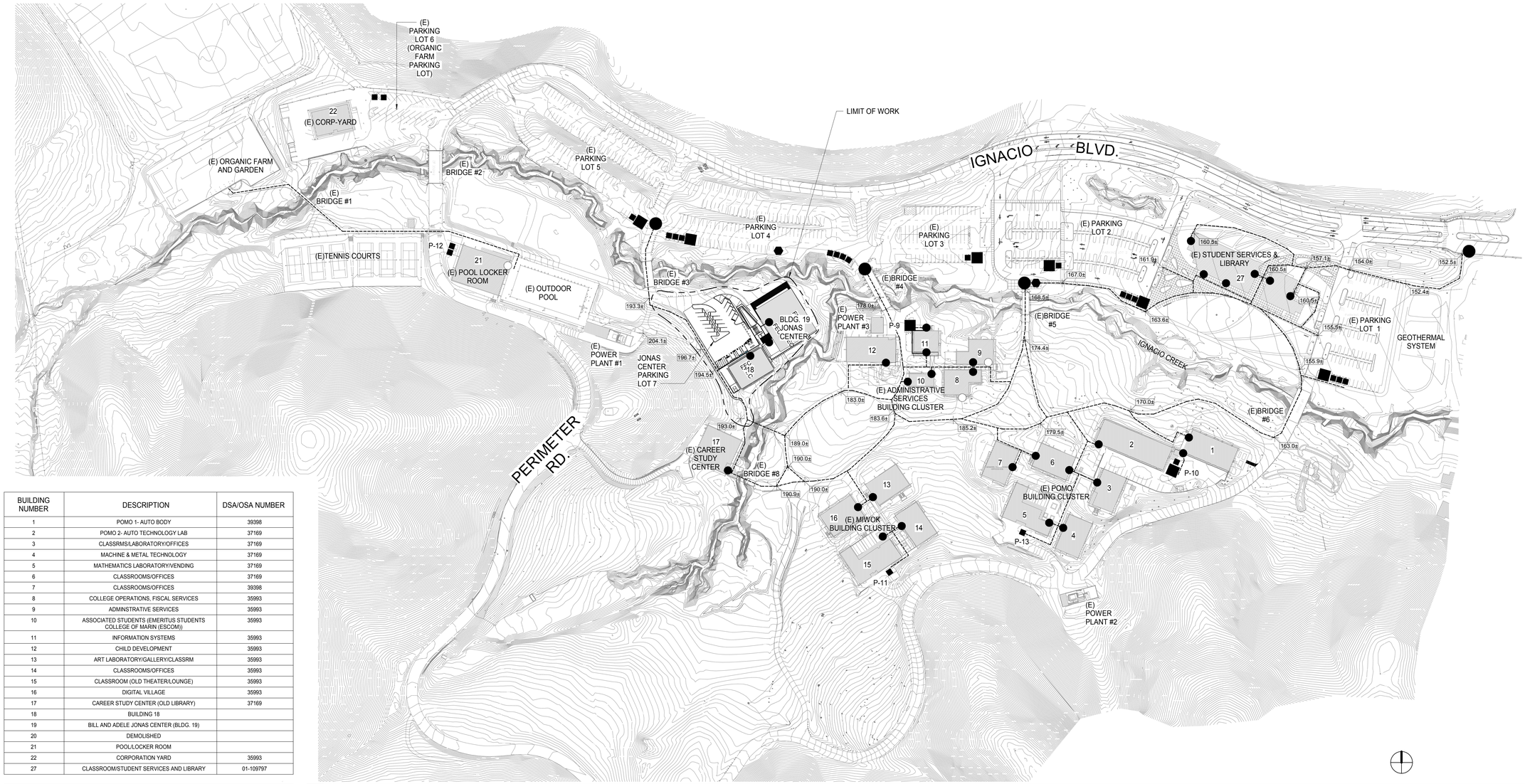
plot date: 12/1/2017 5:02:18 PM

scale: as noted

date:

DEMO ELEVATIONS BLDG 18

A0.2

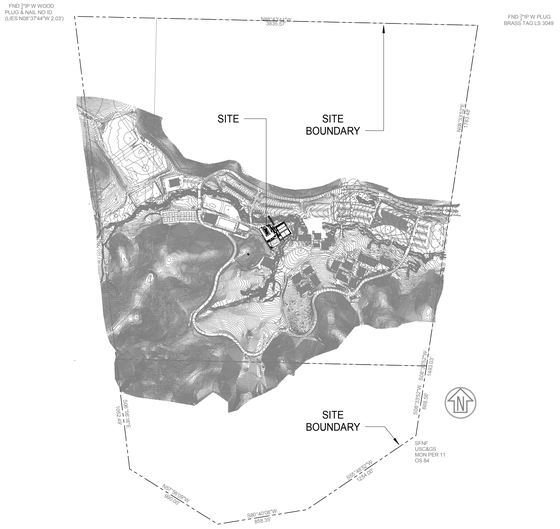


1 SITE ACCESS PLAN 1" = 100'-0"

BUILDING NUMBER	DESCRIPTION	DSA/OSA NUMBER
1	POMO 1- AUTO BODY	39398
2	POMO 2- AUTO TECHNOLOGY LAB	37169
3	CLASSRMS/LABORATORY/OFFICES	37169
4	MACHINE & METAL TECHNOLOGY	37169
5	MATHEMATICS LABORATORY/VENDING	37169
6	CLASSROOMS/OFFICES	37169
7	CLASSROOMS/OFFICES	39398
8	COLLEGE OPERATIONS, FISCAL SERVICES	35993
9	ADMINSTRATIVE SERVICES	35993
10	ASSOCIATED STUDENTS (EMERITUS STUDENTS COLLEGE OF MARIN (ESCOM))	35993
11	INFORMATION SYSTEMS	35993
12	CHILD DEVELOPMENT	35993
13	ART LABORATORY/GALLERY/CLASSRM	35993
14	CLASSROOMS/OFFICES	35993
15	CLASSROOM (OLD THEATER/LOUNGE)	35993
16	DIGITAL VILLAGE	35993
17	CAREER STUDY CENTER (OLD LIBRARY)	37169
18	BUILDING 18	
19	BILL AND ADELE JONAS CENTER (BLDG. 19)	
20	DEMOLISHED	
21	POOL/LOCKER ROOM	
22	CORPORATION YARD	35993
27	CLASSROOM/STUDENT SERVICES AND LIBRARY	01-109797

DSA TABULATION

DATES	DESCRIPTION / OTHER	DSA/OSA NUMBER
05/01/73	SITE 69 71013	35884
05/01/73	PERIMETER ROAD	35884
05/01/73	BRIDGE #6	35884
06/29/73	ADMINISTRATION BUILDING (AS)	35993
06/29/73	BASKETBALL & VOLLEYBALL COURTS	35993
06/29/73	COLLEGE A (OL)	35993
05/01/73	COLLEGE B (MW)	35993
06/29/73	POWERPLANT #1 PP1	35993
06/29/73	POWERPLANT #2 PP2	35993
06/29/73	POWERPLANT #3 PP3	35993
06/29/73	TENNIS COURTS (T1)	35993
07/03/73	PHASE I 71014	35993
04/08/74	SITE 73 72101	36841
11/08/74	PHASE II 72102	37169
08/23/76	PHASE III 75101-72103	39526
08/24/76	IVC PHASE IV 74081 PM7, PM BLDG. 1, IS	39398
12/05/77	MAIN ENTRANCE GATES	75077
04/25/86	STRUCTURAL RENOVATION/REPAIR PH 1	47256
01/22/87	STRUCTURAL RENOVATION/REPAIR PH 2	48011
08/24/87	STRUCTURAL RENOVATION/REPAIR PH 3	48987
11/24/87	COGEN PLANTS	49432
06/24/89	EROSION CONTROL PH 1	51009
09/22/94	AUTO LIFT INSTALLATION	61309
07/02/95	IVC ATHLETIC FIELDS CITY OF NOVATO	64855
07/01/96	AUTO SHOP HEATING SYSTEM	65312
03/24/99	AUTO BODY SHOP HEATING SYSTEM	101371
10/01/99	INFANT TODDLER CENTER	101253
10/12/99	POOL SYSTEM MODERNIZATION	102000
02/14/02	ASPHALT UPGRADES	104299
	(E) PARKING LOT 6 - ORGANIC FARM PARKING LOT IMPROVMENT	01-116739



2 SITE BOUNDARY 1 : 7000

PER CBC TABLE 11B-208.2	
TOTAL NUMBER OF PARKING SPACES PROVIDED IN PARKING FACILITY	MIN. NUMBER OF REQUIRED ACCESSIBLE PARKING SPACES
1-25	1
26-50	2
51-75	3
76-100	4
101-150	5
151-200	6
201-300	7
301-400	8
401-500	9
501-1000	2% OF TOTAL

PER CBC 11B-208.2.4 FOR EVERY SIX OR FRACTION OF SIX PARKING SPACES REQUIRED BY SECTION 11B-208.2 TO COMPLY WITH SECTION 11B-502, AT LEAST ONE SHALL BE A VAN PARKING SPACE COMPLYING WITH SECTION 11B-502.

PARKING LOTS	TOTAL SPACES	CAR ACCESSIBLE SPACES	VAN ACCESSIBLE SPACES
1	76	3	1
2	121	4	2
3	71	1	1
4	111	7	1
5	91	1	1
6	78	1	1
7	20	2	1

ADDITIONAL CAMPUS PARKING

P-9	1	0	1
P-10	2	1	1
P-11	1	1	0
P-12	2	2	0
P-13	4	1	0
TOTALS:	578	24	10

NOTES:
1. PROPOSED ACCESSIBLE PATH OF TRAVEL AS INDICATED ON PLAN IS A BARRIER FREE ACCESS P.O.T. WITHOUT ANY ABRUPT LEVEL CHANGES EXCEEDING 1/2" BEVELED AT 1:2 MAX. SLOPE, OR VERTICAL LEVEL CHANGES NOT EXCEEDING 1/4" MAX. AND AT LEAST 48" WIDE. SURFACE IS SLIP RESISTANT, STABLE, FIRM, AND SMOOTH. CROSS SLOPE DOES NOT EXCEED 2% AND SLOPE IN THE DIRECTION OF TRAVEL IS LESS THAN 5% UNLESS OTHERWISE INDICATED. P.O.T. SHALL MAINTAIN FREE OF OVERHANGING OBSTRUCTIONS TO MINIMUM 80" (11B-307.4) AND PROTRUDING OBJECTS GREATER THAN 4" PROJECTION FROM WALL AND ABOVE 27" AND LESS THAN 80" (11B-307.2)

2. ALL BUILDING ENTRANCES / EXITS ALONG THE INDICATED PROPOSED PATH OF TRAVEL ARE ACCESSIBLE UNLESS OTHERWISE NOTED.

3. EXISTING ACCESSIBLE PARKING, ENTRANCES, AND PATHS OF TRAVEL ARE SHOWN ACCORDING TO INFORMATION PROVIDED BY THE COLLEGE OF MARIN.

4. (1) ACCESSIBLE VAN ELECTRIC CHARGING STATION STALL AND (1) AMBULATORY ELECTRIC CHARGING STATION STALL PROVIDED IN PARKING LOT #7. THESE STALLS ARE NOT INCLUDED IN THE CALCULATION ABOVE PER CBC 11B-208.1

PARKING TABULATION

LEGEND:
- CAMPUS ENTRANCE
- EXISTING DESIGNATED ACCESSIBLE PATH OF TRAVEL
- PROPOSED ACCESSIBLE PATH OF TRAVEL, 48" WIDE MIN, SLOPE <5%
- ACCESSIBLE BUILDING ENTRANCE (2% MAX SLOPE TO DOOR)
- ENTRANCE
- EXISTING ACCESSIBLE PARKING SPACE
- EXISTING ACCESSIBLE VAN PARKING SPACE
- BUS STOP
- PASSENGER DROP OFF
- 174.4± SPOT ELEVATION

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

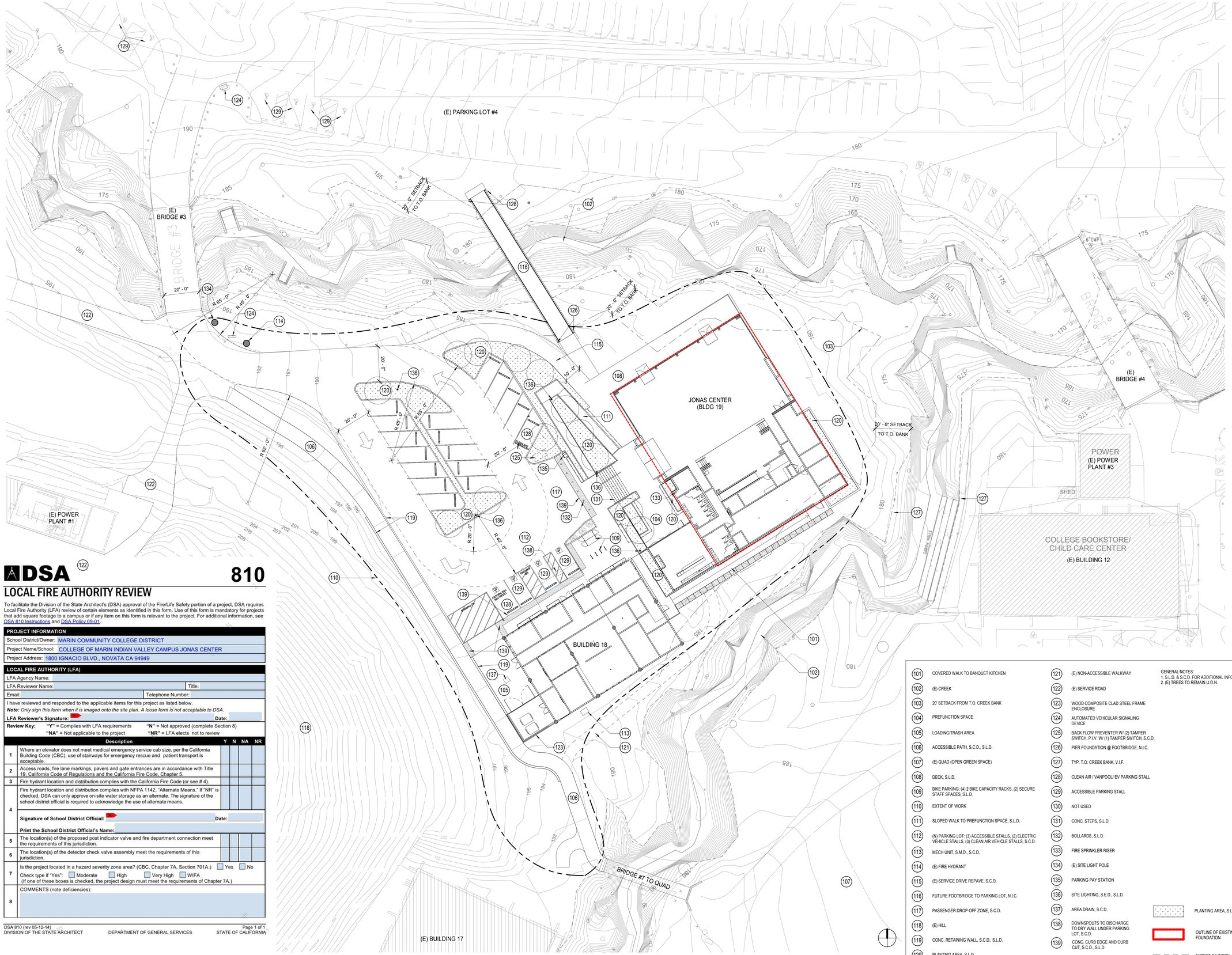
plot date: 12/1/2017 5:02:24 PM

scale: as noted

date:

SITE ACCESSIBILITY PLAN

A1.0



DSA 810

LOCAL FIRE AUTHORITY REVIEW

To facilitate the Division of the State Architect's (DSA) approval of the Fire/Life Safety portion of a project, DSA requires Local Fire Authority (LFA) review of certain elements as identified in this form. Use of this form is mandatory for projects that add square footage to a campus or if any item on this form is relevant to the project. For additional information, see DSA 810 Instructions and DSA Policy 09-01.

PROJECT INFORMATION	
School District/Owner:	MARIN COMMUNITY COLLEGE DISTRICT
Project Name/School:	COLLEGE OF MARIN INDIAN VALLEY CAMPUS JONAS CENTER
Project Address:	1800 IGNACIO BLVD., NOVATA CA 94949

LOCAL FIRE AUTHORITY (LFA)			
LFA Agency Name:			
LFA Reviewer Name:		Title:	
Email:		Telephone Number:	

I have reviewed and responded to the applicable items for this project as listed below.
Note: *Only sign this form when it is imaged onto the site plan. A loose form is not acceptable to DSA.*

LFA Reviewer's Signature: **Date:**

Review Key: **"Y"** = Complies with LFA requirements **"N"** = Not approved (complete Section 8)
"NA" = Not applicable to the project **"NR"** = LFA elects not to review

	Description	Y	N	NA	NR
1	Where an elevator does not meet medical emergency service cab size, per the California Building Code (CBC), use of stairways for emergency rescue and patient transport is acceptable.				
2	Access roads, fire lane markings, pavers and gate entrances are in accordance with Title 19, California Code of Regulations and the California Fire Code, Chapter 5.				
3	Fire hydrant location and distribution complies with the California Fire Code (or see # 4).				
4	Fire hydrant location and distribution complies with NFPA 1142, "Alternate Means." If "NR" is checked, DSA can only approve on-site water storage as an alternate. The signature of the school district official is required to acknowledge the use of alternate means.				
	Signature of School District Official: **Date:**				
	Print the School District Official's Name:				
5	The location(s) of the proposed post indicator valve and fire department connection meet the requirements of this jurisdiction.				
6	The location(s) of the detector check valve assembly meet the requirements of this jurisdiction.				
7	Is the project located in a hazard severity zone area? (CBC, Chapter 7A, Section 701A.) ☐ Yes ☐ No Check type if "Yes": ☐ Moderate ☐ High ☐ Very High ☐ WIFA (If one of these boxes is checked, the project design must meet the requirements of Chapter 7A.)				
8	COMMENTS (note deficiencies):				

1 JONAS CENTER SITE PLAN 1" = 20'-0"

SITE PLAN KEYNOTES

101	COVERED WALK TO BANQUET KITCHEN	121	(E) NON-ACCESSIBLE WALKWAY
102	(E) CREEK	122	(E) SERVICE ROAD
103	20' SETBACK FROM T.O. CREEK BANK	123	WOOD COMPOSITE CLAD STEEL FRAME ENCLOSURE
104	PREFUNCTION SPACE	124	AUTOMATED VEHICULAR SIGNALING DEVICE
105	LOADING/TRASH AREA	125	BACK FLOW PREVENTER W/ (2) TAMPER SWITCH, P.I.V. W/ (1) TAMPER SWITCH, S.C.D.
106	ACCESSIBLE PATH, S.C.D., S.L.D.	126	PIER FOUNDATION @ FOOTBRIDGE, N.I.C.
107	(E) QUAD (OPEN GREEN SPACE)	127	TYP. T.O. CREEK BANK, V.I.F.
108	DECK, S.L.D.	128	CLEAN AIR / VANPOOL/ EV PARKING STALL
109	BIKE PARKING: (4) 2 BIKE CAPACITY RACKS, (2) SECURE STAFF SPACES, S.L.D.	129	ACCESSIBLE PARKING STALL
110	EXTENT OF WORK	130	NOT USED
111	SLOPED WALK TO PREFUNCTION SPACE, S.L.D.	131	CONC. STEPS, S.L.D.
112	(N) PARKING LOT: (3) ACCESSIBLE STALLS, (2) ELECTRIC VEHICLE STALLS, (3) CLEAN AIR VEHICLE STALLS, S.C.D.	132	BOLLARDS, S.L.D.
113	MECH UNIT, S.M.D., S.C.D.	133	FIRE SPRINKLER RISER
114	(E) FIRE HYDRANT	134	(E) SITE LIGHT POLE
115	(E) SERVICE DRIVE REPAVE, S.C.D.	135	PARKING PAY STATION
116	FUTURE FOOTBRIDGE TO PARKING LOT, N.I.C.	136	SITE LIGHTING, S.E.D., S.L.D.
117	PASSENGER DROP-OFF ZONE, S.C.D.	137	AREA DRAIN, S.C.D.
118	(E) HILL	138	DOWNSPOUTS TO DISCHARGE TO DRY WALL UNDER PARKING LOT, S.C.D.
119	CONC. RETAINING WALL, S.C.D., S.L.D.	139	CONC. CURB EDGE AND CURB CUT, S.C.D., S.L.D.
120	PLANTING AREA, S.L.D.		

GENERAL NOTES:
1. S.L.D. & S.C.D. FOR ADDITIONAL INFO
2. (E) TREES TO REMAIN U.O.N.

PLANTING AREA, S.L.D.
OUTLINE OF EXISTING FOUNDATION
EXTENT OF WORK

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca
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plot date: 12/1/2017 5:02:27 PM

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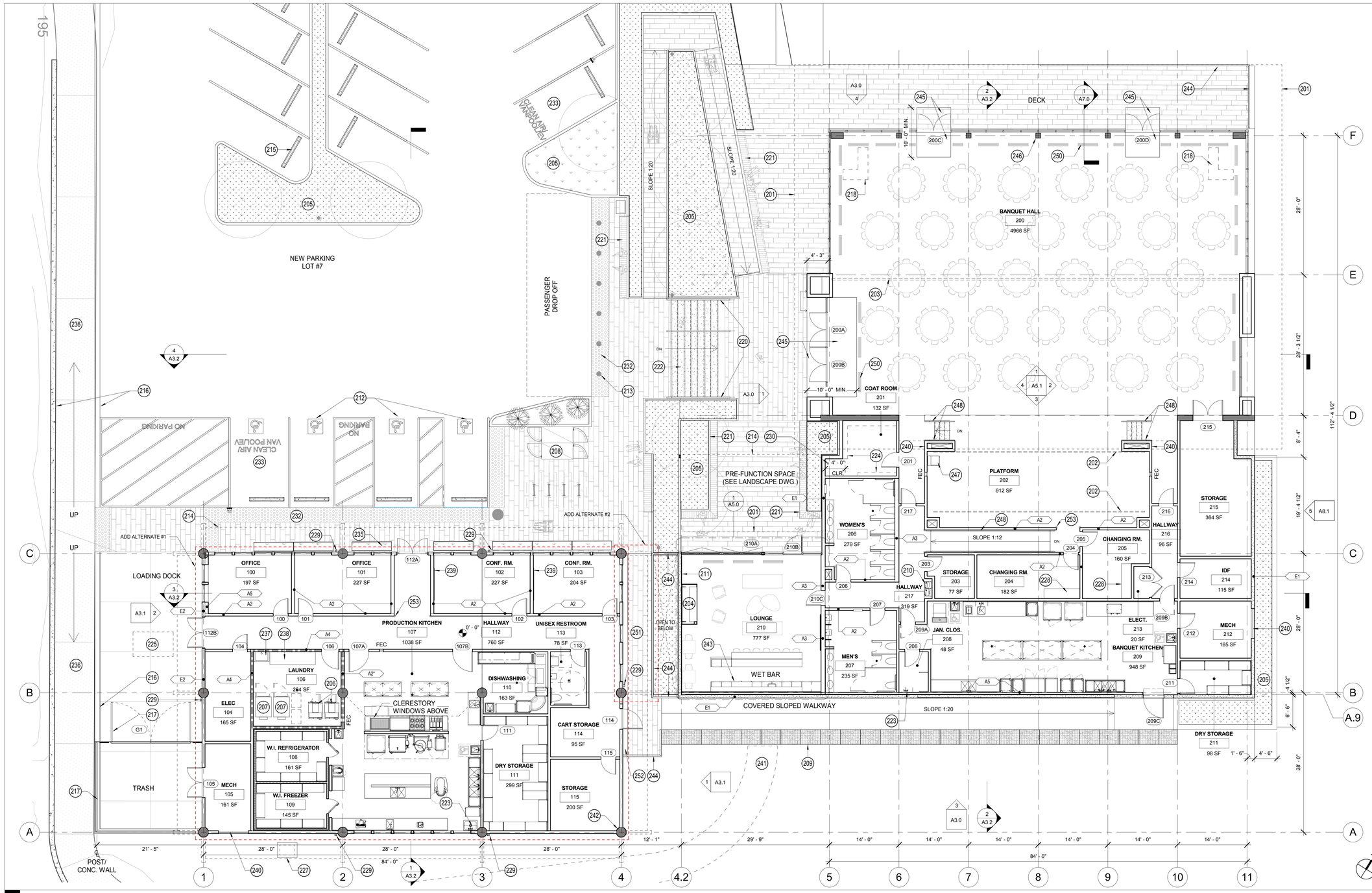
date:

SITE PLAN

A1.1



1 JONAS CENTER — 1/8" = 1'-0"

GENERAL NOTES:
1. FURNITURE SHOWN FOR REF. ONLY
2. ADD ALT. #1 - INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE, STUB OUT FOR UTILITIES
3. ADD ALT. #2 - EXTERIOR SCOPE FOR NEW CONNECTING CONC. WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

WALL ASSEMBLIES KEYNOTES — 1/4" = 1'-0"

A1 TYP. U.O.N.	INTERIOR WALL: GYP BOARD (MOISTURE AND MOLD RESISTANCE AT WET LOCATIONS) U.O.N. @ INTERIOR ELEVATIONS 4" MTL STUD ACOUSTICAL INSULATION	
A2	INTERIOR WALL: GYP BOARD (TYPE X OR C) ON EACH SIDE U.O.N. @ INTERIOR ELEVATIONS STAGGERED 4" MTL STUD CONSTRUCTION WITH 6" BOTTOM TRACK R-13 BATT INSULATION FULLY CAULK AT PERIMETER SEE ACOUSTICAL RECOMMENDATIONS *DENOTES 1 HOUR RATED WALL, USE TYPE X GYP BD (UL 263)	
A3	INTERIOR WALL: MOISTURE AND MOLD RESISTANCE GYP BOARD (TYPE X OR C) ON EACH SIDE U.O.N. @ INTERIOR ELEVATIONS DOUBLE STUD WALL CONSTRUCTION WITH MIN. 1" GAP BETWEEN STUDS. (2) LAYERS OF 3 1/2" BATT INSULATION SEE ACOUSTICAL RECOMMENDATIONS	
A4	INTERIOR WALL 1HR RATED: MOISTURE AND MOLD RESISTANCE GYP BOARD (TYPE X) ON EACH SIDE U.O.N. @ INTERIOR ELEVATIONS 4" MTL STUD ACOUSTICAL INSULATION	
A5	INTERIOR FURRED WALL: 1" GAP TO ADJACENT WALL MOISTURE AND MOLD RESISTANCE GYP BOARD (TYPE X) 6" MTL STUD ACOUSTICAL INSULATION	
E1 JONAS CENTER	EXTERIOR WALL: GYP BOARD U.O.N. @ INTERIOR ELEVATIONS 6" MTL STUD @ 24" O.C. U.O.N., S.S.D. R-21 (5 1/2") BATT INSULATION 5/8" GYP. SHEATHING, TYPE 'X' WEATHER RESISTIVE BARRIER R-2 (1/2") RIGID INSULATION AT EXTERIOR FINISH MATERIAL - SEE ELEVATIONS	
E2 BLDG 18	EXTERIOR WALL: GYP BOARD (E) 2X4 WOOD STUD @ 16" O.C. R-11 BATT INSULATION 5/8" GYP. SHEATHING, TYPE 'X' WEATHER RESISTIVE BARRIER VERTICAL FIBER CEMENT BOARD AND BATTEN	

FLOOR PLAN KEYNOTES — 1/4" = 1'-0"

201	ROOF OVERHANG	212	ACCESSIBLE PARKING STALLS, TYP.	223	MOP SINK, SEE KITCHEN PLANS	234	CONCEALED GUTTER W / DOWNSPOUTS
202	CURTAIN DIVIDER	213	STEEL BOLLARDS, PTD., S.L.D.	224	NOT USED	235	PORTABLE PLANTER, TYP., S.L.D.
203	MOTORIZED ROLLED FABRIC OR PANEL DIVIDER ABOVE	214	TRELLIS (ABOVE), SEE TRELLIS DETAILS ON SHEET A7.1	225	GREASE INTERCEPTOR, S.P.D.	236	WALKWAY, S.L.D., S.C.D.
204	GAS FIREPLACE	215	CONC. WHEEL STOP, TYP., S.C.D.	226	ROOF DRAIN	237	UTILITY SINK, S.P.D.
205	PLANTING AREA, S.L.D.	216	CONCRETE RETAINING WALL, S.L.D., S.C.D.	227	CONC. PAD FOR MECH EQUIPMENT, S.M.D.	238	P-LAM COUNTER
206	COMMERCIAL WASHER	217	WOOD COMPOSITE CLAD STEEL FRAME ENCLOSURE & SWING GATE	228	BUILT IN BENCH	239	MONITOR, S.E.D.
207	COMMERCIAL DRYER	218	PORTABLE BEVERAGE FURNITURE, N.I.C.	229	(E) DOWNSPOUT	240	LOUVER, S.M.D.
208	BIKE PARKING - PROVIDE (4) 2 BIKE CAPACITY RACKS & (2) SECURE STAFF SPACES, S.L.D.	219	MTL. GUARDRAIL, S.L.D.	230	FIRE SPRINKLER RISER, S.P.D.	241	(E) NON-ACCESSIBLE WALKWAY
209	GABION WALL, S.L.D.	220	STAINLESS STEEL HANDRAIL, S.L.D.	231	PARAPET	242	(E) CONC. COLUMN, SEAL, TYP.
210	DRINKING FOUNTAIN, S.P.D.	221	COMPOSITE BENCH, S.L.D.	232	TRUNCATED DOMES, S.C.D., S.L.D.	243	CASEWORK
211	DISPLAY AREA FOR ROTARY CLUB	222	CONC. STAIR, S.C.D., S.L.D.	233	EV CHARGING STATION, S.E.D.	244	STAINLESS STEEL GUARDRAIL
						245	RECESSED MTL ENTRANCE GRATE
						246	SEALED CONCRETE COLUMN
						247	AUDIO VISUAL EQUIPMENT RACK, SEE AV REPORT
						248	WOOD HANDRAIL, TYP.
						249	(E) GLULAM BEAM
						250	LINEAR FLOOR DIFFUSER, S.M.D.
						251	CONCRETE WALKWAY, ADD ALTERNATE #2
						252	SEISMIC GAP BETWEEN (E) BLDG & (N) CONSTRUCTION
						253	CORNER GUARD, TYP.
						254	PLYWOOD CRICKET
						101	DOOR TAG, SEE A8.0 FOR ADDTL INFO

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

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project number: 16-148.04
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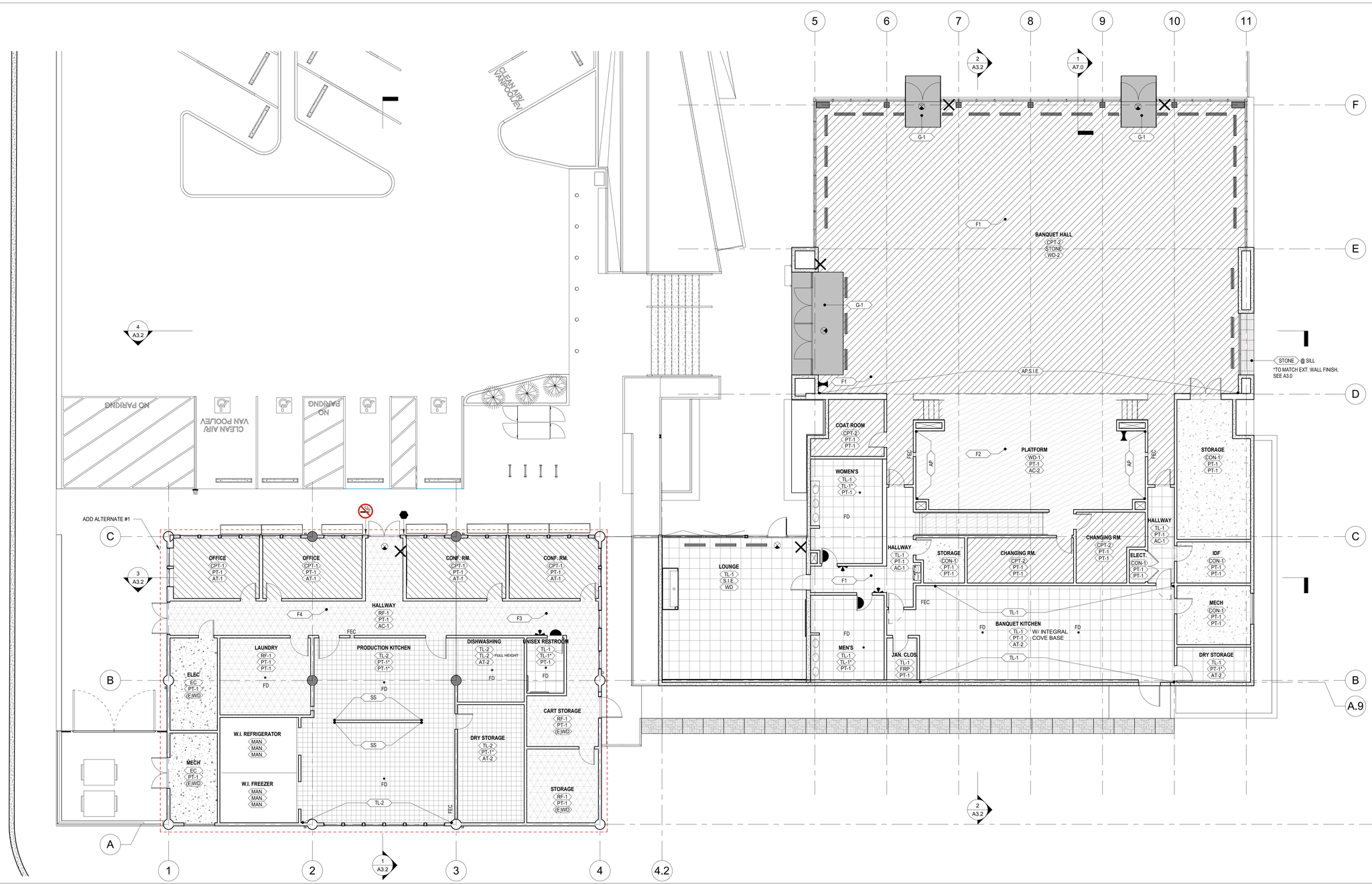
FLOOR PLAN

A2.0



1 MATERIALS AND FINISHES PLAN

1/8" = 1'-0"

RESTROOM TACTILE DOOR SIGN, SIGN TYPE A

ROOM IDENTIFICATION SIGN, SIGN TYPE B1, B2

TACTILE EXIT SIGN, SIGN TYPE C

MAX ROOM OCCUPANCY SIGN

PROPOSITION 65 SIGN, SIGN TYPE F

ASSISTANCE LISTENING SIGN, SIGN TYPE H

CEILING MOUNTED ILLUMINATED EXIT SIGN, S.E.D.

NO SMOKING SIGN, SIGN TYPE I

1. REFER TO DETAIL #1/G3.1 FOR SIGNAGE TYPE DETAILS
2. SIGNAGE SHALL BE PREPARED PER REQUIREMENTS OF 2016 CBC.
3. ALL WAYFINGING SIGNAGE SHALL BE O.F.C.I.
4. EACH ROOM TO HAVE ROOM IDENTIFICATION SIGN, TYPE D

SIGNAGE LEGEND

F1 JONAS CENTER — NEW RAISED FLOOR:
SEE A2.2 FOR FINISHES
CONCRETE SLAB, S.S.D.
2" RIGID INSULATION BELOW SLAB

F2 JONAS CENTER — PATFORM FLOOR:
ENGINEERED WOOD FLOORING
2" GYPCRETE
2X12 JOISTS, S.S.D.

R-30 BATT INSULATION IN CAVITY

SECONDARY CEILING JOISTS,
DISCONNECTED FROM ASSEMBLY ABOVE
2 LAYERS OF GYB BD
2" DUCT LINER PINNED TO CEILING

F3 BLDG 18 — (E) WOOD FLOOR (SEE 1/A0.1 FOR LOCATION):
SEE A2.1 FOR FINISHES
(E) WOOD FRAMING + WOOD DECK
R-11 BATT INSULATION BELOW FLOOR ASSEMBLY

F4 BLDG 18 — (E) CONCRETE FLOOR (SEE 1/A0.1 FOR LOCATION):
SEE A2.1 FOR FINISHES
(E) SLAB ON GRADE

FINISH ASSEMBLIES KEYNOTES

SYMBOL	DESCRIPTION	FINISH	SYMBOL	DESCRIPTION	FINISH
	RESILIENT FLOORING - RF-1	LINOLEUM FLOORING		STONE	CLEAR SEAL
	WOOD FLOORING - WD-1	ENGINEERED HARDWOOD FLOORING W/ ACOUSTIC UNDERLAYMENT		FRP	UP TO 6' - 0" A.F.F.
				SS	STAINLESS STEEL
	EXISTING CONCRETE - EC	SEALED		WOOD SLATS AND FRAMING - WD-2	CLEAR SEAL
	CONCRETE - CON-1	SEALED			
	TILE - TL-1	PORCELAIN TILE W/ 6" TILE BASE * DENOTES WALL TILE TO 5'-0" A.F.F.		WOOD DECK + FRAMING - (E)WD	(E)
	TILE - TL-2	QUARRY TILE - 6" AND INTEGRAL 6" COVE BASE PER HEALTH CODE			
	GRILLE - G-1	RECESSED MTL. GRILLE NON-ABSORBENT FLOORING MATERIAL TO EXTEND 5' BEYOND ENTRY DOOR ON BOTH SIDES OF DOOR		AT1 - ACOUSTIC TILE	2X4 ACOUSTIC TILE, SUSPENDED CEILING
				AT2 - ACOUSTIC TILE	2X4 ACOUSTIC TILE, SUSPENDED CEILING, SANITARY-TYPE PANELS
	CARPET - CPT-1	CARPET TILE		AC1 - ACOUSTIC CEILING	PERFORATED GYP BOARD, SEE ACOUSTICAL REPORT
	CARPET - CPT-2	CARPET TILE		AC2 - ACOUSTIC CEILING	SOUND ABSORBING PANEL, SEE ACOUSTICAL REPORT
	PAINT - PT-1	GYP BOARD, PTD., COLOR TBD PTD. *@KITCHENS, FINISH PER HEALTH CODE		AP - ACOUSTIC PANEL	SOUND ABSORBING PANEL, 50% OF WALL AREA, SEE ACOUSTICAL REPORT

FINISH LEGEND

1/8" = 1'-0"

GENERAL NOTES:

1. ALL FLOOR TILE TO BE THIN SET PER TCNA F131-11 FOR INTERIOR FLOORS OVER CONCRETE.
2. ALL WALL TILE TO BE THIN SET PER TCNA W244C-11 FOR INTERIOR WALLS OVER WOOD STUDS.
3. ADD ALT. #1 - INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE, STUB OUT FOR UTILITIES

OFFICE — ROOM NAME
CPT1 — FLOOR FINISH
RB1 — GENERAL WALL FINISH, OR SEE INTERIOR ELEVATIONS (S.I.E.)
PT1 — CEILING FINISH

MAN — BY MANUFACTURER
S.I.E — SEE INTERIOR ELEVATIONS

LINEAR FLOOR DIFFUSER , S.M.D.

FD — FLOOR DRAIN , S.P.D.

FEC — FIRE EXTINGUISHER CABINET

FINISH LEGEND NOTES

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indian valley campus, novato ca

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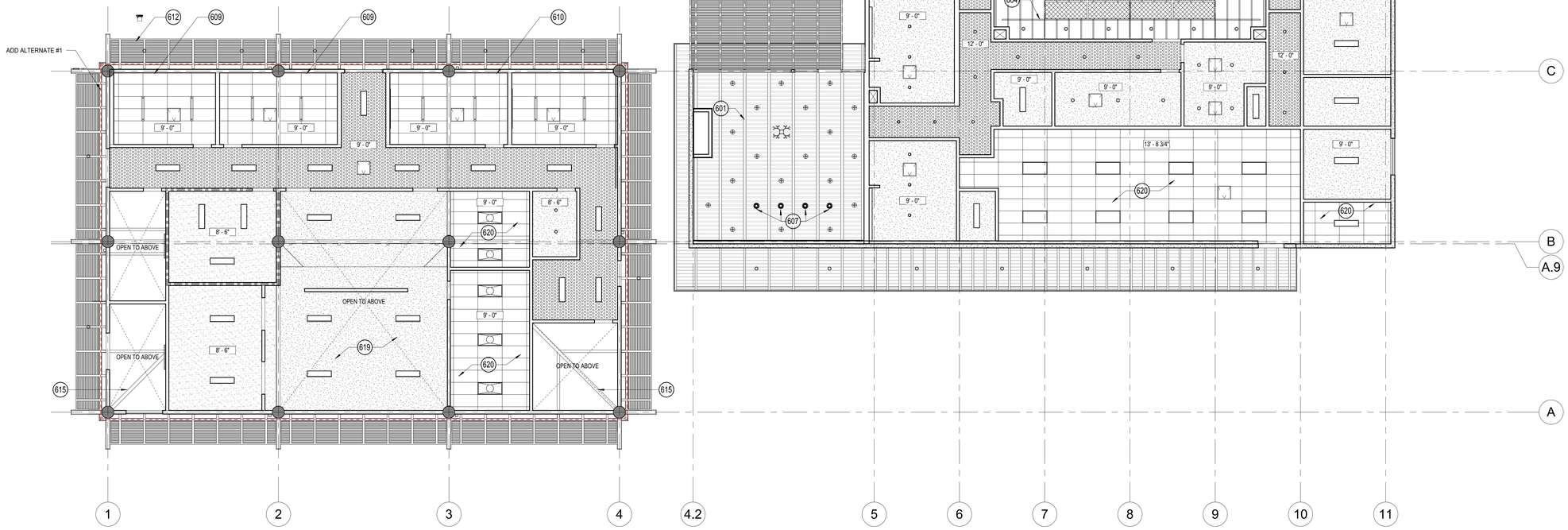
FINISH & SIGNAGE PLAN

A2.1



1 REFLECTED CEILING PLAN

1/8" = 1'-0"

GENERAL NOTES:
ADD ALT. #1 - INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE, STUB OUT FOR UTILITIES

RCP KEYNOTES

601 WOOD BEAM, TYP., S.S.D.
602 WOOD PURLIN, TYP.
603 MOTORIZED DIVIDER, RECESSED BETWEEN BEAMS
604 CURTAIN DIVIDER
605 STONE CLADDING TO MATCH EXTERIOR WALL
606 WOOD COMPOSITE STAL & MTL. FRAME TRELLIS, PTD., S.S.D.
607 NOT USED
608 CEILING FAN, S.M.D.
609 MANUAL ROLLER SHADE AT EACH WINDOW
610 MANUAL DUAL ROLL BLACKOUT & SHEER ROLLER SHADE AT EACH WINDOW
611 MOTORIZED DUAL ROLL BLACKOUT & SHEER ROLLER SHADE WITH ACOUSTIC LAYER, AT ALL FIXED GLAZING IN BANQUET HALL
612 WOOD COMPOSITE SLATS IN (E) MTL TRELLIS FRAME, SEE A7.1
613 T&G WOOD SOFFIT
614 ALUMINUM COMPOSITE PANEL SOFFIT, PTD.
615 (E) ROOF FRAMING, TYP.
616 PROJECTION SCREEN, SEE AV REPORT
617 CEILING MOUNTED PROJECTOR, SEE AV REPORT
618 RETURN AIR REGISTER, S.M.D.
619 50% OF CEILING TREATED W/ GLUE-ON SANITARY-TYPE ACOUSTICAL PANEL - SEE ACOUSTICAL REPORT
620 SANITARY TYPE ACOUSTICAL PANEL, SEE ACOUSTICAL REPORT
9' - 0" CEILING HEIGHT A.F.F.

SURFACE MOUNTED FIXTURE
RECESSED FIXTURE
SUSPENDED FIXTURE
LINEAR FIXTURE
DECORATIVE PENDANT FIXTURE
DECORATIVE PENDANT FIXTURE
PENDANT FIXTURE
SURFACE MTD FIXTURE

WOOD PLANK DECKING, 25% OPEN W/ 1" BLACK FACED DUCT LINER MAT ABOVE
SUSPENDED ACOUSTIC TILE CEILING
GWB CEILING, PTD.
PERFORATED ACOUSTICAL GWB CEILING, SEE ACOUSTICAL REPORT
ACOUSTICAL CLOUD DIFFUSER, SEE ACOUSTICAL REPORT
OPEN TO ABOVE

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

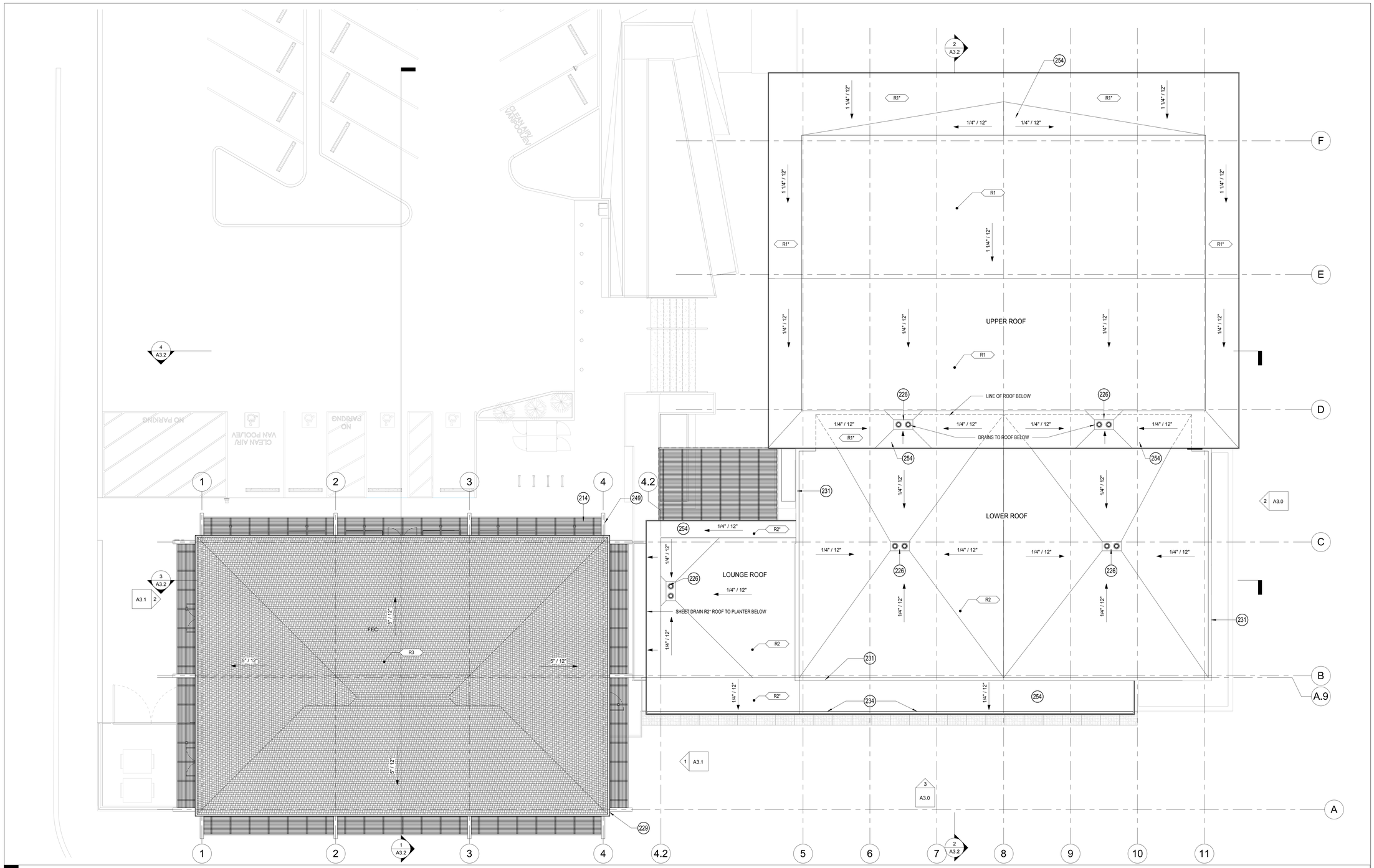
plot date: 12/1/2017 5:02:44 PM

scale: as noted

date:

REFLECTED CEILING PLAN

A2.2



1 ROOF PLAN 1/8" = 1'-0"

ROOF ASSEMBLIES KEYNOTES

R1 — JONAS CENTER
BANQUET HALL ROOF:
GLULAM BEAM (S.S.D.)
4X10 PURLIN (S.S.D.)
2X6 DECKING, 25% OPEN
ACOUSTIC MAT
5/8" PLYWOOD SHEATHING
R-30 (6") RIGID INSULATION BTW NAILER
*OMIT INSULATION @ ROOF OVERHANG, USE PLYWOOD CRICKETS TO CREATE POSITIVE DRAINAGE
COVER BOARD
TPO ROOFING

R2 — JONAS CENTER
FLAT ROOF:
GYP BOARD
18" WOOD I-JOISTS @ 24" O.C.
5/8" PLYWOOD SHEATHING
R-30 (6") RIGID INSULATION BTW NAILER
*OMIT INSULATION @ ROOF OVERHANG, USE PLYWOOD CRICKETS TO CREATE POSITIVE DRAINAGE
COVER BOARD
TPO ROOFING

R3 — BLDG 18
PITCHED ROOF:
(E) GLULAM BEAM
(E) 2X6 T&G
(E) PLYWOOD SHEATHING
(E) R-30 (1 LAYER LAMINATED NAIL BOARD WITH INTERGRAL 3" POLYISO INSULATION OVER 2" RIGID POLYISO INSULATION)
(E) ASPHALT SHINGLE ROOF

FLOOR PLAN KEYNOTES 1/4" = 1'-0"

201 ROOF OVERHANG
202 CURTAIN DIVIDER
203 MOTORIZED ROLLED FABRIC OR PANEL DIVIDER ABOVE
204 GAS FIREPLACE
205 PLANTING AREA, S.L.D.
206 COMMERCIAL WASHER
207 COMMERCIAL DRYER
208 BIKE PARKING - PROVIDE (4) 2 BIKE CAPACITY RACKS & (2) SECURE STAFF SPACES, S.L.D.
209 GABION WALL, S.L.D.
210 DRINKING FOUNTAIN, S.P.D.
211 DISPLAY AREA FOR ROTARY CLUB
212 ACCESSIBLE PARKING STALLS, TYP.
213 STEEL BOLLARDS, PTD., S.L.D.
214 TRELLIS (ABOVE), SEE TRELLIS DETAILS ON SHEET A7.1
215 CONC. WHEEL STOP, TYP., S.C.D.
216 CONCRETE RETAINING WALL, S.L.D., S.C.D.
217 WOOD COMPOSITE CLAD STEEL FRAME ENCLOSURE & SWING GATE
218 PORTABLE BEVERAGE FURNITURE, N.I.C.
219 MTL. GUARDRAIL, S.L.D.
220 STAINLESS STEEL HANDRAIL, S.L.D.
221 COMPOSITE BENCH, S.L.D.
222 CONC. STAIR, S.C.D., S.L.D.
223 MOP SINK, SEE KITCHEN PLANS
224 NOT USED
225 GREASE INTERCEPTOR, S.P.D.
226 ROOF DRAIN
227 CONC. PAD FOR MECH EQUIPMENT, S.M.D.
228 BUILT IN BENCH
229 (E) DOWNSPOUT
230 FIRE SPRINKLER RISER, S.P.D.
231 PARAPET
232 TRUNCATED DOMES, S.C.D., S.L.D.
233 EV CHARGING STATION, S.E.D.
234 CONCEALED GUTTER W / DOWNSPOUTS
235 PORTABLE PLANTER, TYP., S.L.D.
236 WALKWAY, S.L.D., S.C.D.
237 UTILITY SINK, S.P.D.
238 P-LAM COUNTER
239 MONITOR, S.E.D.
240 LOUVER, S.M.D.
241 (E) NON-ACCESSIBLE WALKWAY
242 (E) CONC. COLUMN, SEAL, TYP.
243 CASEWORK
244 STAINLESS STEEL GUARDRAIL
245 RECESSED MTL ENTRANCE GRATE
246 SEALED CONCRETE COLUMN
247 AUDIO VISUAL EQUIPMENT RACK, SEE AV REPORT
248 WOOD HANDRAIL, TYP.
249 (E) GLULAM BEAM
250 LINEAR FLOOR DIFFUSER, S.M.D.
251 CONCRETE WALKWAY, ADD ALTERNATE #2
252 SEISMIC GAP BETWEEN (E) BLDG & (N) CONSTRUCTION
253 CORNER GUARD, TYP.
254 PLYWOOD CRICKET
101 DOOR TAG, SEE A8.0 FOR ADDTL INFO

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

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project number: 16-148.04
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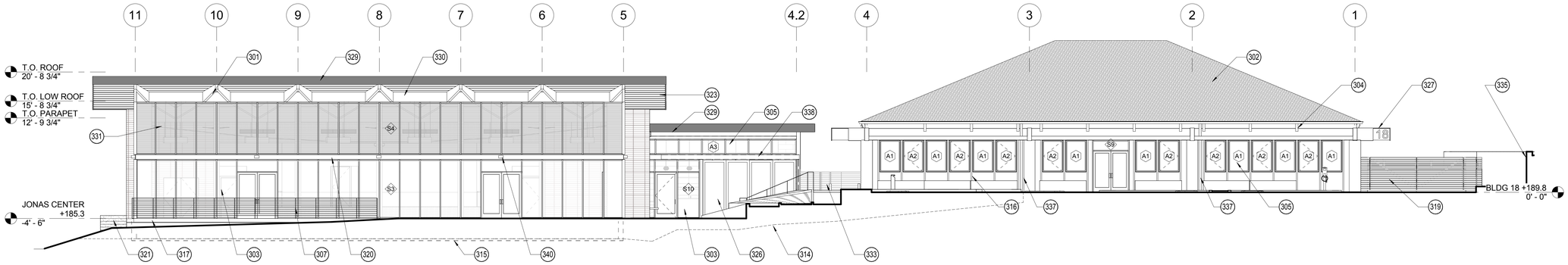
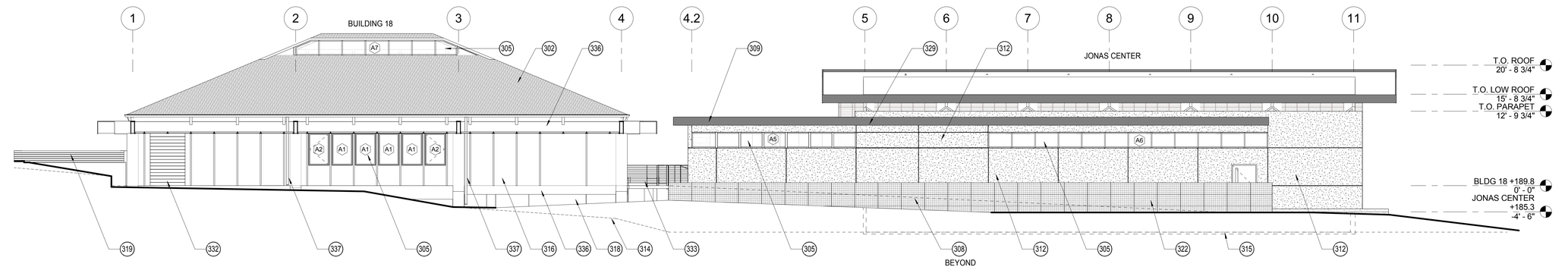
ROOF PLAN

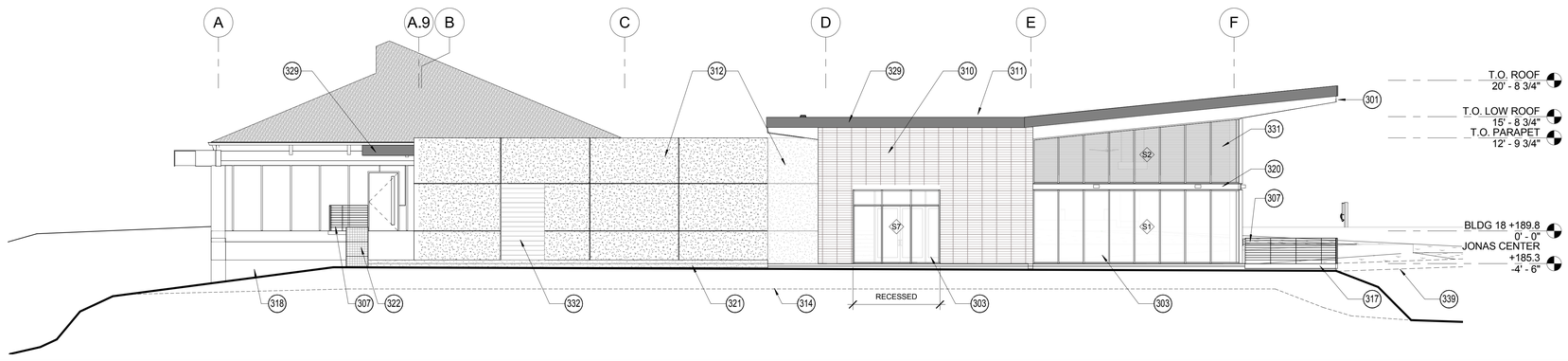
A2.3



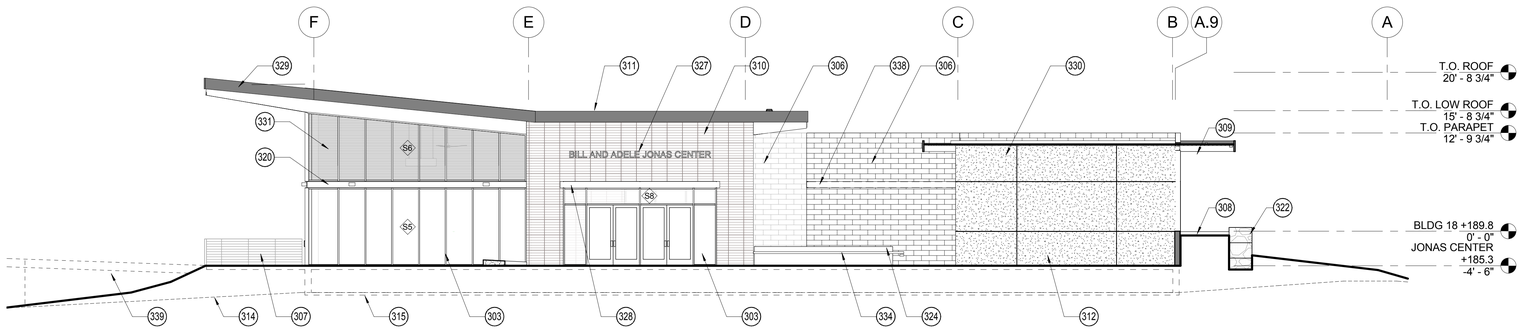
4 NORTH ELEVATION 1/8" = 1'-0"



3 SOUTH ELEVATION 1/8" = 1'-0"



2 EAST ELEVATION 1/8" = 1'-0"



1 WEST ELEVATION 1/8" = 1'-0"

301	WOOD GLULAM BEAM, CLEAR SEALER
302	(E) ASPHALT SHINGLE ROOF, SEE ASSEMBLIES ON SHEET A2.3
303	ALUM. STOREFRONT
304	(E) EXTERIOR METAL TRELLIS FRAME, PTD., TYP.
305	ALUMINUM WINDOW
306	PORCELAIN TILE
307	S.S. RAILING, S.L.D.
308	CONCRETE WALKWAY, S.S.D., S.L.D.
309	ROOF OVERHANG
310	STONE CLADDING
311	BUILT UP ROOF, SEE ASSEMBLIES ON SHEET A2.3
312	STUCCO W/ REVEAL JOINT
313	NOT USED
314	APPROX. EXISTING GRADE
315	(E) FOUNDATION BEYOND
316	FIBER CEMENT BOARD W/ WOOD BATTEN, PTD.
317	CONC. SLAB DECK, S.S.D.
318	(E) CRAWLSPACE
319	WOOD COMPOSITE CLAD STEEL FRAME ENCLOSURE & SWING GATE
320	STEEL BEAM, PTD., S.S.D.
321	CONC. PLANTER, S.L.D., S.S.D.
322	GABION WALL, S.L.D.
323	T&G WOOD SOFFIT, CLEAR SEALER
324	PLANTING AREA, S.L.D.
325	NOT USED
326	FOLDING GLASS DOOR
327	ARCHITECTURAL SIGNAGE, S.S. LETTERS, REVERSE HALO ON STAND-OFFS
328	ALUMINUM COMPOSITE PANEL ELEMENT, PTD.
329	MTL FASCIA, PTD.
330	WD BLOCKING BETWEEN BEAMS TO MATCH GLULAM, TYP., S.S.D.
331	INSULATED GLASS WITH INTEGRAL WOOD SOLAR GRID (OKALUX)
332	MECHANICAL LOUVER, PTD, S.M.D.
333	NOT USED
334	COMPOSITE BENCH, S.L.D.
335	CONC. RETAINING WALL, S.L.D., S.C.D.
336	(E) GLULAM STRUCTURE
337	(E) DOWNSPOUT, PTD.
338	EXTERIOR MTL TRELLIS FRAME, PTD. W/ WOOD COMPOSITE SLATS
339	FUTURE FOOTBRIDGE TO PARKING LOT, N.I.C.
340	LIGHT FIXTURE, S.E.D.

S1 STOREFRONT TAG - SEE A8.0 FOR ADDTL INFO

A2 WINDOW TAG - SEE A8.0 FOR ADDTL INFO

F2 ASSEMBLY TAG - SEE A2.0 FOR ASSEMBLIES

ELEVATION KEYNOTES 1/4" = 1'-0"

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COLLEGE OF MARIN IVC
JONAS CENTER
& BLDG 18
ALTERATIONS

indian valley campus, novato ca
project number: 16-148.04
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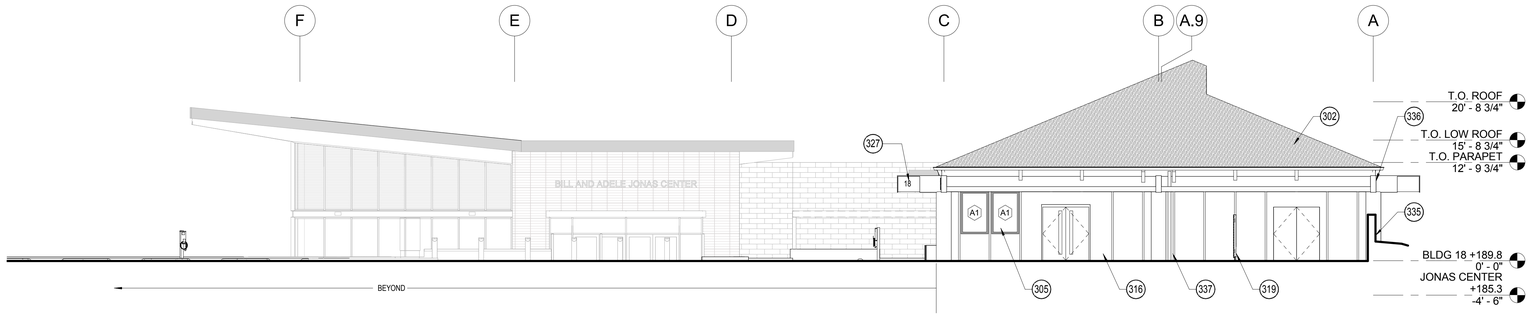
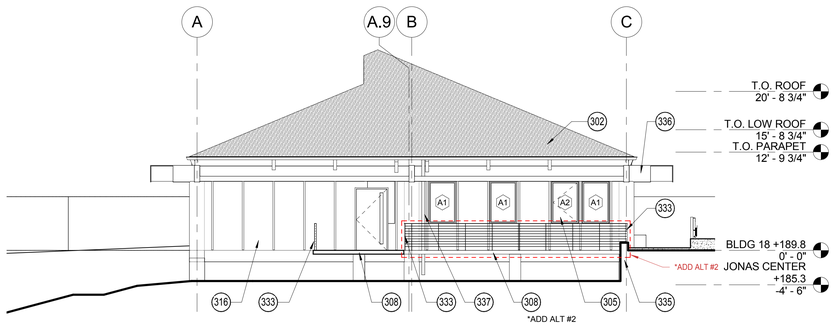
ELEVATIONS

A3.0



2 WEST ELEVATION BLDG 18 1/8" = 1'-0"



1 EAST ELEVATION BLDG 18 1/8" = 1'-0"

ELEVATION KEYNOTES

301	WOOD GLULAM BEAM, CLEAR SEALER
302	(E) ASPHALT SHINGLE ROOF, SEE ASSEMBLIES ON SHEET A2.3
303	ALUM. STOREFRONT
304	(E) EXTERIOR METAL TRELLIS FRAME, PTD., TYP.
305	ALUMINUM WINDOW
306	PORCELAIN TILE
307	S.S. RAILING, S.L.D.
308	CONCRETE WALKWAY, S.S.D., S.L.D.
309	ROOF OVERHANG
310	STONE CLADDING
311	BUILT UP ROOF, SEE ASSEMBLIES ON SHEET A2.3
312	STUCCO W/ REVEAL JOINT
313	NOT USED
314	APPROX. EXISTING GRADE
315	(E) FOUNDATION BEYOND
316	FIBER CEMENT BOARD W/ WOOD BATTEN, PTD.
317	CONC. SLAB DECK, S.S.D.
318	(E) CRAWLSPACE
319	WOOD COMPOSITE CLAD STEEL FRAME ENCLOSURE & SWING GATE
320	STEEL BEAM, PTD., S.S.D.
321	CONC. PLANTER, S.L.D., S.S.D.
322	GABION WALL, S.L.D.
323	T&G WOOD SOFFIT, CLEAR SEALER
324	PLANTING AREA, S.L.D.
325	NOT USED
326	FOLDING GLASS DOOR
327	ARCHITECTURAL SIGNAGE, S.S. LETTERS, REVERSE HALO ON STAND-OFFS
328	ALUMINUM COMPOSITE PANEL ELEMENT, PTD.
329	MTL FASCIA, PTD.
330	WD BLOCKING BETWEEN BEAMS TO MATCH GLULAM, TYP., S.S.D.
331	INSULATED GLASS WITH INTEGRAL WOOD SOLAR GRID (OKALUX)
332	MECHANICAL LOUVER, PTD, S.M.D.
333	NOT USED
334	COMPOSITE BENCH, S.L.D.
335	CONC. RETAINING WALL, S.L.D., S.C.D.
336	(E) GLULAM STRUCTURE
337	(E) DOWNSPOUT, PTD.
338	EXTERIOR MTL TRELLIS FRAME, PTD. W/ WOOD COMPOSITE SLATS
339	FUTURE FOOTBRIDGE TO PARKING LOT, N.I.C.
340	LIGHT FIXTURE, S.E.D.

S1 STOREFRONT TAG - SEE A8.0 FOR ADDTL INFO

A2 WINDOW TAG - SEE A8.0 FOR ADDTL INFO

F2 ASSEMBLY TAG - SEE A2.0 FOR ASSEMBLIES

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

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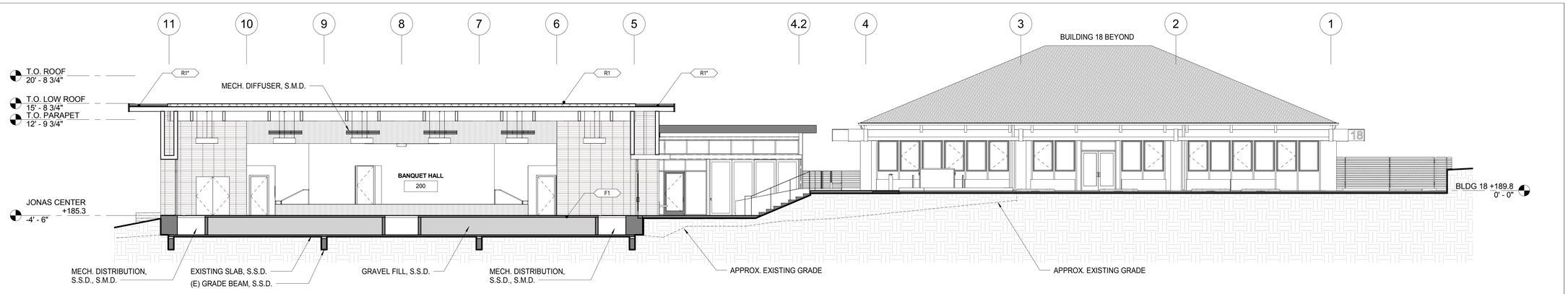
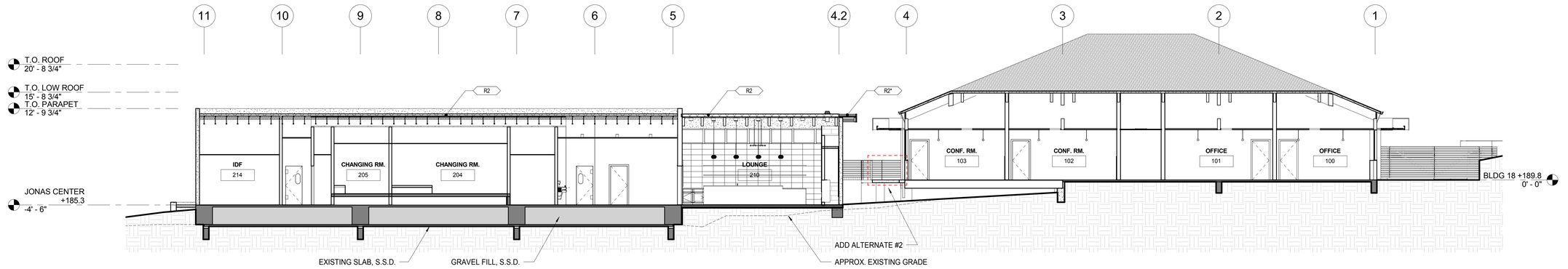
ELEVATIONS

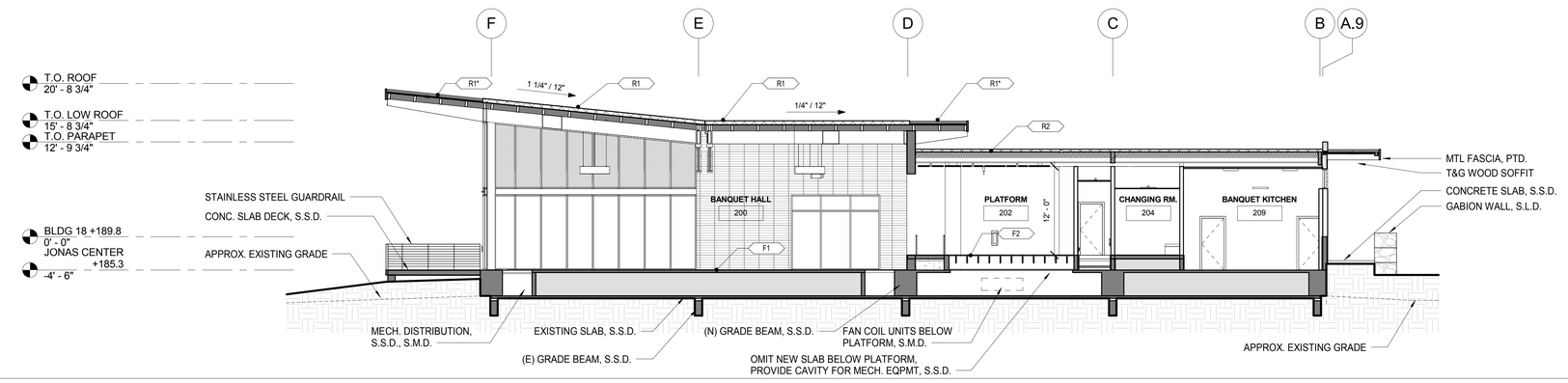
A3.1



4 SECTION AT BANQUET 1/8" = 1'-0"



3 SECTION AT LOUNGE 1/8" = 1'-0"



2 SECTION AT PLATFORM 1/8" = 1'-0"

GENERAL NOTES:

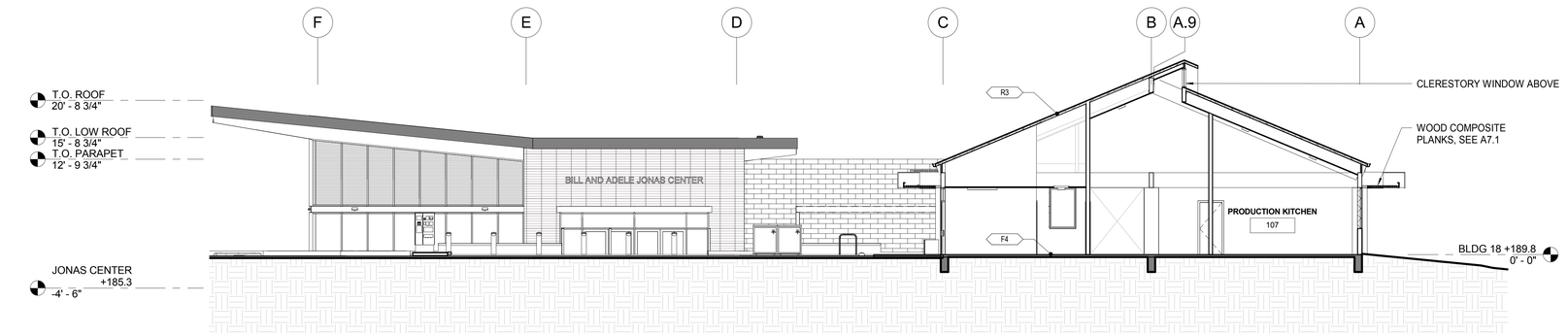
1. REFER TO A2.0 - A2.3 FOR FLOOR, WALL, AND CEILING ASSEMBLIES

R1 JONAS CENTER — BANQUET HALL ROOF:
GLULAM BEAM (S.S.D.)
4X10 PURLIN (S.S.D.)
2X6 DECKING, 25% OPEN
ACOUSTIC MAT
5/8" PLYWOOD SHEATHING
R-30 (6") RIGID INSULATION BTW NAILER
*OMIT INSULATION @ ROOF OVERHANG, USE
PLYWOOD CRICKETS TO CREATE POSITIVE DRAINAGE
COVER BOARD
TPO ROOFING

R2 JONAS CENTER — FLAT ROOF:
GYP BOARD
18" WOOD I-JOISTS @ 24" O.C.
5/8" PLYWOOD SHEATHING
R-30 (6") RIGID INSULATION BTW NAILER
*OMIT INSULATION @ ROOF OVERHANG, USE
PLYWOOD CRICKETS TO CREATE POSITIVE DRAINAGE
COVER BOARD
TPO ROOFING

R3 BLDG 18 — PITCHED ROOF:
(E) GLULAM BEAM
(E) 2X6 T&G
(E) PLYWOOD SHEATHING
(E) R-30 (1 LAYER LAMINATED NAIL BOARD WITH
INTERGRAL 3" POLYISO INSULATION OVER 2" RIGID
POLYISO INSULATION)
(E) ASPHALT SHINGLE ROOF

ROOF ASSEMBLIES KEYNOTES 1/4" = 1'-0"



1 SECTION AT BLDG 18 1/8" = 1'-0"

F1 JONAS CENTER — NEW RAISED FLOOR:
SEE A2.2 FOR FINISHES
CONCRETE SLAB, S.S.D.
2" RIGID INSULATION BELOW SLAB

F2 JONAS CENTER — PATFORM FLOOR:
ENGINEERED WOOD FLOORING
2" GYPCRETE
2X12 JOISTS, S.S.D.

R-30 BATT INSULATION IN CAVITY

SECONDARY CEILING JOISTS,
DISCONNECTED FROM ASSEMBLY ABOVE
2 LAYERS OF GYB BD
2" DUCT LINER PINNED TO CEILING

F3 BLDG 18 — (E) WOOD FLOOR (SEE 1/A0.1 FOR LOCATION):
SEE A2.1 FOR FINISHES
(E) WOOD FRAMING + WOOD DECK
R-11 BATT INSULATION BELOW FLOOR ASSEMBLY

F4 BLDG 18 — (E) CONCRETE FLOOR (SEE 1/A0.1 FOR LOCATION):
SEE A2.1 FOR FINISHES
(E) SLAB ON GRADE

FINISH ASSEMBLIES KEYNOTES 1/4" = 1'-0"

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COLLEGE OF MARIN IVC
JONAS CENTER
& BLDG 18
ALTERATIONS

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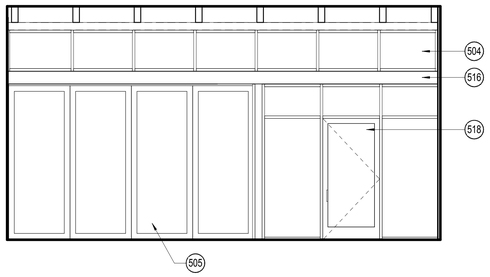
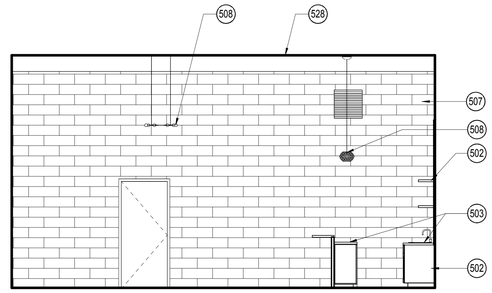
SECTIONS

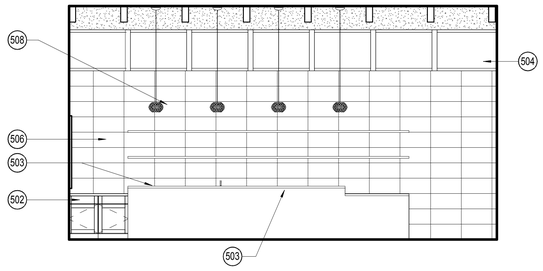
A3.2



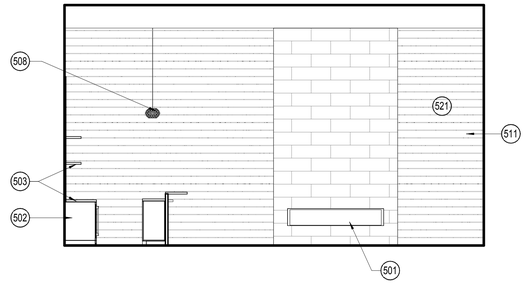
5 INTERIOR ELEVATION LOUNGE 1/4" = 1'-0"



3 INTERIOR ELEVATION LOUNGE 1/4" = 1'-0"



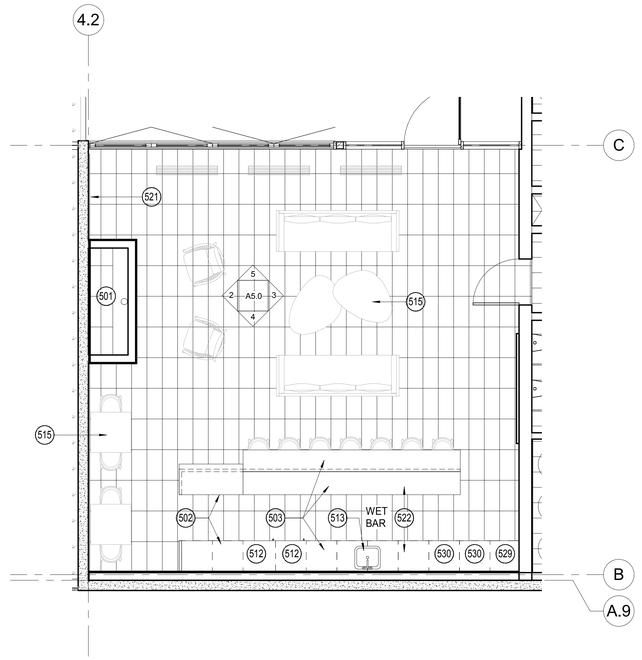
4 INTERIOR ELEVATION LOUNGE 1/4" = 1'-0"



2 INTERIOR ELEVATION LOUNGE 1/4" = 1'-0"

501	STONE CLAD GAS FIREPLACE	517	CONC. COLUMN, SEALED, TYP., S.S.D.
502	CASEWORK (50% OF LOUNGE CASEWORK TO BE LOCKABLE)	518	STOREFRONT SYSTEM, SEE STOREFRONT SCHEDULE
503	SOLID SURFACE COUNTERTOP	519	GLULAM BEAM, S.S.D.
504	ALUMINUM WINDOW, TYP.	520	MTL TRUSS, S.S.D., PTD.
505	FOLDING GLASS DOOR	521	DISPLAY AREA
506	CERAMIC TILE	522	WET BAR KITCHEN SUPPLY STANDARD METAL UNDER COUNTER EQUIPMENT
507	PORCELAIN TILE	523	MOTORIZED DUAL ROLL BLACKOUT AND SHEER ROLLER SHADE AT ALL FIXT. GLAZING IN BANQUET HALL, U.O.N., PROVIDE FINISH PANEL @ ANGLED GLAZING TO COVER GAP
508	PENDANT LIGHT FIXTURE, S.E.D.	524	MOTORIZED DIVIDER RECESSED BETWEEN BEAMS
509	STONE CLADDING	525	WOOD HANDRAIL, CLEAR SEAL, TYP.
510	PLATFORM W/ WOOD FLOORING	526	LINEAR DIFFUSERS, TYP., S.M.D.
511	WOOD SIDING TO MATCH T&G WOOD CEILING	527	CEILING MOUNT PROJECTOR
512	UNDERCOUNTER WINE FRIDGE	528	SURFACE MOUNTED LIGHT FIXTURE, SEE AV REPORT
513	SINK, S.P.D.	529	ICE MACHINE
514	CEILING FAN	530	BACKBAR REFRIGERATOR
515	FURNITURE N.I.C., TYP.	531	SOUND ABSORBING PANEL, 50% OF WALL AREA, SEE ACOUSTICAL REPORT
516	STEEL BEAM HEADER, PTD., S.S.D.		

INTERIOR ELEVATION LEGEND



1 ENLARGED PLAN - LOUNGE 1/4" = 1'-0"

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

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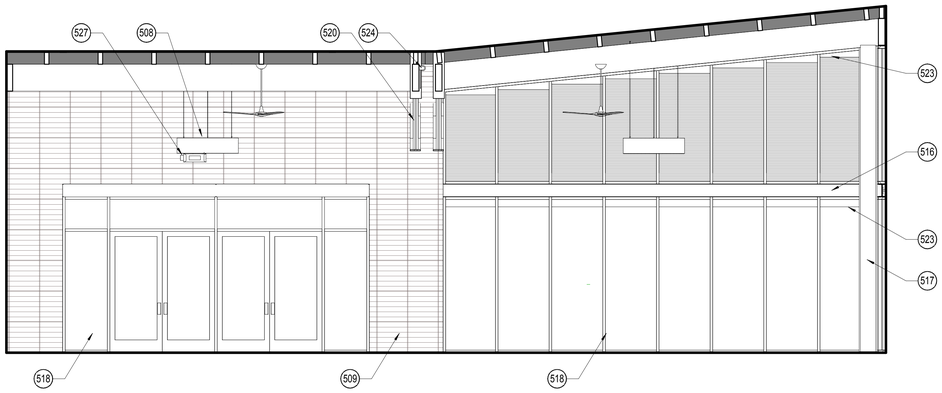
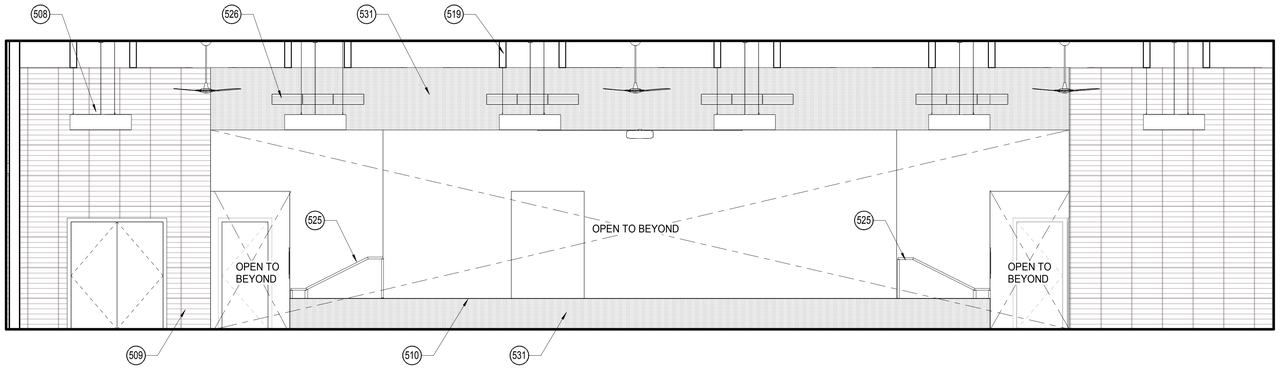
INTERIOR ELEVATIONS LOUNGE

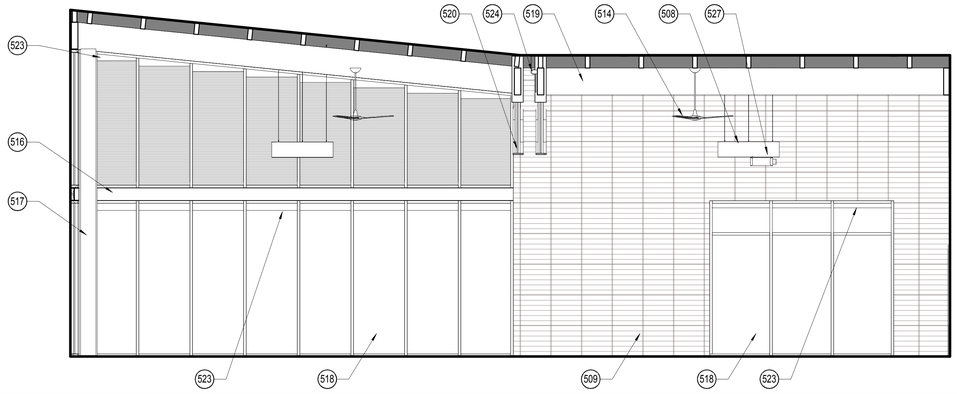
A5.0



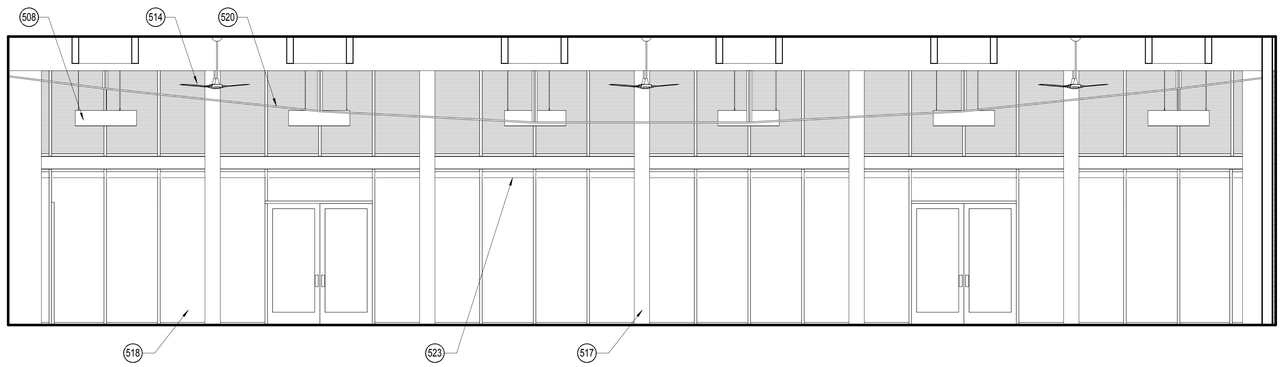
4 INTERIOR ELEVATION BANQUET HALL - D 1/4" = 1'-0"



3 INTERIOR ELEVATION BANQUET HALL - C 1/4" = 1'-0"



2 INTERIOR ELEVATION BANQUET HALL - B 1/4" = 1'-0"



1 INTERIOR ELEVATION BANQUET HALL - A 1/4" = 1'-0"

501	STONE CLAD GAS FIREPLACE
502	CASEWORK (50% OF LOUNGE CASEWORK TO BE LOCKABLE)
503	SOLID SURFACE COUNTERTOP
504	ALUMINUM WINDOW, TYP.
505	FOLDING GLASS DOOR
506	CERAMIC TILE
507	PORCELAIN TILE
508	PENDANT LIGHT FIXTURE, S.E.D.
509	STONE CLADDING
510	PLATFORM W/ WOOD FLOORING
511	WOOD SIDING TO MATCH T&G WOOD CEILING
512	UNDERCOUNTER WINE FRIDGE
513	SINK, S.P.D.
514	CEILING FAN
515	FURNITURE N.I.C., TYP.
516	STEEL BEAM HEADER, PTD., S.S.D.
517	CONC. COLUMN, SEALED, TYP., S.S.D.
518	STOREFRONT SYSTEM, SEE STOREFRONT SCHEDULE
519	GLULAM BEAM, S.S.D.
520	MTL TRUSS, S.S.D., PTD.
521	DISPLAY AREA
522	WET BAR KITCHEN SUPPLY STANDARD METAL UNDER COUNTER EQUIPMENT
523	MOTORIZED DUAL ROLL BLACKOUT AND SHEER ROLLER SHADE AT ALL FIXT. GLAZING IN BANQUET HALL, U.O.N., PROVIDE FINISH PANEL @ ANGLED GLAZING TO COVER GAP
524	MOTORIZED DIVIDER RECESSED BETWEEN BEAMS
525	WOOD HANDRAIL, CLEAR SEAL, TYP.
526	LINEAR DIFFUSERS, TYP., S.M.D.
527	CEILING MOUNT PROJECTOR
528	SURFACE MOUNTED LIGHT FIXTURE, SEE AV REPORT
529	ICE MACHINE
530	BACKBAR REFRIGERATOR
531	SOUND ABSORBING PANEL, 50% OF WALL AREA, SEE ACOUSTICAL REPORT

INTERIOR ELEVATION LEGEND

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

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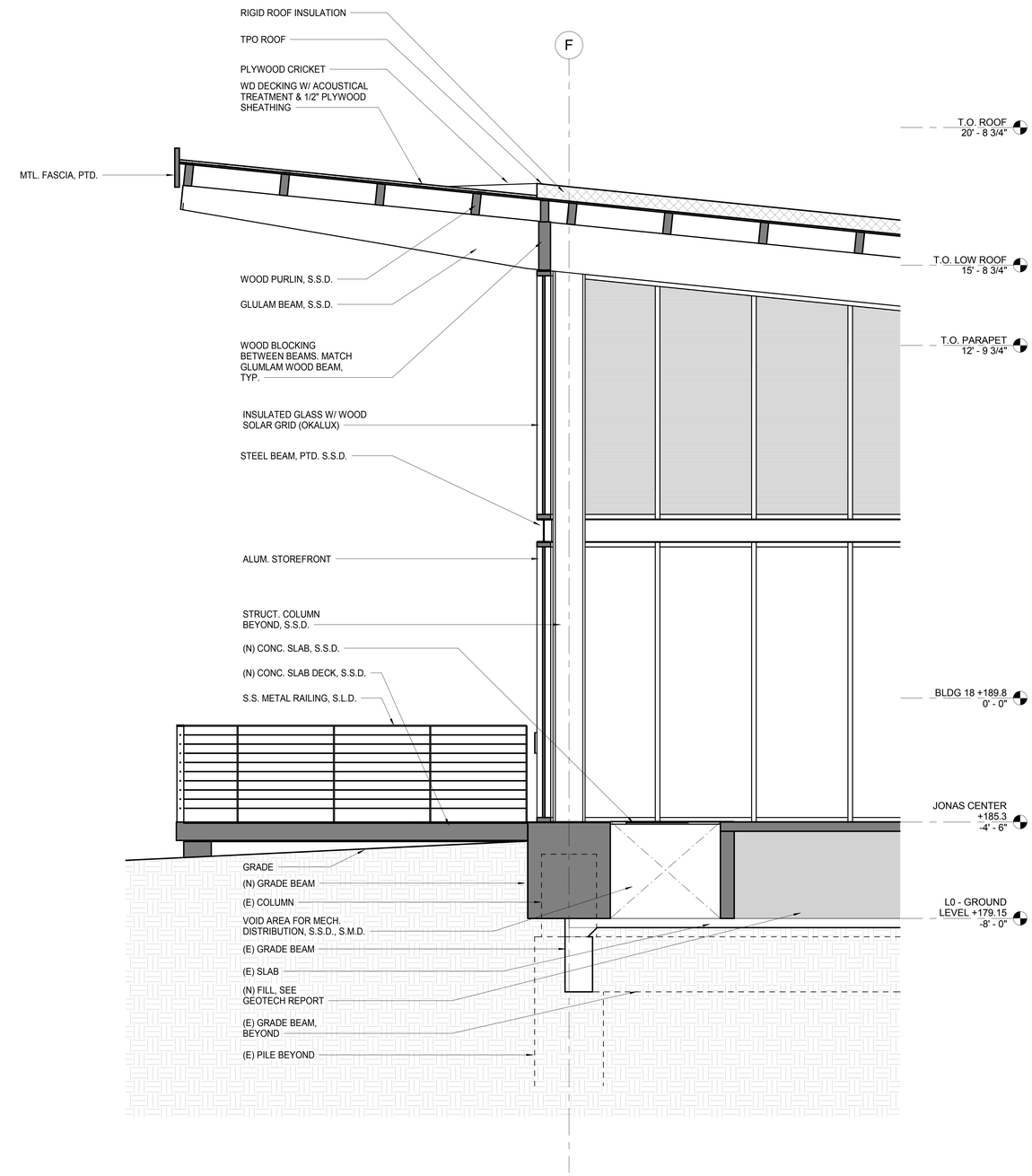
INTERIOR ELEVATIONS BANQUET HALL

A5.1



1 ENLARGED SECTION AT BANQUET HALL NORTH 1/2" = 1'-0"

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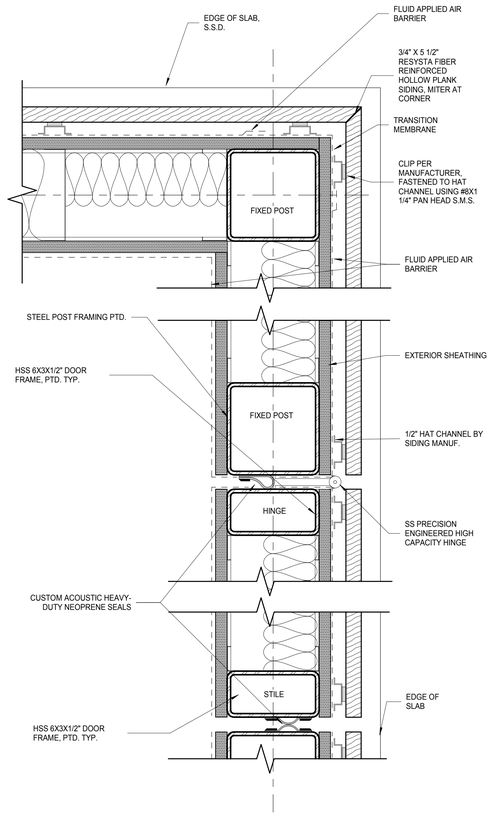
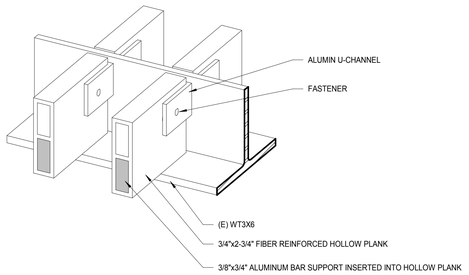
WALL SECTIONS

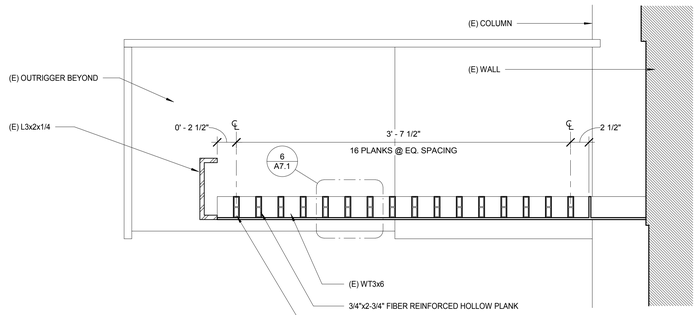
A7.0



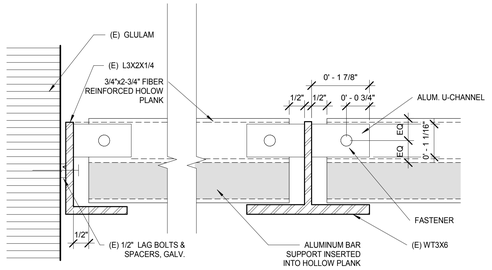
3 TRASH ENCLOSURE CORNER DETAIL 3" = 1'-0"



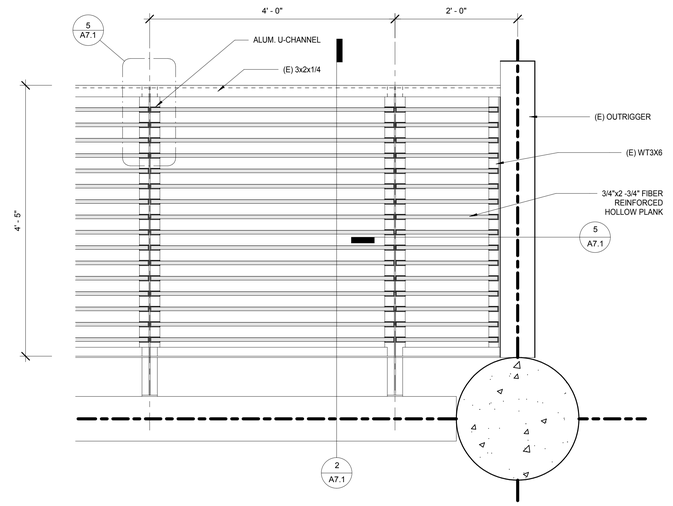
6 TRELLIS AXON 1" = 1'-0"



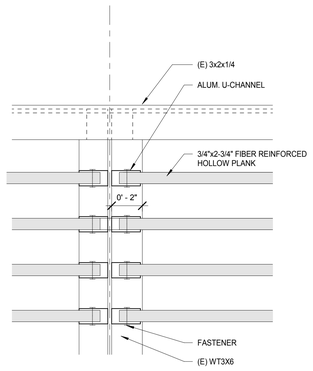
2 NEW TRELLIS FIBER REIFORCED HOLLOW PLANK INFILL 1 1/2" = 1'-0"



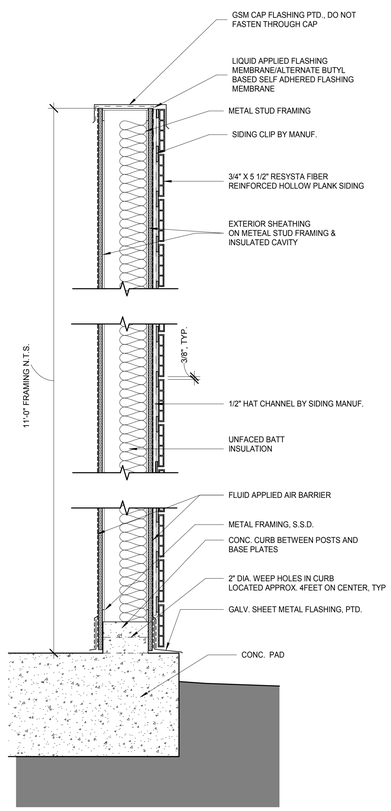
5 TRELLIS DETAIL AT INTERMEDIATE SUPPORT 6" = 1'-0"



1 TRELLIS DETAIL 1" = 1'-0"



4 TRELLIS DETAIL ENLARGED 3" = 1'-0"



7 TRASH ENCOSURE SECTION DETAIL 1 1/2" = 1'-0"

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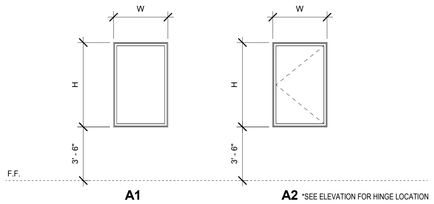
TRELLIS & ENCLOSURE DETAILS

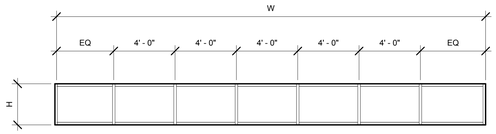
A7.1

WINDOW SCHEDULE		
MARK	H	W
A1	5' - 6"	3' - 7"
A2	5' - 6"	3' - 7"
A3	2' - 8"	28' - 11"
A5	2' - 8"	28' - 7"
A6	2' - 8"	48' - 1"
A7	3' - 11"	35' - 2"



A1

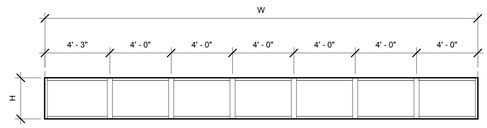
A2 *SEE ELEVATION FOR HINGE LOCATION



A3

NOT USED

A3, A4



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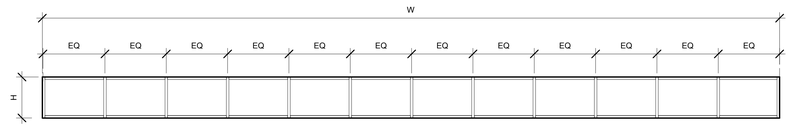
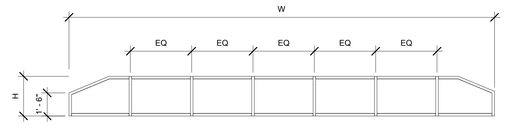


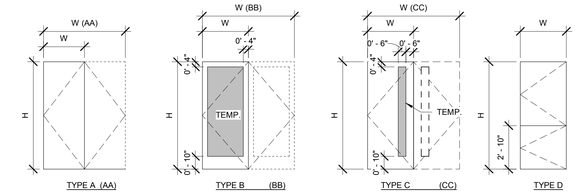
A6

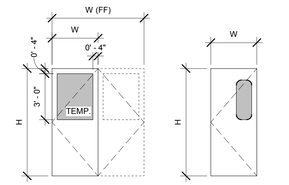


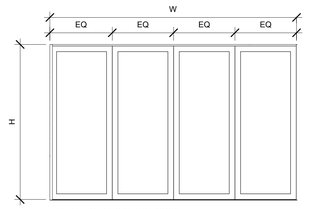
A7

WINDOW LEGEND

DOOR SCHEDULE												
Door No.	Room	Type	Width	Height	Thickness	Hardware Group	Door Material	Door Finish	Frame Material	Frame Finish	Fire Rating	Comments
100	OFFICE	E	3' - 0"	7' - 0"	0' - 1 3/4"	3	SC	PTD	HM	PTD		
101	OFFICE	E	3' - 0"	7' - 0"	0' - 1 3/4"	3	SC	PTD	HM	PTD		
102	CONF. RM.	E	3' - 0"	7' - 0"	0' - 1 3/4"	3	SC	PTD	HM	PTD		
103	CONF. RM.	E	3' - 0"	7' - 0"	0' - 1 3/4"	3	SC	PTD	HM	PTD		
104	ELEC	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	HM	PTD	HM	PTD		
105	MECH	AA	6' - 0"	7' - 0"	0' - 1 3/4"	5	HM	PTD	HM	PTD		
106	LAUNDRY	C	3' - 6"	7' - 0"	0' - 1 3/4"	2	HM	PTD	HM	PTD	45 MIN.	1HR WALL ASSEMBLY
107A	PRODUCTION KITCHEN	F	4' - 0"	7' - 0"	0' - 1 3/4"	2	HM	PTD	HM	PTD		
107B	PRODUCTION KITCHEN	F	4' - 0"	7' - 0"	0' - 1 3/4"	2	HM	PTD	HM	PTD		
111	DRY STORAGE	A	3' - 0"	7' - 0"	0' - 1 3/4"	4	SC	PTD	HM	PTD		
112A	HALLWAY	BB	6' - 0"	7' - 1"	0' - 1 3/4"	1	AL/GL	AL	SF	AL		
112B	HALLWAY	CC	6' - 0"	7' - 0"	0' - 1 3/4"	1	HM	PTD	HM	PTD		
113	UNISEX RESTROOM	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD.	HM	PTD		
115	STORAGE	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
200A	BANQUET HALL	BB	6' - 10"	7' - 11"	0' - 1 3/4"	1	AL/GL	AL	SF	AL		
200B	BANQUET HALL	BB	6' - 10"	7' - 11"	0' - 1 3/4"	1	AL/GL	AL	SF	AL		
200C	BANQUET HALL	BB	6' - 10"	7' - 11"	0' - 1 3/4"	1	AL/GL	AL	SF	AL		
200D	BANQUET HALL	BB	6' - 10"	7' - 11"	0' - 1 3/4"	1	AL/GL	AL	SF	AL		
201	COAT ROOM	D	3' - 0"	7' - 0"	0' - 1 3/4"	6	SC	PTD	HM	PTD		
203	STORAGE	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
204	CHANGING RM.	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
205	CHANGING RM.	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
206	WOMEN'S	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
207	MEN'S	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
208	JAN. CLOS.	A	3' - 0"	7' - 0"	0' - 1 3/4"	8	SC	PTD	HM	PTD		
209A	BANQUET KITCHEN	F	3' - 0"	7' - 0"	0' - 1 3/4"	9	MFR	MFR	HM	PTD		
209B	BANQUET KITCHEN	F	3' - 0"	7' - 0"	0' - 1 3/4"	9	MFR	MFR	HM	PTD		
209C	BANQUET KITCHEN	C	4' - 0"	8' - 0"	0' - 1 3/4"	10	HM	PTD	HM	PTD		
210A	LOUNGE	G	4' - 0"	10' - 0"	0' - 1 3/4"	MFR	AL/GL	AL	SF	AL		
210B	LOUNGE	B	3' - 8"	7' - 11"	0' - 1 3/4"	1.1	AL/GL	AL	SF	AL		
210C	LOUNGE	A	3' - 0"	7' - 0"	0' - 1 3/4"	3	SC	PTD	HM	PTD		
211	DRY STORAGE	A	3' - 0"	7' - 0"	0' - 1 3/4"	4	SC	PTD	HM	PTD		
212	MECH	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	HM	PTD	HM	PTD		
213	ELECT.	AA	6' - 0"	7' - 0"	0' - 1 3/4"	2	HM	PTD	HM	PTD		
214	IDF	A	3' - 0"	7' - 0"	0' - 1 3/4"	2	SC	PTD	HM	PTD		
215	STORAGE	A	6' - 0"	7' - 0"	0' - 1 3/4"	11	HM	PTD	HM	PTD		
216	HALLWAY	A	3' - 0"	7' - 0"	0' - 1 3/4"	7	SC	PTD	HM	PTD		STC 40 MIN.
217	HALLWAY	A	3' - 0"	7' - 0"	0' - 1 3/4"	7	SC	PTD	HM	PTD		STC 40 MIN.
G1		SEE ELEV.	16' - 0"	6' - 0"	0' - 3"	12	STL. & COMPOSITE WD.	PTD	STL.	PTD.		







TYPE G - FOLDING GLASS DOOR

1 DOOR LEGEND

ABBREVIATIONS

AL	CLEAR ANNODIZED ALUMINUM
CD	COIL DOOR
CW	CURTAINWALL
FAC	FACTORY FINISH
GALV	GALVANIZED
GL	GLASS
HI	HIGH IMPACT DOORS (TRAFFIC DOORS)
HM	HOLLOW METAL
MFR	MANUFACTURER
PGW	PAINT GRADE WOOD
PTD	PAINTED
SC	SOLID CORE WOOD
SF	STOREFRONT
SS	STAINLESS STEEL
ST	STEEL
STN	STAINED
WD	WOOD
WV	WOOD VENEER

GENERAL NOTES

1. SEE FLOOR PLANS FOR DOOR SYMBOL REFERENCES.
2. ALL EXTERIOR DOORS TO HAVE METAL THRESHOLDS
3. ALL HOLLOW METAL DOOR FRAMES TO BE PAINTED TO MATCH ADJACENT SURFACE
4. A PERMANENT LABEL SHALL IDENTIFY REQUIRED SAFETY GLAZING (I.E. TEMPERED) INSTALLED IN THE FOLLOWING LOCATIONS: A) WITHIN 24" OF EITHER SIDE OF ANY DOOR; (B) GREATER THAN 9 SQ.FT. IN AREA WITH BOTTOM EDGES LESS THAN 18" ABOVE (AND HORIZONTALLY WITHIN 36") OF A WALKING SURFACE; (C) LITES IN DOOR PANELS. CBC 2406.3 AND 2406.4
5. ALL WOOD DOORS SHALL BE SOLID CORE PER CBC 708A.3, PAINT GRADE.
6. PER CBC 704A.3.2.3, NEW EXTERIOR DOORS OR DOOR REPLACEMENTS 1) MUST BE APPROVED NON-COMBUSTIBLE CONSTRUCTION OR SOLID WOOD HAVING STILES AND RAILS NOT LESS THAN 1 3/4 INCHES THICK AND INTERIOR FIELD PANELS NOT LESS THAN 1 1/4 INCHES THICK OR 2) 20 MIN. FIRE RESISTANCE RATED ASSEMBLY OR 3) CONFORM TO PERFORMANCE STANDARDS OF SFM A5-7A-1.

2 GENERAL NOTES DOORS

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JONAS CENTER & BLDG 18 ALTERATIONS

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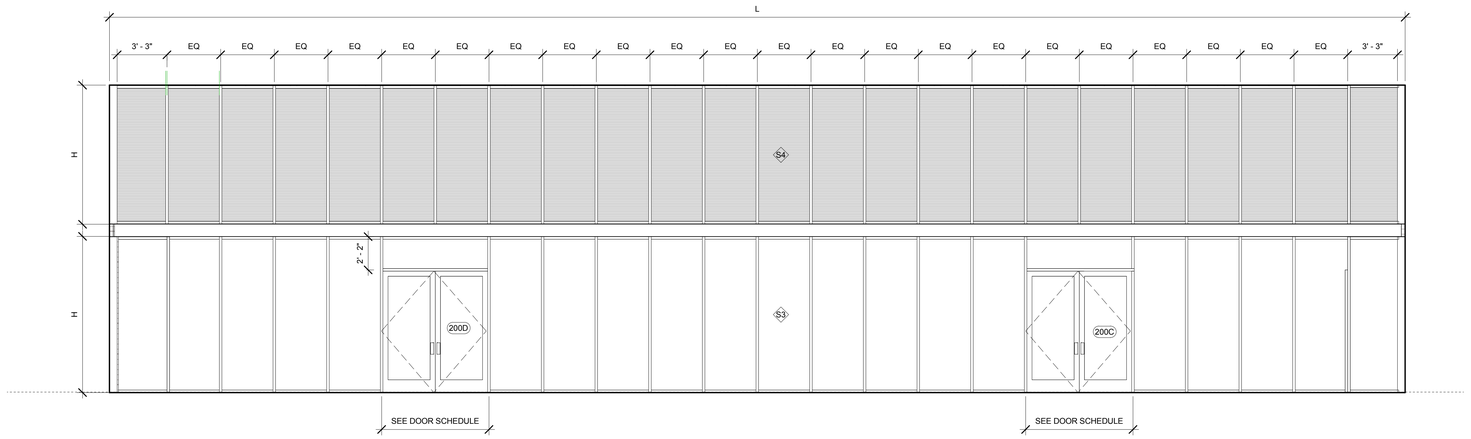
DOOR & WINDOW SCHEDULES

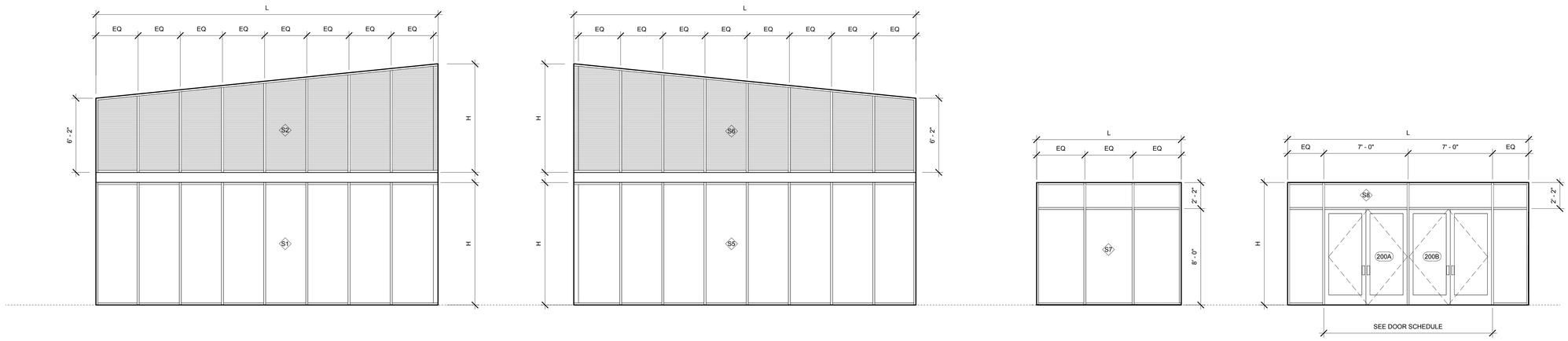
A8.0

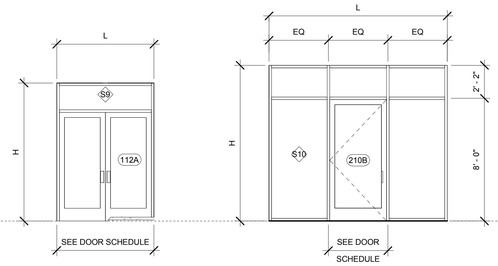


STOREFRONT SCHEDULE		
MARK	H	L
S1	10' - 2"	28' - 11"
S2	9' - 0"	28' - 11"
S3	10' - 2"	84' - 6"
S4	9' - 0"	84' - 6"
S5	10' - 2"	28' - 11"
S6	9' - 0"	28' - 11"
S7	10' - 2"	12' - 0"
S8	10' - 2"	20' - 0"
S9	9' - 0"	6' - 4"
S10	10' - 2"	12' - 0"

GENERAL SCHEDULE

GL-1 : PER CBC SECTION 704A.2.2.2, ALL EXTERIOR GLAZING, 1" INSULATED LOW 2 SOLARBAN 60 GLAZING WITH TEMPERED GLAZING ON OUTSIDE PANE PER NOVATO LOCAL ORDINANCE WILDLAND URBAN INTERFACE REQUIREMENTS, U.O.N.





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COLLEGE OF MARIN IVC
JONAS CENTER
& BLDG 18
ALTERATIONS

indian valley campus, novato ca

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STOREFRONT SCHEDULE

A8.1

STRUCTURAL ABBREVIATIONS

A	
A.B.	ANCHOR BOLT
AC	ALASKA CEDAR (WOOD)
ABT	ABOUT
ABV	ABOVE
ADD'L	ADDITIONAL
ADJ.	ADJACENT
ALT.	ALTERNATE
AMP.	AMPLITUDE
AGGR.	AGGREGATE
APPROX.	APPROXIMATE(LY)
ARCH.	ARCHITECT(URE)(URAL)
B	
BD	BOARD
BF	BRACED FRAME
B.F.	BOUNDARY FASTENER
B.L.	BOTTOM LOWER
BLDG	BUILDING
BLK.	BLOCK
BLKG	BLOCKING
BM	BEAM
B.N.	BOUNDARY NAIL(ING)
BOT.	BOTTOM
B.A.	BOTTOM OF
B.A.C.	BOTTOM OF CONCRETE
B.A.F.	BOTTOM OF FOOTING
B.A.S.	BOTTOM OF STEEL
BRG	BEARING
B.S.	BOTH SIDES
BSMT	BASEMENT
B.U.	BOTTOM UPPER
BTWN	BETWEEN
C	
C	CHANNEL (STEEL SHAPE)
CFS	COLD-FORMED STEEL
CIDH	CAST-IN-DRILLED HOLE
C.I.P.	CAST-IN-PLACE
C.J.	CONSTRUCTION JOINT
C.J.P.	COMPLETE JOINT PENETRATION (GROOVE WELD)
CLG	CEILING
CLR	CLEAR, CLEARANCE
C.M.U.	CONCRETE MASONRY UNIT
COL.	COLUMN
COLL.	COLLECTOR
CONC.	CONCRETE
CONN.	CONNECTION
CONST.	CONSTRUCT(ING)(ION)
CONT.	CONTINUOUS
CONTR.	CONTRACT(OR)
CRV'D.	CURVED
C.P.	COMPLETE PENETRATION (WELD)
CST.	CONSTRUCTION
CTR	CENTER, CENTRAL
CTSK	COUNTERSINK
CWT	COUNTERWEIGHT
CVN	CHARPY V-NOTCH
D	
d	PENNY WEIGHT (NAIL)
D2L	NELSON WELDED REBAR
D.B.A.	DEFORMED BAR ANCHOR
DBL	DOUBLE
DEMO.	DEMOLITION
DTL	DETAIL
DF	DOUGLAS FIR (WOOD)
DIA.	DIAMETER
DIAG.	DIAGONAL
DIM.	DIMENSION
DISCONT.	DISCONTINUOUS
DN	DOWN
DO	DITTO
DP	DEEP
DWG	DRAWING
E	
(E)	EXISTING
EA.	EACH
E.A.	EACH FACE
E.B.	SUCH AS
EL.	ELEVATION
ELEC.	ELECTRICAL
ELEVR	ELEVATOR
E.J.	EXPANSION JOINT
EMBED.	EMBEDMENT
E.N.	EDGE NAIL(ING)
E.O.	EDGE OF
E.O.S.	EDGE OF SLAB
E.P.S.	EXPANDED POLYSTYRENE
EQ.	EQUAL (EQUIVALENT)
EQ. SP.	EQUALLY SPACED
EQUIP.	EQUIPMENT
E.S.	EACH SIDE
E.W.	EACH WAY
E.W.E.F.	EACH WAY, EACH FACE
E/W	EAST/WEST
EXP.	EXPANSION
EXT.	EXTERIOR
F	
FB	FLAT BAR (STEEL SHAPE)
F.D.	FLOOR DRAIN
FDN	FOUNDATION
F.F.	FAR FACE OR FIELD FASTENER
FIN.	FINISH(ED)
FLG.	FLANGE
FLR	FLOOR
F.N.	FIELD NAIL
F.O.	FACE OF
F.O.C.	FACE OF CONCRETE
F.O.S.	FACE OF STUD OR FACE OF STEEL
F.P.	FULL PENETRATION (WELD)
FPRF.	FIREPROOFING
FRMG	FRAMING
F.S.	FAR SIDE
FT	FEET OR FOOT
FTG.	FOOTING
G	
ga	GAUGE
GALV.	GALVANIZED
GAR.	GARAGE
G.B.	GRADE BEAM
G.C.	GENERAL CONTRACTOR
GEN.	GENERAL
GLB	GLUED LAMINATED TIMBER BEAM
GLC	GLUED LAMINATED TIMBER COLUMN
GR.	GRADE
GYP.	GYPSUM
H	
(H), HORIZ.	HORIZONTAL
H.A.	HOLLON CLAY TILE
HD	HOLDOWN
H.D.G.	HOT-DIP GALVANIZED
HDPE	HIGH-DENSITY POLYETHYLENE
HDR.	HEADER
HGR	HANGER
HK	HOOK
H.S.	HEADED STUD OR HIGH STRENGTH (BOLT)
HSS	HOLLON STRUCTURAL SECTION
HT	HEIGHT
I	
I.D.	INSIDE DIAMETER
I.E.	THAT IS, SPECIFICALLY
I.F.	INSIDE FACE
IN.	INCH
INCL.	INCLUDED
INFO.	INFORMATION
INSP.	INSPECTION
INSUL.	INSULATION
INT.	INTERIOR
IRREG.	IRREGULAR
J	
JCT.	JUNCTION
JST	JOIST
JT, JNT	JOINT
K	
K	KIP (1,000 POUNDS)
K.D.	KILN DRIED
KSI	KIPS PER SQUARE INCH
KSF	KIPS PER SQUARE FOOT
L	
L	ANGLE (STEEL SHAPE)
LB.	POUND
LGS	LIGHT-GAUGE STEEL
L.L.B.B.	LONG LEGS BACK TO BACK
L.L.G.	LONG LEG HORIZONTAL
L.L.V.	LONG LEG VERTICAL
LMBR	LUMBER
L.S.	LONG SLOTTED (HOLE)
LSL	LAMINATED STRAND LUMBER
LSLH	LONG SLOTTED (HOLE) W/ LONG AXIS HORIZ.
LSLT.	LONG SLOTTED (HOLE)
LSLV	LONG SLOTTED (HOLE) W/ LONG AXIS VERT.
LTWT	LIGHTWEIGHT
LVL	LEVEL OR LAMINATED VENEER LUMBER
LWC	LIGHTWEIGHT CONCRETE
M	
MANUF.	MANUFACTURER
MATL	MATERIAL
MAX.	MAXIMUM (NO MORE THAN; AT MOST)
M.B.	MACHINE BOLT
MC	MISCELLANEOUS CHANNEL (STEEL SHAPE)
MECH.	MECHANICAL
MEP	MECHANICAL, ELECTRICAL, PLUMBING
MEZZ.	MEZZANINE
MF	MOMENT FRAME
MFR	MANUFACTURER(R)
M.I.	MALLEABLE IRON
MIN.	MINIMUM (NO LESS THAN; AT LEAST)
MISC.	MISCELLANEOUS
MOD.	MODIFY(I)CATION)
MT	MISCELLANEOUS TEE (STEEL SHAPE)
MTL	METAL
N	
N	NORTH
(N)	NEW
N/A	NOT APPLICABLE
N.F.	NEAR FACE
N.I.C.	NOT IN CONTRACT
NO.	NUMBER
NOM.	NOMINAL
NFS	NEAR & FAR SIDE
N.T.S.	NOT TO SCALE
NR	NEAR
N.S.	NEAR SIDE
N/S	NORTH/SOUTH
N.W.	NORMAL WEIGHT
NWC	NORMAL WEIGHT CONCRETE
O	
O/	OVER
O.C.	ON CENTER
O.D.	OUTSIDE DIAMETER
O.F.	OUTSIDE FACE
OG	OPEN GRAIN (REDWOOD)
O.H.	OPPOSITE HAND
OPG	OPENING
OPNG	OPENING
OPP.	OPPOSITE
ORIG.	ORIGINAL
O.S.	OVERSIZED (HOLE)
P	
P.A.F.	POWDER ACTUATED FASTENER(S)
PC, PCS	PIECE, PIECES
PCF	POUNDS PER CUBIC FOOT
PCI	POUNDS PER CUBIC INCH
P.D.	POWDER DRIVEN
P.D.F.	POWDER DRIVEN FASTENER(S)
P.E.F.	(PLYWOOD) PANEL EDGE FASTENER
P.E.N.	(PLYWOOD) PANEL EDGE NAILING
PERF.	PERFORATED
PIPE-X	EXTRA STRONG PIPE
PIPE-XX	DOUBLE EXTRA STRONG PIPE
P.J.P.	PARTIAL JOINT PENETRATION (GROOVE WELD)
PL	PLATE
P.L.	PROPERTY LINE
PLWD.	PLYWOOD
PLYWD	PLYWOOD
P.P.	PARTIAL PENETRATION (WELD)
PREFAB.	PREFABRICATE(D)
PRELIM.	PRELIMINARY
PRESTR.	PRESTRESSED
PREV.	PREVIOUS(LY)
PROJ.	PROJECT(ED)(ING)(ION)
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSL	PARALLEL STRAND LUMBER
PT	POINT
P.T.	POST-TENSION(ED)(ING)
R	
(R)	REUSED
RAD.	RADIUS
RB	ROUND BAR (STEEL SHAPE)
R.C.	REINFORCED CONCRETE
REINF.	REINFORC(ED)(ING)
REBAR	REINFORCING BAR
REF.	REFERENCE
REQ'D	REQUIRED
RET.	RETAINING
REV.	REVIS(E)(ION)
RF	ROOF
RFG	ROOFING
RND	ROUND
R.O.	ROUGH OPENING
RW	REDWOOD
S	
S.A.D.	SEE ARCHITECTURAL DRAWINGS
S.B.	SOLID BLOCKING
S.C.D.	SEE CIVIL DRAWINGS
SCHED.	SCHEDULE
SECT.	SECTION
S.E.D.	SEE ELECTRICAL DRAWINGS
SEP.	SEPARATION
SFHCS	SOCKET FLAT HEAD CAP SCREW
SHT	SHEET
SHTG	SHEATHING
SIM.	SIMILAR
S.L.B.B.	SHORT LEGS BACK TO BACK
S.L.D.	SEE LANDSCAPE DRAWINGS
SLRS	SEISMIC LOAD RESISTING SYSTEM
S.M.D.	SEE MECHANICAL DRAWINGS
S.M.S.	SHEET METAL SCREW
S.O.G.	SLAB ON GRADE
SP	SOUTHERN PINE (WOOD)
SPG.	SPAC(ES)(ING)
S.P.D.	SEE PLUMBING DRAWINGS
SPEC(S).	SPECIFICATION(S)
SQ.	SQUARE
S.S.	STAINLESS STEEL
S.S.	SHORT SLOTTED (HOLE)
SSLT.	SHORT SLOTTED (HOLE)
ST	AMERICAN STANDARD TEE (STEEL SHAPE)
STAG.	STAGGER(ED)
STAGG.	STAGGER(ED)
STD	STANDARD
STFNR.	STIFFENER
STL	STEEL
STRUC.	STRUCTURAL
SUP.	SUPPORT
SUSP.	SUSPENDED
SYM., SYMM.	SYMMETRICAL
T	
T&B	TOP & BOTTOM
T&G	TONGUE & GROOVE
T.B.D.	TO BE DETERMINED
TD	TIE DOWN
THD	THREADED
THK	THICK(NESS)
THRD	THREADED
THRU	THROUGH
T.L.	TOP LOWER
T.N.	TOE NAIL
T.O.	TOP OF
T.O.C.	TOP OF CONCRETE ELEVATION
T.O.F.	TOP OF FOOTING
T.O.S.	TOP OF STEEL
TS	TUBE STEEL
T.U.	TOP UPPER
TYP.	TYPICAL
U	
U.O.N.	UNLESS OTHERWISE NOTED
URM	UNREINFORCED MASONRY
V	
(V), VERT.	VERTICAL
VOL.	VOLUME
V.I.F.	VERIFY IN FIELD
V.M.M.	VERIFY W/ MANUF.
W	
W/	WITH
WD	WOOD
WF	WIDE FLANGE
W.H.	WEB HORIZONTAL
W/IN	WITHIN
WKG	WORKING
W.O.	WHERE OCCURS
W/O	WITHOUT
W.P.	WORK POINT
WPFG	WATERPROOFING
WT	WIDE-FLANGE TEE (STEEL SHAPE)
WT.	WEIGHT
W.W.F.	WELDED WIRE FABRIC
X	
XS	EXTRA STRONG (PIPE)
XXS	DOUBLE EXTRA STRONG (PIPE)

SPECIAL CHARACTERS

&	AND
∠	ANGLE (MEASUREMENT)
@	AT
℄	CENTER LINE
⌀	DIAMETER OR ROUND
//	PARALLEL
⊥	PERPENDICULAR
ℙ	PLATE, PROPERTY LINE
#	POUND OR NUMBER
±	TOLERANCE

OTHER ABBREVIATIONS (PRODUCT ABBREVIATIONS):

FOR WOOD FRAMING FASTENER AND CONNECTOR ABBREVIATIONS, SEE SIMPSON STRONG-TIE WOOD CONSTRUCTION CONNECTORS CATALOG (available at www.strongtie.com).

FOR POWDER-DRIVEN FASTENERS AND CONCRETE ANCHOR ABBREVIATIONS, SEE HILTI NORTH AMERICAN PRODUCT TECHNICAL GUIDE (available at www.us.hilti.com) AND SIMPSON STRONG-TIE ANCHOR SYSTEMS CATALOG (available at www.strongtie.com).

FOR LIGHT-GAUGE STEEL CONNECTOR ABBREVIATIONS, SEE STEEL NETWORK LIGHT STEEL FRAMING CONNECTION CATALOG (available at www.steelnetwork.com) AND SIMPSON STRONG-TIE COLD-FORMED STEEL CONNECTORS CATALOG (available at www.strongtie.com).

FOR ENGINEERED WOOD PRODUCT ABBREVIATIONS, SEE ILEVEL CATALOG (available at www.ilevel.com), LP BUILDING PRODUCTS CATALOG (available at www.lpcorp.com), REDBUILT CATALOG (available at www.redbuilt.com), AND STANDARD STRUCTURES, INC., CATALOG (available at www.standardstructures.com).

"THRD STUD" INDICATES FULL FUSION WELDED STUD PER SPECIFICATION SECTION 05120.

STRUCTURAL DRAWING SHEET INDEX

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NOT FOR CONSTRUCTION

11/21/2017 100% SD

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 2017.016

plot date: 12/1/2017 5:07:59 PM

scale: as noted

date: X-XX-17

STRUCTURAL ABBREVIATIONS & SHEET INDEX

S1.0

STRUCTURAL NOTES

DIVISION 01: GENERAL CONDITIONS

SECTION A: GENERAL REQUIREMENTS

1. These Structural Notes supplement the Project Specifications, and provide design loads and material properties not listed in the Project Specifications.

2. These structural drawings are copyrighted instruments of service of Mar Structural Design (MSD), for sole use for this project.

3. The Structural Drawings show the structural features. Some dimensions and elevations are defined on the Architectural Drawings. See Architectural and other project drawings for finishes, depressions, curbs, openings, inserts and other features that need to be coordinated with these drawings.

4. Bound specifications have been prepared for this project. These notes complement the project specifications that will, among other things, define responsibilities, products, and workmanship issues. Reading these notes without reading the specifications can result in misunderstandings. There is not a one-to-one correspondence between these notes and the specifications, i.e., some numbered sections appear in the notes but not the specifications and vice versa.

5. In the event of conflict between these structural notes, the project specifications and the drawings, consult with the Architect before proceeding.

6. Verify all existing conditions and proposed dimensions at the job site. Compare structural drawings with architectural, mechanical, and electrical and plumbing drawings before commencing work. Notify Architect of any discrepancies and do not proceed with affected work until they are resolved. In the case of conflict between the drawings and the specifications, the most costly option to the Contractor applies unless otherwise expressly allowed by the Architect's response to RFI.

7. Do not scale the drawings to determine dimensions, instead use written dimensions. Where no dimension is provided, consult with the Architect for clarification before proceeding with the work. Where member locations are not specifically dimensioned, members are either located on column lines, or equally spaced between members on column lines or between members otherwise located.

8. Unless otherwise shown or noted, all typical details shall be used where applicable. All details shall be considered typical at similar conditions.

9. Submit shop drawings, design-build calculations, and product data for review as required by specifications prior to fabrication. Do not fabricate prior to receiving review comments. Each shop drawing submittal to the Engineer shall be submitted electronically:
    1. Except for mock-ups, samples, and as otherwise specified, all submittals to be in electronic form (Adobe Portable Document Format).
    2. Submit shop drawings, design-build calculations, and product data for review as required by specifications prior to fabrication. Do not fabricate prior to receiving review comments. In addition submit the following:
        1. Survey of existing column centerlines, wall lines and floor elevations.
        2. Shop drawings and structural calculations for lateral and vertical support of any equipment exceeding 400 pounds.
        3. Penetration plans, using structural drawings as backgrounds, showing the size and location of all slab openings, sleeves, cores and penetrations, including HVAC, electrical, telephone, fire sprinkler, plumbing and any other utilities. This includes pipes or conduits routed through or embedded within structural elements such as beams, slabs or walls.

10. Safety Measures:

    1. Contractor is solely and completely responsible for job site conditions including safety of people and property, and for all necessary independent engineering reviews of these conditions.

    2. Install shoring and bracing of soil, and of existing and new structures, where needed to adequately support imposed vertical and lateral loads. Maintain shoring and bracing until the new structure can support the anticipated loads. Submit shoring calculations by independent engineer for information only.

    3. Engineer's job site visits are not intended to include review of adequacy of Contractor's safety measures.

11. Any openings, holes, cuts or discontinuities not shown on the structural drawings and extending into or through structural elements require Engineer's prior approval and may require special structural detailing.

SECTION B: STRUCTURAL TESTING, INSPECTION, AND OBSERVATION

1. Tests and inspections for all items will be provided as required by California Building Code and all applicable local ordinances.

2. The owner will retain an independent testing agency to perform all required testing and inspections.

3. The Contractor is responsible for coordinating with Owner's Testing Agency and Special Inspector to schedule all required tests and inspections. See specifications for specific items requiring testing and inspection.

4. Structural Observation: In addition to inspection by Special Inspector, Structural Engineer will review construction for general conformance with Structural Drawings. Contractor shall notify Architect and Structural Engineer at least five working days prior to concealing structural elements. Structural Engineer will then determine if a site visit is appropriate. Notification shall include the following items:

    1. Reinforcement, post-tensioning tendons, and embedded items, prior to concrete or shotcrete placement.

    2. Structural framing and shear walls, prior to concealment by fireproofing or finish surfaces.

SECTION C: STRUCTURAL DESIGN BASIS

1. Design is based on the 2013 California Building Code and applicable local ordinances.

2. Design vertical live loads (unfactored loads not including live load reductions):

    1. Jonas Center
        1. Banquet Hall 100 psf (1,000 lbs on 2'-6"x2'-6" area)
        2. All other areas 100 psf (1,000 lbs on 2'-6"x2'-6" area)

    2. Roofs
        1. Ordinary 20 psf (300 lbs on 2'-6"x2'-6" area)
        2. Elevated Platforms 60 psf
        3. Patios & Terraces 100 psf

3. Design lateral loads are based on the following criteria:

    1. Occupancy Category III

    2. Wind
        1. Basic Wind Speed 115 mph (3-second gust)
        2. Exposure Category C
        3. Importance Factor, Iw 1.15
        4. Topographic Factor, Kzt 1.0
        5. Gust effect factor, G 0.85

    3. Seismic
        1. Importance Factor, I 1.25
        2. S-s 1.50g (0.2 sec site specific response)
        3. S-1 0.60g (1.0 sec site specific response)
        4. Site Soil Class D
        5. S-ds 1.00g (0.2 sec site specific response)
        6. S-d1 0.60g (1.0 sec site specific response)
        7. SDC D (Seismic Design Category)
        8. Basic Lateral System:
            1. A.1, Special Reinforced Concrete Shear Walls
            2. A.15, Light-Frame (Wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance
            3. G.3, Cantilevered Column Systems Detailed to Conform to the Requirements for Special Reinforced Concrete Moment Frames
        9. T-a 0.256 sec (Approximate Fundamental Period)
        10. C-s 0.500 g (Seismic Response Coefficient)
        11. R 2.5 (Response Modification Factor)
        12. Design Base Shear 117.6 kips
        13. Analysis Procedure Equivalent Lateral Force Analysis

4. The seismic load resisting system (SLRS) of the structure comprises the following elements described in the drawings:

    1. Cantilever Columns, Shear walls, collectors, and associated connections;

    2. Drilled piers, Grade beams; and

    3. Other elements labeled "COLL" and "SLRS" in the drawings.

SECTION D: DESIGN-BUILD CRITERIA

1. General:

    1. Submit shop drawings and structural calculations for all design-build items, stamped and signed by a California-licensed Civil or Structural Engineer.

2. Design-build metal stairs:

    1. Shall satisfy deflection compatibility with the primary structure under seismic loads, and shall maintain egress function after a code design-basis earthquake. Assume a maximum allowable code drift of 2.0% unless otherwise noted.

3. Cladding and glazing:

    1. Shall accommodate interstory seismic drifts of at least 2.0% without damage that could result in falling hazards or injuries. At half this drift limit, the cladding and glazing must remain weathertight and be substantially free of damage.

    2. Design-build metal stud and mullion out-of-plane deflections shall not exceed L/240 for exterior facades under code minimum design loads, unless designer demonstrates that facade can accommodate greater deflections without loss of watertightness.

4. Interior partitions:

    1. Out-of-plane deflection shall not exceed L/240.

    2. Elevator shaft walls shall be designed for elevator "piston effect" pressures defined by the elevator manufacturer.

5. Mechanical, electrical, plumbing and fire protection systems and equipment:

    1. Contractor is responsible for vertical and lateral support and anchorage of all equipment and utilities, and transfer of such forces back to primary structural elements shown on the structural drawings.

    2. Support and bracing shall be designed to comply with CBC and ASCE 7, Chapter 13.

    3. Lateral seismic design forces on all life-safety systems and equipment shall be increased by an importance factor of 1.50.

    4. Shop drawings and structural calculations shall be submitted for support and bracing of all floor-mounted equipment over 400 pounds and all ceiling-hung equipment over 100 pounds.

    5. Pipes, conduits and ducts: Unless specifically designed by a California-licensed Civil or Structural Engineer, bracing shall conform to Seismic Hazard Level A in SMACNA "Seismic Restraint Manual: Guidelines for Mechanical Systems," most recent edition, except:
        1. Bracing of life-safety systems and components shall be increased by 50% (importance factor = 1.50).
        2. Hangers 12 inches or less in length shall be capable of swaying at least 30 degrees out of plumb in either direction without losing strength, unless augmented by seismic bracing.
        3. Ducts four square feet or greater in cross-sectional area shall be braced.
        4. Pipes:
            1. Brace all pipes containing gas or liquid fuel.
            2. Brace all pipes 1-1/4 inch nominal diameter or greater in boiler, electrical and mechanical rooms.
            3. Brace all other pipes 2-1/2-inch nominal diameter or greater.
            4. Fire sprinkler pipe bracing shall comply with both ASCE 7, Chapter 13, and NFPA 13.

DIVISION 31: EARTHWORK

SECTION 31 60 00: FOUNDATIONS

1. The foundation design is based on a Geotechnical Report prepared by Geosphere Consultants dated August 11, 2017.

2. Except where otherwise shown, excavations shall be made as near as possible to the neat lines required by the size and shape of the structure. Foundations may be poured without the use of side forms where possible. If the trenches cannot stand, fully form sides to dimensions shown.

3. Do not allow water to stand in trenches. If bottoms of trenches become softened due to rain or other water before concrete is cast, excavate softened material and replace with properly compacted backfill or concrete at no cost to the owner.

4. Notify the owner ten days prior to excavation and subgrade preparation work to allow owner to schedule observation by the Geotechnical Engineer. Excavations and subgrade preparation will be observed by the Geotechnical Engineer.

DIVISION 03: CONCRETE

SECTION 03 20 00: REINFORCING STEEL

1. All mild-steel reinforcing steel shall have a minimum yield stress (Fy) of 60 ksi (420 MPa). For additional requirements see Specifications.

2. T-heads:

    1. T1-Head: End anchorage plate with net area at least 4 times reinforcing bar area.

    2. T2-Head: End anchorage plate with net area at least 9 times reinforcing bar area.

    3. T2-heads shall be used unless otherwise noted on the drawings.

    4. See specifications for additional T-head requirements.

3. Anchor Bolts and Rods (unless otherwise noted on the drawings):

    1. Wood Framing:
        1. Typical anchor bolts for wood sills and ledgers: ASTM F1554 Gr. 36, A36 or A307.
        2. Hold down anchor bolts for single-piece hardware such as Simpson HDU or HDQ: ASTM F1554 Gr. 36, A36, or A307.
        3. Hold down anchor rods for multi-story rod systems such as the Simpson Anchor Tiedown System (ATS): ASTM A449, F1554 Gr. 105, or A193 Gr. B7.

    2. Steel Framing:
        1. Anchor rods for typical base plates and steel connections: F1554, Gr. 55.

    3. Nuts and Washers: see Specifications.

4. Concrete Cover: Unless otherwise shown on the drawings, maintain coverage to face of reinforcing bars as follows:

Location	Clear Cover
Cast against earth:	3 in.
Slab-on-grade over earth or VB:	2 in.
Exposed to earth or weather:	
Slabs, Walls	2 in.
Beam ties	(1-1/2 in. for #5 & smaller)
Beam primary reinf.	1-1/2 in.
	1-1/2 in.
Not exposed to earth or weather:	
Slabs, walls, joists	3/4 in.
Beam & column ties	(1 in. for shotcrete)
	1-1/2 in.
Beam & column primary reinf.	1-1/2 in.

Notes:

1. Tolerances per ACI 117, except that clear cover may not be reduced in fire-rated members or assemblies.

5. Pipes, Conduits and Other Embedded Items: See Specifications.

SECTION 03 25 00: CONCRETE AND MASONRY ANCHORS

1. Epoxy dowels in concrete:

    1. Epoxy dowels are not permitted for shear wall holdown or braced frame anchor rods.

    2. Owner's Testing Agency to verify diameter, depth and cleanliness of drilled holes.

    3. Owner's Testing Agency to torque test all epoxy-grouted threaded rods and bolts:

1/2" diam. thrd. rod	20 ft lbs
5/8" diam. thrd. rod	30 ft lbs
3/4" diam. thrd. rod	45 ft lbs
7/8" diam. thrd. rod	60 ft lbs
1" diam. thrd. Rod	80 ft lbs

    4. Owner's Testing Agency to test 25% of the first 100 dowels installed in direct tension to the following values:

#3 bar	5,000	3/8" Thrd. Rod	3,500 #
#4 bar	9,000	1/2" Thrd. Rod	6,000 #
#5 bar	14,000	5/8" Thrd. Rod	9,000 #
#6 bar	20,000	3/4" Thrd. Rod	12,000 #
#7 bar	27,000	7/8" Thrd. Rod	18,000 #
#8 bar	36,000	1" Thrd. Rod	22,000 #

    5. If testing of the first 100 dowels results in a "pass" rate of 95% or better, sampling may be reduced to 10% of the remaining work.

2. Mechanical anchors: Owner's Testing Agency to make periodic inspections during anchor installation to verify anchor type and dimensions, concrete thickness and type (normal weight vs. lightweight), anchor embedment, and adherence to manufacturer's installation instructions.

SECTION 03 30 00: CAST-IN-PLACE CONCRETE

1. Concrete Mix Schedule:

Location	f'c (psi)	Age (days)	Aggr. Type	Aggregate Max. Size (inches)	Max. Portland (lb/cy)	SCM* (%)
Fdn./S.O.G.	3,000	56	Normal	3/4-1.5	200	50-70
CIP Walls	4,000	56	Normal	3/4-1.5	200	50-70
Elevated Slabs	4,000	56	Normal	3/4-1.5	300	30-60
Metal Deck Fill	3,000	56	Ltwt.	3/8-1/2	200	50-70
Shotcrete	4,000	56	Normal	1/2	300	30-60

    * SCM = Supplementary Cementitious Material content, measured as percentage of total cementitious material by weight. See Specifications for further SCM requirements.

2. Water-to-cementitious material (W/CM) ratio not to exceed 0.45. Use water-reducing admixtures as needed.

DIVISION 05: METALS

SECTION 05 12 00: STRUCTURAL STEEL

1. Structural steel wide-flange shapes shall conform to ASTM A913 or ASTM A992 (Fy = 50 ksi). See Specifications for additional requirements for moment frame members and members with flange thickness exceeding 2 inches.

2. Pipe sections shall conform to ASTM A53, Type E or S, Grade B (Fy = 35 ksi). Finish black, except where required to receive hot-dip galvanized coating.

3. Round HSS shall conform to ASTM A500 Grade C (Fy = 46 ksi); ASTM A847 (Fy = 50 ksi) may be substituted.

4. Square or rectangular HSS shall conform to ASTM A500 Grade C (Fy = 50 ksi); ASTM A847 (Fy = 50 ksi) may be substituted.

5. HP sections shall conform to A572 Grade 50.

6. M and S sections shall conform to ASTM A36 (Fy = 36 ksi).

7. Structural steel channels, angles and miscellaneous iron shall conform to ASTM A36 (Fy = 36 ksi); ASTM A572 Grade 50 may be substituted.

8. Non-seismically loaded structural steel plates and bars:

    1. ASTM A36 (Fy = 36 ksi); ASTM A572 Grade 50 may be substituted.

    2. See Specifications for additional requirements where thickness exceeds 2 inches.

9. Seismically loaded structural steel plates and bars:

    1. ASTM A572 Grade 50 meeting minimum notch toughness requirements given in Specifications.

    2. Seismically loaded plates include, but are not limited to, gusset and connection plates in braced frames, splice plates in collectors, continuity plates in moment frames and any other plate designated "SLRS" or "CVN tough" on the drawings.

10. Sheet steel shall conform to ASTM A570 or A606.

11. "Group A" or "A325" indicates a high-strength bolt assembly conforming to ASTM A325 Type 1 or F1852, with ASTM A563 heavy hex nuts and ASTM F436 or F959 Grade 325 washers as required by RCSC. ASTM A325 Type 3 bolts may be substituted only where hot-dip galvanizing is not required.

12. "Group B" or "A490" indicates a high-strength bolt assembly confirming to ASTM A490 or F2280, with ASTM A563 heavy hex nuts and ASTM F436 or F959 Grade 490 washers as required by RCSC.

13. All high-strength bolts shall be fully pretensioned unless otherwise noted. Bolts other than high-strength shall be installed snug-tight.

14. For anchor bolt material specifications, see Section 03 20 00, Reinforcing Steel.

15. Threaded studs and headed shear studs shall conform to AWS D1.1, and shall be carbon steel studs conforming to ASTM A108 Grades 1010 through 1020, unless otherwise noted. Stud bases shall be full-fusion arc welded. Stud welding shall be qualified through tests per AWS D1.1, Section 7.6-7.8. Where stainless steel studs are required by the Notes or Drawings, studs to be post-annealed as required to prevent brittle failure.

SECTION 05 40 00: COLD FORMED METAL FRAMING

1. Steel Studs, Joists, Tracks, and Channels: ASTM A1003.

    1. Grade 33 Type H, for all material 43 mils (18 ga) and thinner.

    2. Grade 50 Type H, for all material 54 mils (16 ga) and thicker.

    3. Zinc coating per ASTM A653, G60 minimum. Touch up abrasions and welds in the field after erection.

    4. Structural section properties to be computed in accordance with AISI S100, and meet or exceed those specified for the corresponding member size in Steel Stud Manufacturers Association (SSMA) Product Technical Information (ICC-ES Report No. ER-4943P).

    5. Provide punched webs for studs.

    6. Bottom and top track gauge to match stud gauge, except that 54-mil (16 ga) tracks may be used at 68- or 97-mil (12 or 14 ga) studs.

    7. Install stud and joist bridging in accordance with manufacturer's recommendations.

2. Straps: ASTM A1003 Grade 50 Class 1 or Class 3.

3. Fasteners:

    1. Screws: ASTM C1513 self-drilling/tapping, installed in accordance with AISI S200 Section D1.

    2. Welds: fillet, plug, butt or seam and made in accordance with AWS D1.3, "Structural Welding Code - Steel Sheet," and AISI S200 Section D2. Stitch-weld double vertical studs with 1/16" groove welds, 1" long at 12" on center, at both flanges unless otherwise noted. Welding is only permitted on material 43 mil (18 ga) and thicker. Electrodes to be E6X or E7X unless otherwise noted.

    3. Bottom tracks at non-bearing walls to be attached to concrete with powder-driven fastener pins with 0.145-inch minimum shank diameter and 1-1/4-inch minimum embedment at 24 inches on center staggered, unless otherwise noted.

4. Unless a larger gap is shown on the drawings, non-bearing walls shall allow at least plus or minus 3/8-inch vertical movement between floors, or between floor and roof, by use of nested top tracks or top tracks with vertical slots for screws.

5. Attach joist rim tabs or support clips to hard side of joist unless otherwise noted. Align joists, rafters and trusses with wall studs in accordance with AISI S200 section C1.

6. Corrugated Sheathing: Shallow Vercor deck as manufactured by Verco: ASTM A1003 Grade 50 Type H, with zinc coating per ASTM A653, G90 minimum.

DIVISION 06: WOOD

SECTION 06 10 00: ROUGH CARPENTRY

1. Wood connector call-outs on the Drawings refer to Simpson Strong-Tie Connectors unless otherwise noted. See Specifications regarding possible substitution of other manufacturer's connectors may only be used if approved as an equal or better substitution, substantiated by evaluation service reports and Simpson-equivalent reference numbers and labels. Unless otherwise shown on the Drawings:

    1. Fill all fastener holes with the maximum number, diameter and length of fasteners (nails, bolts, etc.).

    2. For straps where manufacturer offers nailed or bolted alternatives, install nails.

2. All machine bolts through wood shall be ASTM A307, installed through holes 1/16 inch larger than diameter of bolt. Provide washers under all bolt heads and nuts bearing on wood. Provide malleable iron washers (ASTM A47) unless otherwise shown on the drawings. Provide standard steel cut washers (ASTM F844) only where specifically allowed on the drawings.

3. All wood and wood products in contact with concrete or masonry shall be pressure-treated.

4. Corrosion-resistant fasteners and washers shall be used where exposed to weather or soil, or in contact with pressure-preservative-treated or fire-retardant-treated wood. Refer to the Specifications for additional requirements.

SECTION 06 11 00: FRAMING LUMBER

1. All framing lumber shall be Douglas Fir-Larch graded per WCLIB Grading Rules. All lumber shall be surfaced dry (SD, MC 19 or less) or kiln dried (KD, MC 19 or less), except that heavy timber posts may be surfaced green. Plywood edge nail spacing in surfaced green posts shall be decreased by one third (i.e., number of nails increased 50%). MC = Maximum moisture content at initial use, in percent.

2. Grading:

Item	Sizes	Grade
Studs	2x4	No. 2 or Stud
Studs	Other 2x, 3x	No. 2
Studs & Posts	4x	No. 1
Posts & Timbers	6x, 8x	No. 1
Sill & Top Plates	2x	No. 1 or Construction
Sill & Top Plates	3x, 4x	No. 1 or Construction
Beams	3x, 4x	No. 1
Beams & Stringers	6x, 8x	No. 1
Floor Joists	2x	No. 2
Roof Joists	2x	No. 2
T & G Decking	Any	Select
Ledgers	2x	No. 2
Ledgers	3x, 4x, 6x	No. 1
Blocking & Nailers	2x	Construction
Blocking & Nailers	3x, 4x, 6x	Construction
Plates & Misc.	2x	No. 2 or Construction

3. See Project Specifications and Drawings for bridging and blocking requirements.

4. Refer to minimum fastening schedule in CBC Table 2304.10.1, except where more restrictive requirements are given on the drawings.

SECTION 06 12 00: WOOD STRUCTURAL PANELS: PLYWOOD AND ORIENTED STRAND BOARD (OSB)

1. Roof sheathing to be 1/2" nominal (15/32" actual) APA-rated sheathing, Exposure 1, with span rating of 32/16 unless otherwise noted on the drawings.

2. Floor sheathing to be 3/4" nominal (23/32" actual) APA-rated Sturd-I-Floor, Exposure 1, with span rating of 24 OC, or 3/4" nominal (23/32" actual) APA-rated T&G Sheathing, Exposure 1, with span rating of 48/24, unless otherwise noted on the drawings. Tongue and groove edges may be omitted where edges are blocked.

3. Wall sheathing to be 1/2" actual (15/32" nominal) APA-rated Structural I, Exposure 1, with span rating of 32/16, unless otherwise noted on the drawings.

SECTION 06 17 20: STRUCTURAL COMPOSITE LUMBER

1. Laminated Strand Lumber (LSL) to meet or exceed grade 1.5E (Fb = 2,250 psi; Fv = 400 psi; E = 1,500,000 psi). Products:

    1. Timberstrand LSL by Weyerhaeuser,

    2. LP SolidStart LSL by Louisiana-Pacific Corp., or

    3. Approved equal or better substitution.

2. Laminated Veneer Lumber (LVL) to meet or exceed grade 1.9E (Fb = 2,600 psi; Fv = 285 psi; E = 1,900,000 psi). Products:

    1. Microllam LVL by Weyerhaeuser,

    2. Versalam LVL by Boise Cascade,

    3. RedLam LVL by RedBuilt,

    4. LP SolidStart LVL by Louisiana-Pacific Corp., or

    5. Approved equal or better substitution.

3. Parallel Strand Lumber (PSL) to meet or exceed grade 2.0E (Fb = 2,900 psi; Fv = 290 psi; E = 2,000,000 psi). Product: Parallam PSL by Weyerhaeuser or approved equal or better substitution.

SECTION 06 17 50: ENGINEERED WOOD I-JOISTS

1. All prefabricated wood I-joists to be Red-I by RedBuilt, SSI by Standard Structures, Inc., TJI by Weyerhaeuser, or an approved equal or better substitution conforming to ASTM D5055.

2. I-joist manufacturer to supply all bridging, blocking, rim boards, squash blocks, and web stiffeners as shown on the drawings, as required by the Specifications, and as required for a proper installation.

SECTION 06 18 50: STRUCTURAL GLUED LAMINATED TIMBER (GLULAM)

1. Glulam Beam (GLB) Species and Combinations:

Loc'n Type	Span	Combination and Species	Fbx bott. (psi)	Fbx top (psi)	Fvx (psi)	Ex (psi)	Camber radius (ft)
Int.	Simple	24F-V4 (DF)	2,400	1,850	265	1,800,000	3,500
Int.	Multiple*	24F-V8 (DF)	2,400	2,400	265	1,800,000	None

    * Multiple = beams continuous over supports or with cantilevers.

2. Special high-strength GLB, labeled "30F-E2" on the drawings, to be manufactured from Southern Pine to meet or exceed Fbx = 3,000 psi top and bottom; Fvx = 270 psi; Ex = 2,000,000 psi.

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11/21/2017 100% SD

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 2017.016

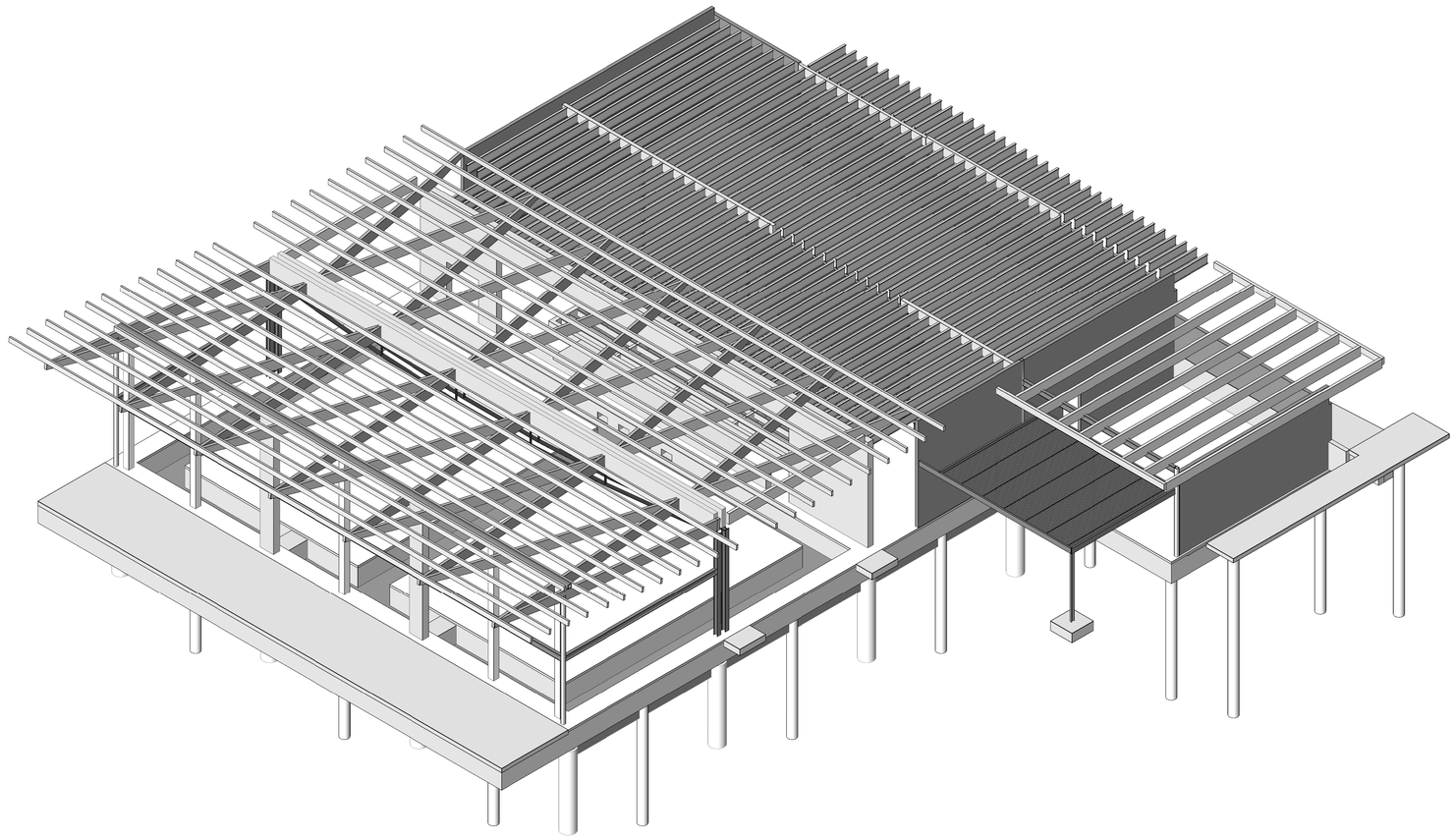
plot date: 12/1/2017 5:08:01 PM

scale: as noted

date: X-XX-17

GENERAL NOTES

S1.1



1 S1.2 ISOMETRIC VIEW

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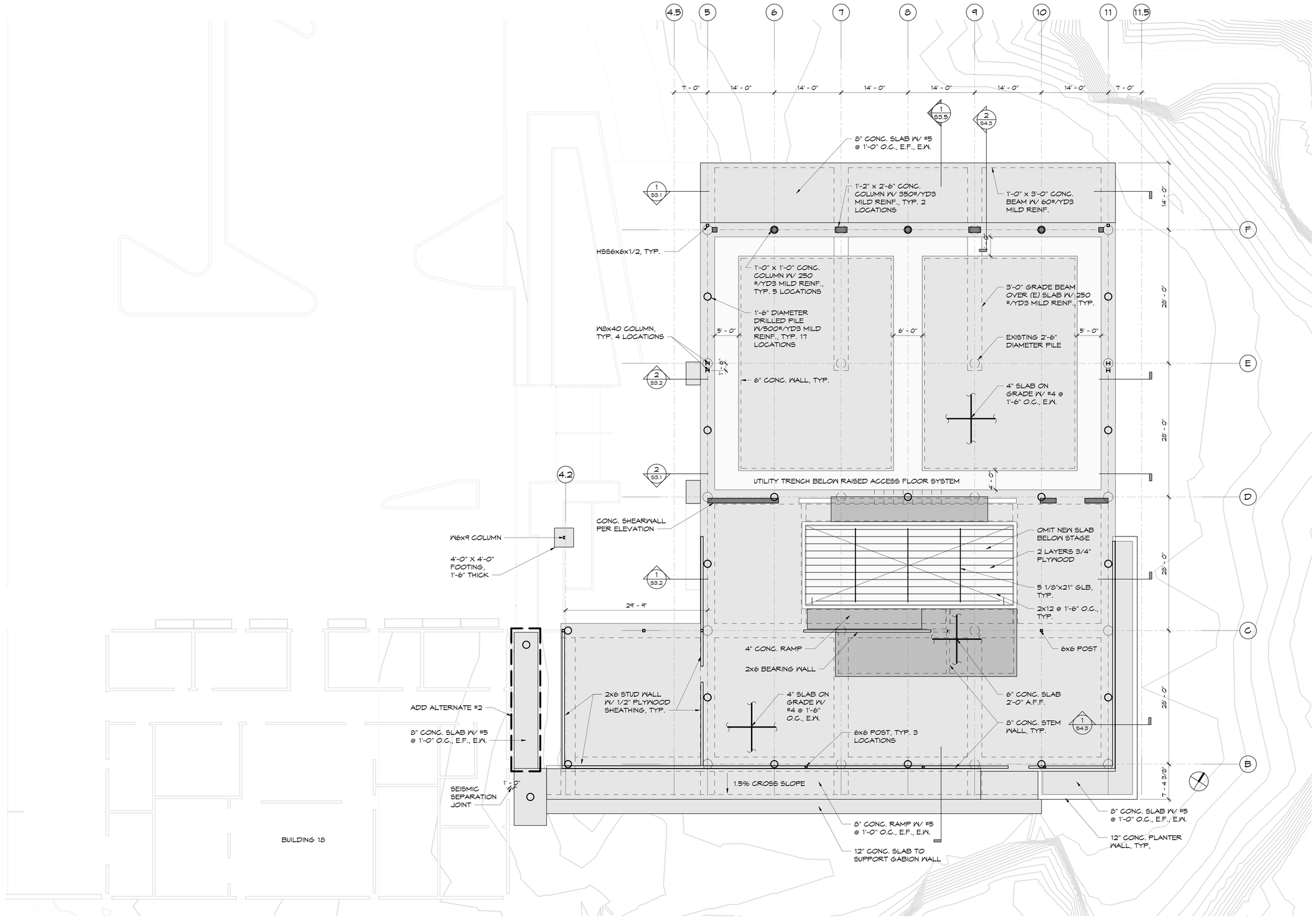
date: X-XX-17

ISOMETRIC VIEW

S1.2



1 S2.0 FLOOR PLAN
1/8" = 1'-0"

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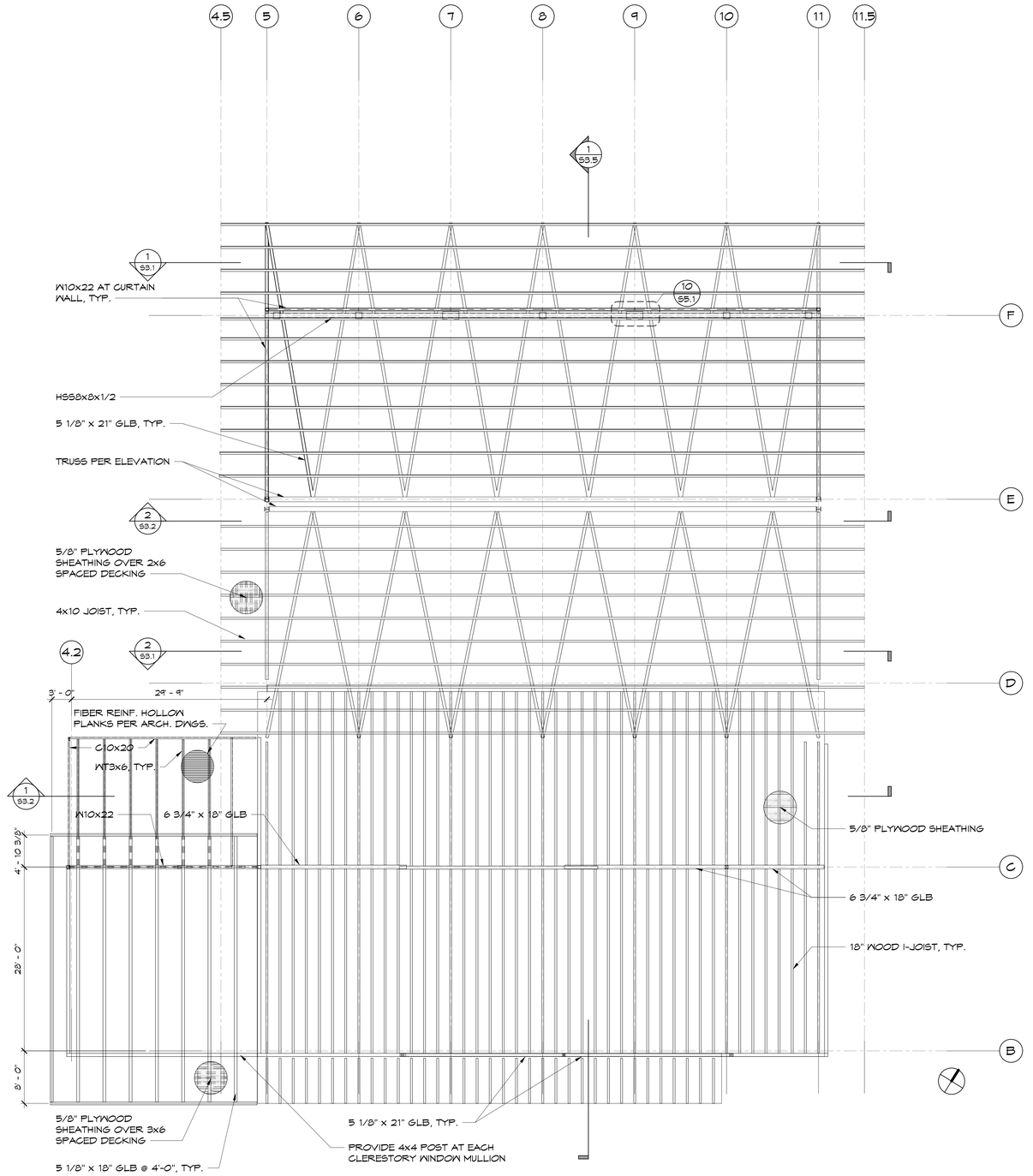
FLOOR PLAN

S2.0



1 S2.1 ROOF PLAN

1/8" = 1'-0"

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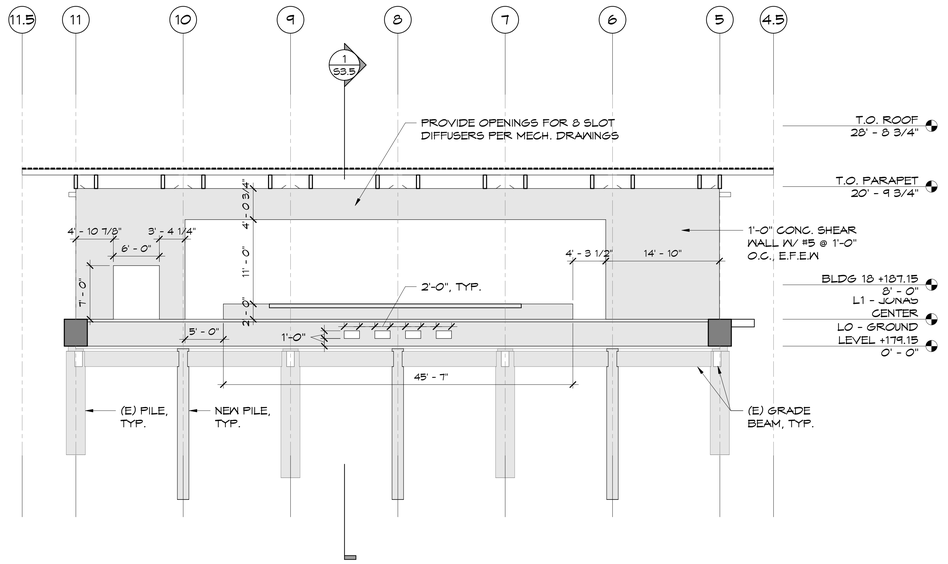
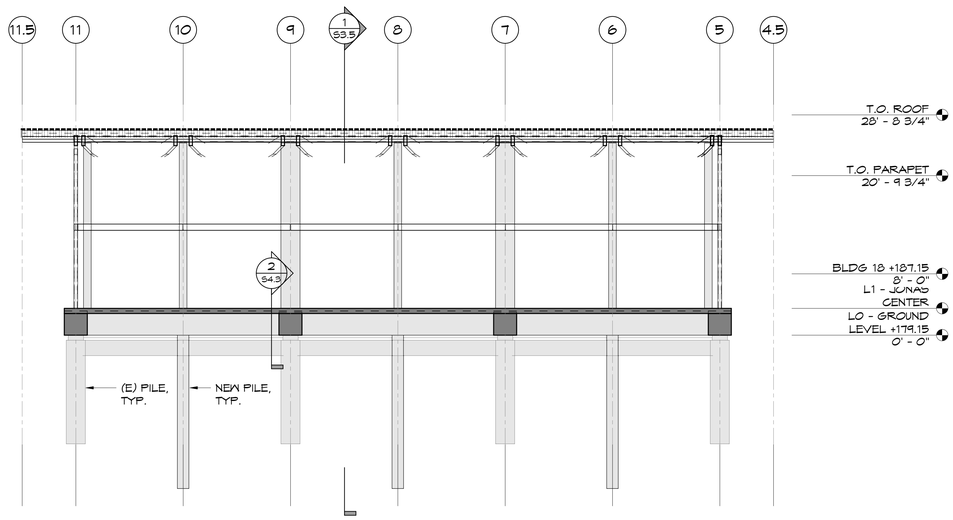
ROOF PLAN

S2.1



2 S3.1 LINE D TRANSVERSE SECTION

1/8" = 1'-0"



1 S3.1 LINE J TRANSVERSE SECTION

1/8" = 1'-0"

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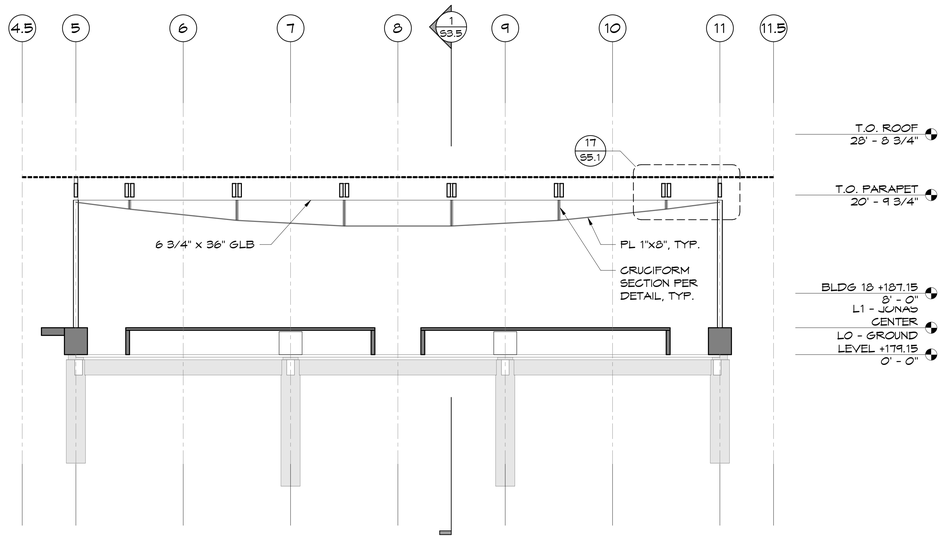
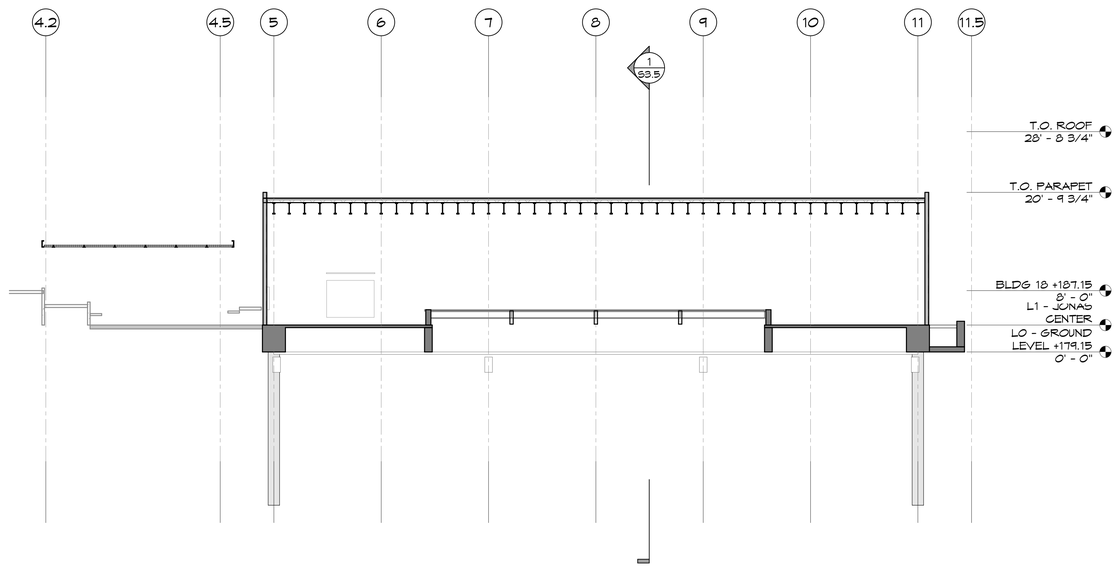
TRANSVERSE SECTIONS

S3.1



2 S3.2 LINE G TRANSVERSE SECTION

1/8" = 1'-0"



1 S3.2 LINE C TRANSVERSE SECTION

1/8" = 1'-0"

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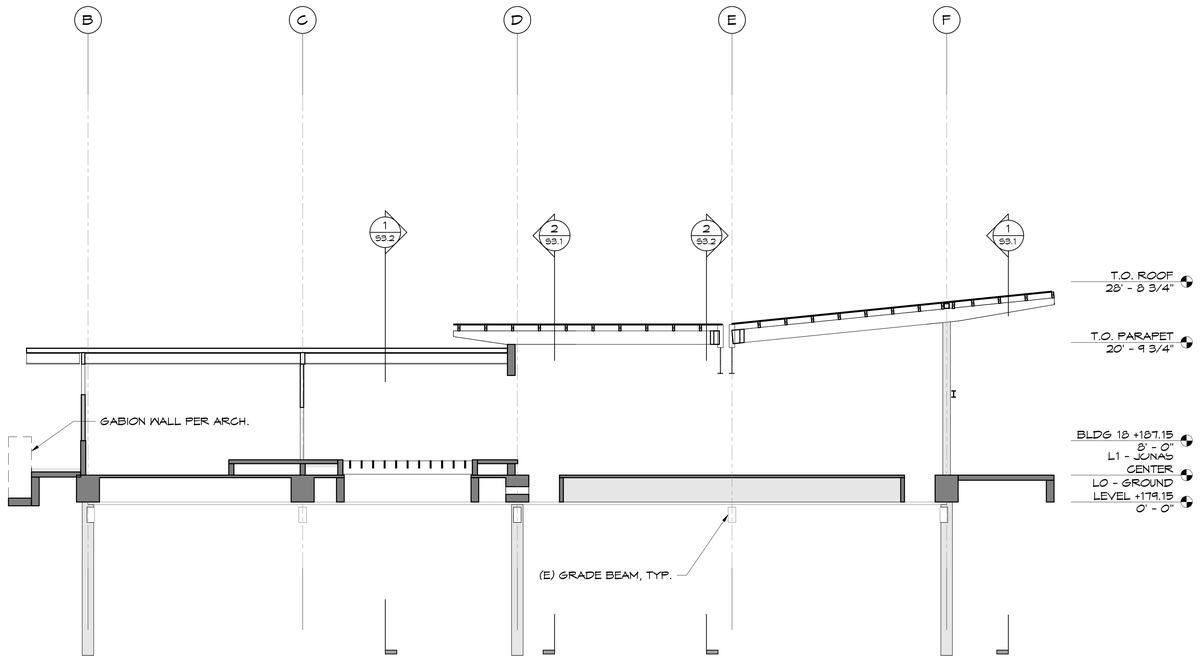
TRANSVERSE SECTIONS

S3.2



1 S3.5 LONGITUDINAL SECTION
1/8" = 1'-0"

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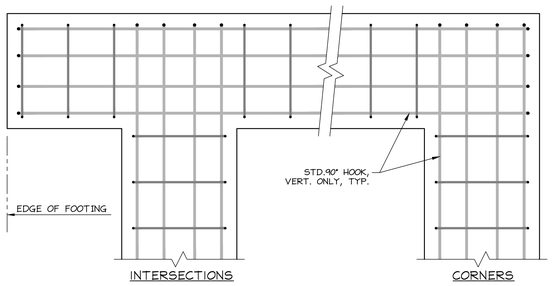
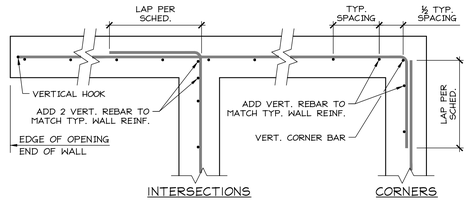
LONGITUDINAL SECTIONS

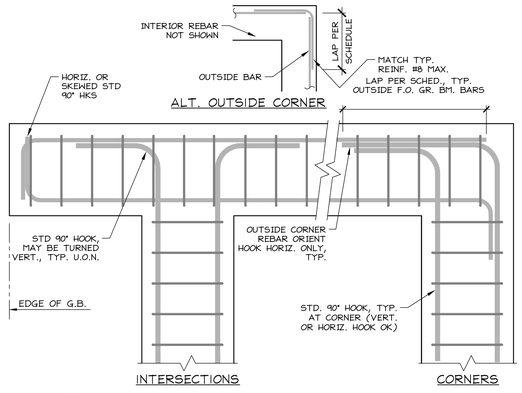
S3.5



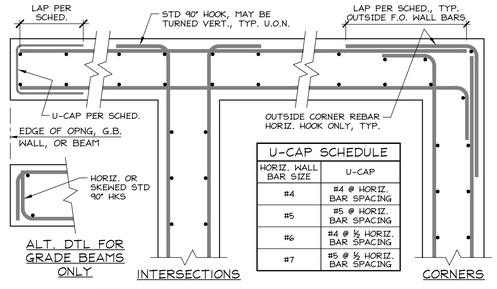
D BOTTOM LAYER OF FOOTING REBAR



B ONE CURTAIN OF REBAR



C TWO CURTAINS OF GRADE BEAM REBAR

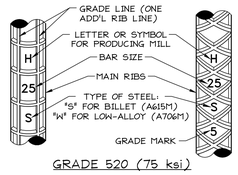


U-CAP SCHEDULE

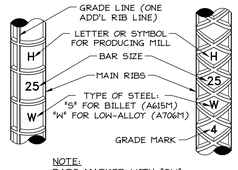
HORIZ. WALL BAR SIZE	U-CAP
#4	#4 @ HORIZ. BAR SPACING
#5	#5 @ HORIZ. BAR SPACING
#6	#4 @ ½ HORIZ. BAR SPACING
#7	#5 @ ½ HORIZ. BAR SPACING

A TWO CURTAINS OF REBAR

6 S4.1 TYPICAL WALL, BEAM & GRADE BEAM INTERSECTION, PLAN DETAIL N.T.S.



GRADE 520 (75 ksi)



NOTE:
BARS MARKED WITH "SW" MEET BOTH A615M & A706M

GRADE 420 (60 ksi)

REBAR METRIC MARKINGS

REBAR SIZES

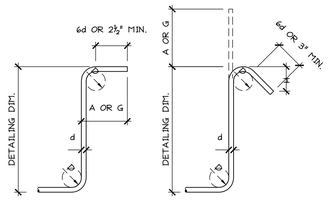
POUND-INCH UNITS USED IN THESE DRAWINGS	METRIC EQUIVALENTS (mm)
#3	#10
#4	#13
#5	#16
#6	#19
#7	#22
#8	#25
#9	#29
#10	#32
#11	#36
#14	#43
#18	#57

REBAR TYPE AND GRADE

POUND-INCH UNITS USED IN THESE DRAWINGS	METRIC EQUIVALENTS (MPa)
A615, GRADE 60 (ksi)	A615M, GRADE 420 (MPa)
A615, GRADE 75 (ksi)	A615M, GRADE 520 (MPa)
A706 (Fy = 60 ksi)	A706M (Fy = 420 MPa)

REBAR METRIC EQUIVALENTS

5 S4.1 REBAR METRIC MARKINGS & EQUIVALENTS
REBAR METRIC MARKINGS & EQUIVALENTS N.T.S.



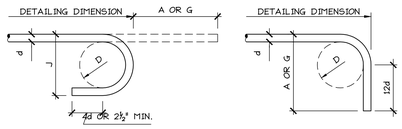
90° HOOK 135° HOOK

BAR SIZE	D	90° HOOK	135° HOOK	
		A or G	A or G	H (APPROX.)
#3	1½"	4"	4¼"	3"
#4	2"	4½"	4½"	3"
#5	2½"	6"	5½"	3¾"
#6	4½"	12"	8"	4½"

NOTES:

1. 135° COLUMN TIE HOOKS MAY NOT BE BENT TO LESS THAN THE DIAMETER OF THE COLUMN VERTICAL BAR ENCLOSED IN THE HOOK.
2. INSIDE DIAMETER OF BEND IN WELDED WIRE FABRIC SHALL NOT BE LESS THAN 4d FOR DEFORMED WIRE LARGER THAN D6 AND 2d FOR ALL OTHER WIRES. BENDS SHALL NOT BE LESS THAN 4d FROM NEAREST WELDED INTERSECTION.

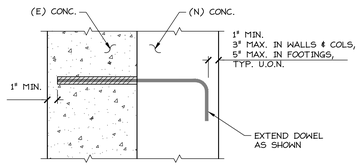
4 S4.1 STIRRUP & TIE BENDS N.T.S.



180° HOOK 90° HOOK

BAR SIZE	D		180° HOOKS		90° HOOKS
			A or G	J	A or G
#3	2¼"	6d	5"	3"	6"
#4	3"		6"	4"	8"
#5	3¾"		7"	5"	10"
#6	4½"		8"	6"	12"
#7	5¼"		10"	7"	14"
#8	6"		11"	8"	16"
#9	9½"	8d	15"	11¾"	19"
#10	10¾"		17"	13½"	22"
#11	12"		19"	14¾"	24"
#14	18¼"	10d	27"	21¾"	31"
#18	24"		36"	28½"	41"

3 S4.1 STANDARD HOOKS N.T.S.



DOWEL SIZE	THREADED ROD SIZE	DRILLED HOLE DIAM. (1)	MINIMUM EMBEDMENT LENGTH (2),(3)
#3	⅜"Φ	½"-⅝"	4½"
#4	½"Φ	⅝"-¾"	6"
#5	⅝"Φ	¾"-⅞"	7½"
#6	¾"Φ	⅞"-1"	9"
#7	⅞"Φ	1"-1⅛"	10½"
#8	1"Φ	1⅛"-1¼"	12"
#9	1⅛"Φ	1¼"-1⅜"	15"

NOTES:

1. FOLLOW SPECIFIC MANUFACTURER GUIDELINES FOR DRILLED HOLE DIAMETER.
2. EMBEDMENT LENGTHS SHOWN ON SPECIFIC DETAILS OVERRULE THIS SCHEDULE.
3. DOWEL EMBEDMENT INTO WALLS & SLABS SHALL NOT EXCEED THICKNESS (IN DIRECTION OF DRILLING) MINUS ONE INCH.
4. SCHEDULE DOES NOT APPLY TO DOWELS IN BRICK MASONRY.
5. SEE SPECIFICATIONS FOR EPOXY & SUBMIT EPOXY TECHNICAL INFORMATION TO STRUCTURAL ENGINEER FOR APPROVAL.

2 S4.1 EPOXY GROUTED DOWEL SCHEDULE N.T.S.

TENSION LAP SPLICE SCHEDULE (1), (2), (4)

BAR SIZE	HARDROCK (5) CONCRETE		CMU
	VERT. C.I.P. BARS, HORIZ. SLAB BARS	HORIZ. BARS IN WALLS, BEAMS & COLLECTORS, ALL SHOTCRETE BARS	
#3	22"	28"	25"
#4	29"	37"	33"
#5	36"	47"	41"
#6	43"	56"	49"
#7	63"	81"	57"
#8	72"	93"	65"
#9	81"	105"	74"
#10	91"	118"	
#11 (3)	101"	131"	

NOTES :

1. THE LAP LENGTHS LISTED ABOVE ARE APPLICABLE UNDER THE FOLLOWING CONDITIONS:
   -CONCRETE STRENGTH F'c AT LEAST 3000 psi.
   -BEAM & COLUMN BARS SPACED AT LEAST 2 DIAMETERS O.C.
   -WALL & SLAB REBAR SPACED AT LEAST 3 DIAMETERS O.C.
   FOR CONDITIONS OTHER THAN THOSE LISTED, CONTACT STRUCTURAL ENGINEER.
2. CLASS A LAP SPLICES ARE 75% OF THE LENGTHS SHOWN IN THE TABLE ABOVE. CLASS A LAP SPLICES MAY ONLY BE USED WHERE SPECIFICALLY CALLED OUT ON THE STRUCTURAL DRAWINGS (ONLY PERMITTED WHERE REBAR IS LESS THAN 50% STRESSED). CLASS A LAP SPLICES SHALL BE STAGGERED BY AT LEAST ONE SPLICE LENGTH.
3. BARS LARGER THAN #11 SHALL BE MECHANICALLY COUPLED; SMALLER BARS MAY ALSO BE MECHANICALLY COUPLED. COUPLERS SHALL BE STAGGERED AT LEAST 30".
4. WHERE A LARGER BAR LAPS A SMALLER BAR, THE SMALLER BAR LAP APPLIES, U.O.N.
5. FOR LIGHTWEIGHT AGGREGATE CONCRETE, MULTIPLY TABULATIONS BY 1.3 TIMES.

1 S4.1 LAP SPLICE SCHEDULE N.T.S.

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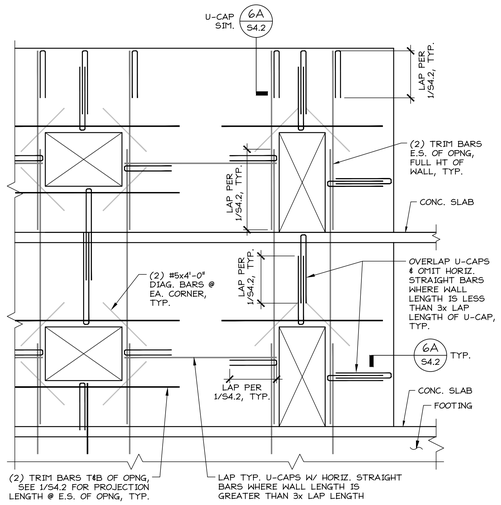
TYPICAL CONCRETE DETAILS

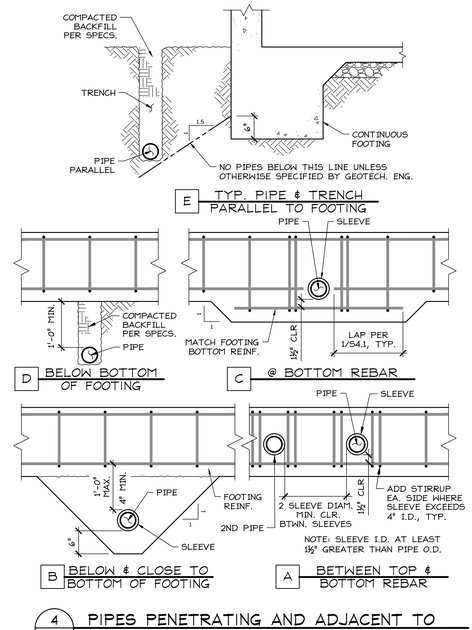
S4.1



NOTES:

1. TRIM BAR SIZES TO MATCH WALL REINFORCING, #5 MINIMUM.
2. TRIM BARS ARE IN ADDITION TO TYPICAL WALL REINFORCING
3. VERTICAL STEEL SHALL BE FULL HEIGHT EACH SIDE OF OPENINGS. PROVIDE LAP SPLICES TO MATCH VERTICAL STEEL.
4. APPLIED ONLY TO WALLS 2'-0" OR THINNER. FOR OPENINGS THROUGH THICKER WALLS, SEE STRUCTURAL ENGINEER FOR SPECIAL DETAILS.

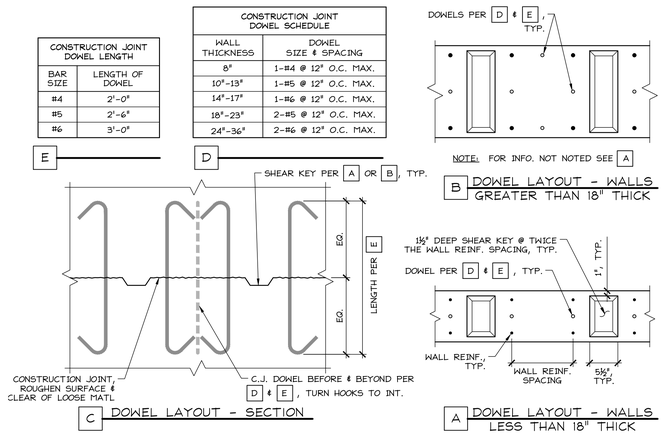
5 S4.2 MINIMUM REINFORCING AROUND CONCRETE WALL OPENINGS N.T.S.



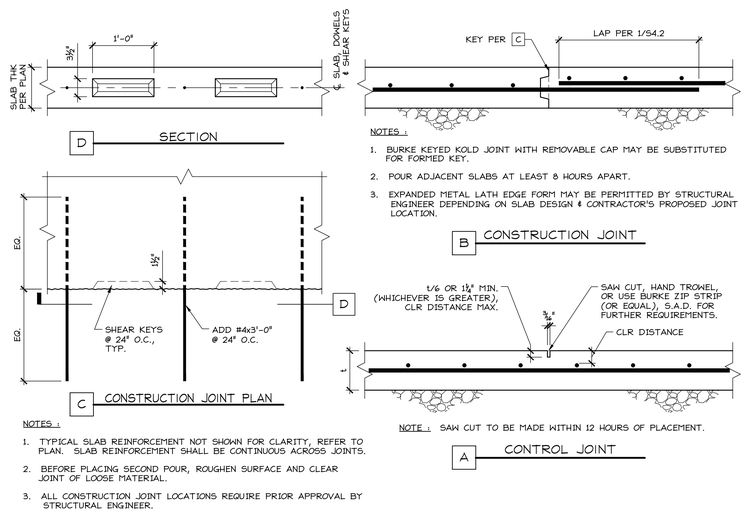
4 S4.2 PIPES PENETRATING AND ADJACENT TO GRADE BEAMS OR FOOTINGS N.T.S.

CONSTRUCTION JOINT DOWEL LENGTH	
BAR SIZE	LENGTH OF DOWEL
#4	2'-0"
#5	2'-6"
#6	3'-0"

CONSTRUCTION JOINT DOWEL SCHEDULE	
WALL THICKNESS	DOWEL SIZE & SPACING
8"	1-#4 @ 12" O.C. MAX.
10"-13"	1-#5 @ 12" O.C. MAX.
14"-17"	1-#6 @ 12" O.C. MAX.
18"-23"	2-#5 @ 12" O.C. MAX.
24"-36"	2-#6 @ 12" O.C. MAX.



2 S4.2 TYPICAL HORIZONTAL & VERTICAL CONST. JOINTS IN SHEARWALLS N.T.S.



1 S4.2 TYPICAL JOINTS IN CONCRETE SLAB-ON-GRADE N.T.S.

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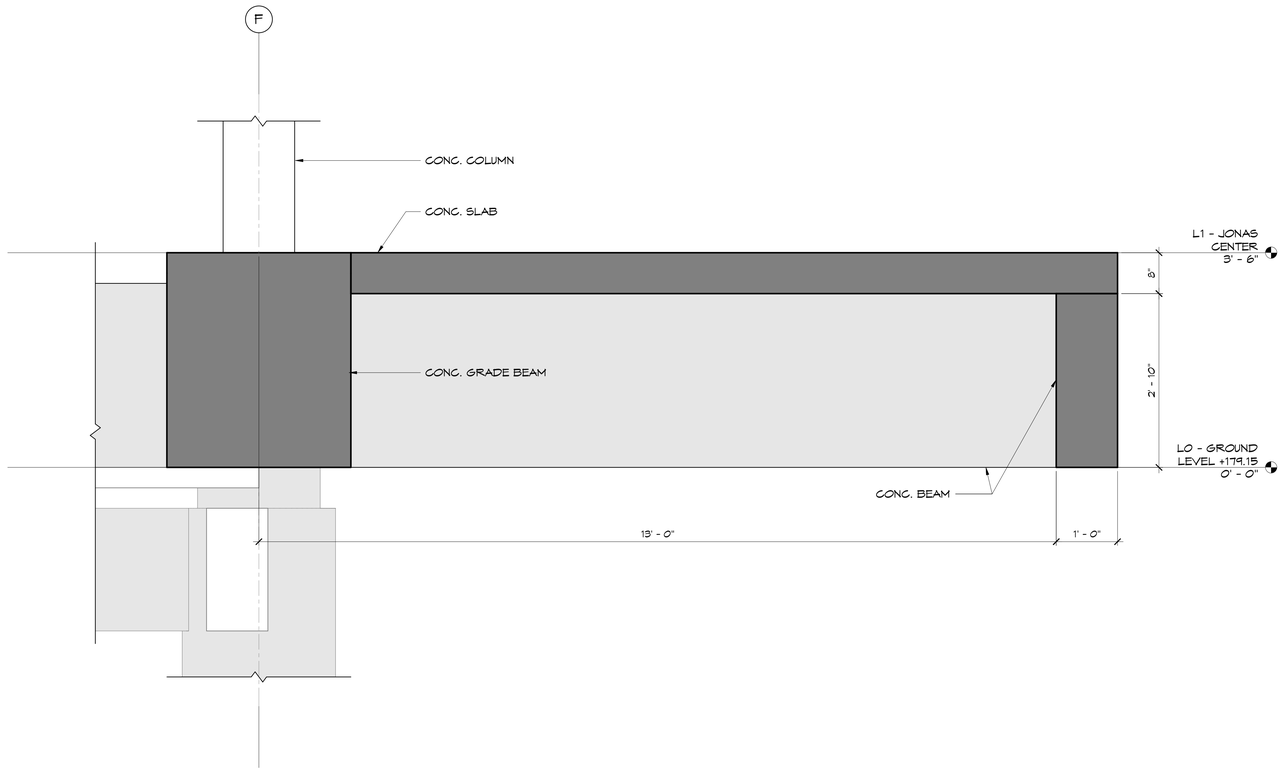
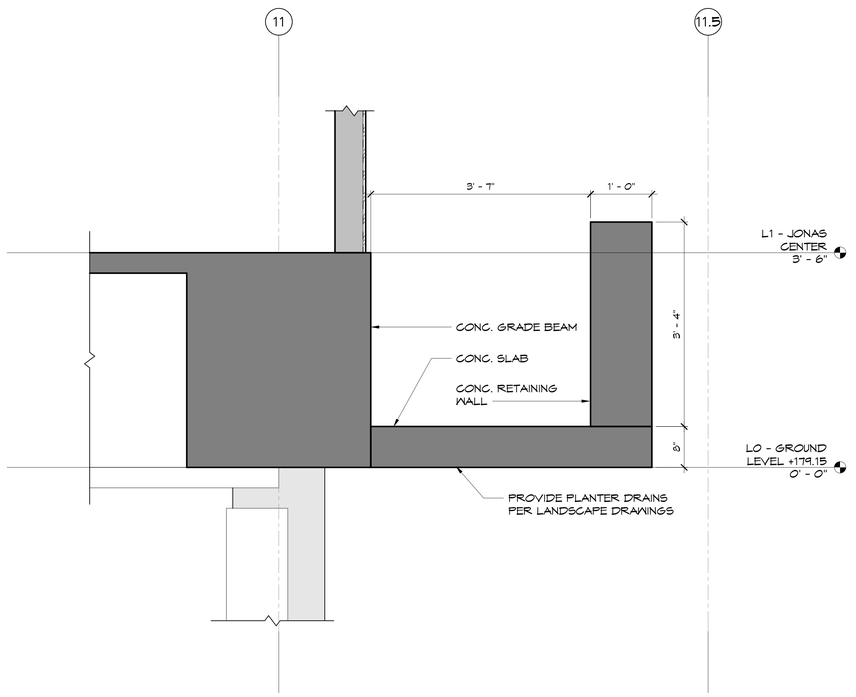
T□□ICAL CONCRETE DETAILS

S4.2



2 S4.3 BALCONY SECTION
1" = 1'-0"



1 S4.3 PLANTER SECTION
1" = 1'-0"

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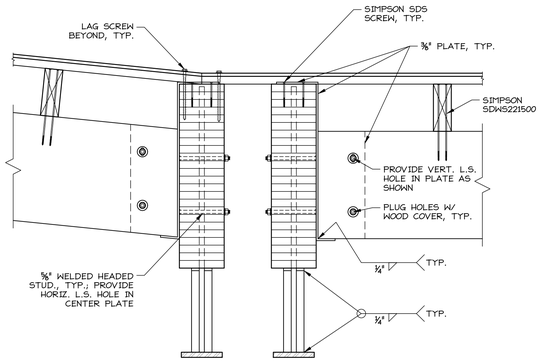
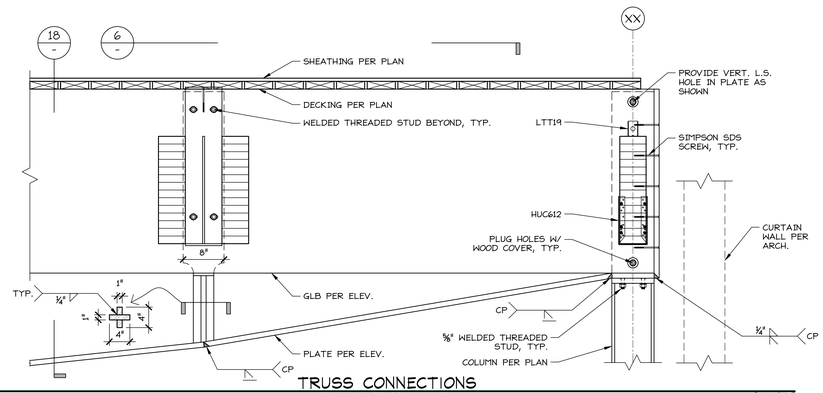
CONCRETE DETAILS

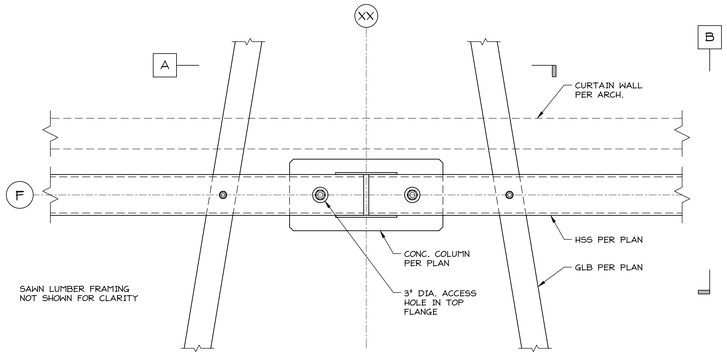
S4.3



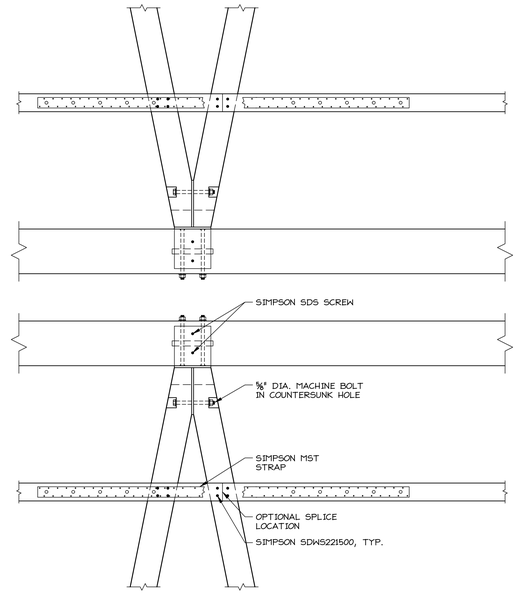
18 S5.1 — TRUSS CONNECTIONS SECTION VIEW — 1" = 1'-0"



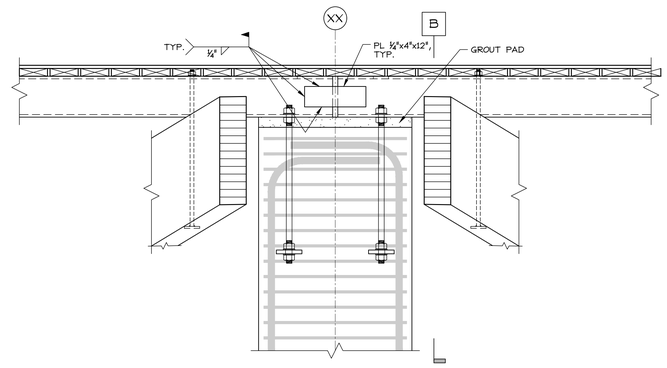
17 S5.1 — TRUSS CONNECTIONS ELEVATION VIEW — 1" = 1'-0"



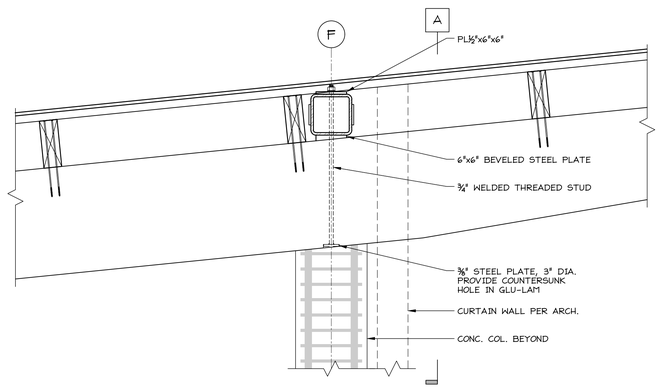
10 S5.1 — GLU-LAM SUPPORT PLAN VIEW — 1" = 1'-0"



6 S5.1 — TRUSS CONNECTIONS PLAN VIEW — 1" = 1'-0"



A — GLU-LAM SUPPORT ELEVATION VIEW



B — GLU-LAM SUPPORT SECTION VIEW

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ROOF DETAILS

S5.1

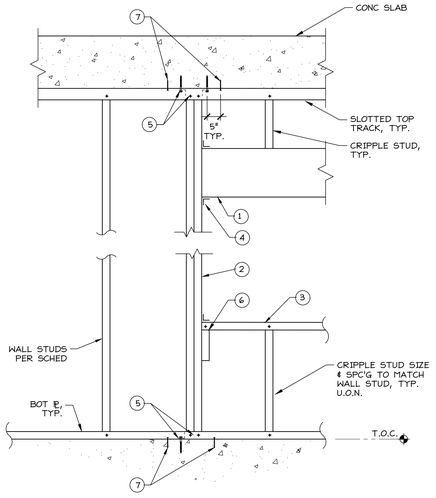


TABLE A. EXT. WALLS

MAX. SPAN	MAX. WALL HT.	(1) HEADER SHAPE	(1) HEADER MEMBERS	(2) JAMB STUD SHAPE	(2) JAMB STUD MEMBERS	(3) SILL SHAPE	(3) SILL MEMBERS	(4) MIN. HDR CONN. TO JAMB STUD	(5) MIN. JAMB STUD CONN. TO TOP TRACK	(5) MIN. JAMB STUD CONN. TO BOT. TRACK	(5) MIN. JAMB STUD CONN. TO BOT. TRACK @ DOOR	(6) MIN. SILL CONN. TO JAMB STUD	(7) ADD'L TRACK FASTENERS TYP. TO T4B TRACK	(7) ADD'L TRACK FASTENERS TO BOT. TRACK @ DOOR
3'-0"	10'-0"		(1) 600T200-43		(1) 600S162-43		(1) 600T200-43	BOT. CLIP L2"x2"x16ga, 5" LONG W/ 2-#10 EA. LEG	#8 E.S. EA. STUD	#8 E.S. EA. STUD	#8 E.S. EA. STUD	BOT. CLIP L2"x2"x16ga, 5" LONG W/ 2-#10 EA. LEG	0.157"ϕ PDF E.S. OF JAMB STUD @ MIN. 5" O.C. PER 5/S7.1	(2) 0.157"ϕ PDF @ MIN. 5" O.C. STAG. PER 4/S7.1
8'-0"	10'-0"		(2) 600T200-43 + (2) 600S162-43		(2) 600S162-43		(2) 600T200-43 + (2) 600S162-43	T4B CLIP L2"x2"x16ga, 5" LONG W/ 2-#10 EA. LEG	(2) SCW3.25 CLIP W/ (2) ⅜"ϕ TITEN SCREWS	SSC2.25 CLIP W/ ⅜"ϕ TITEN HD ANCHOR	SSC2.25 CLIP W/ ⅜"ϕ TITEN HD ANCHOR	T4B CLIP L2"x2"x16ga, 5" LONG W/ 2-#10 EA. LEG	NOT REQ'D W/ CLIP	NOT REQ'D W/ CLIP

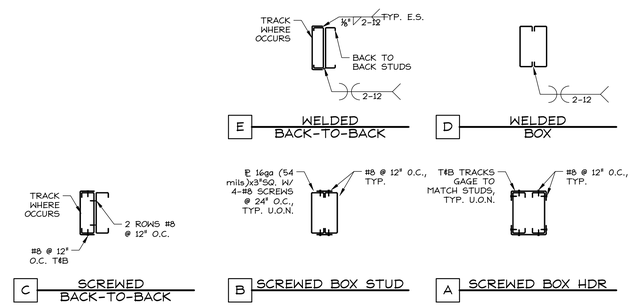
TABLE B. INT. WALLS

MAX. SPAN	MAX. WALL HT.	(1) HEADER SHAPE	(1) HEADER MEMBERS	(2) JAMB STUD SHAPE	(2) JAMB STUD MEMBERS	(3) SILL SHAPE	(3) SILL MEMBERS	(4) MIN. HDR CONN. TO JAMB STUD	(5) MIN. JAMB STUD CONN. TO TOP TRACK	(5) MIN. JAMB STUD CONN. TO BOT. TRACK	(5) MIN. JAMB STUD CONN. TO BOT. TRACK @ DOOR	(6) MIN. SILL CONN. TO JAMB STUD	(7) ADD'L TRACK FASTENERS TYP. TO T4B TRACK	(7) ADD'L TRACK FASTENERS TO BOT. TRACK @ DOOR
3'-0"	18'-0"		(1) 600T200-54		(1) 600S200-54		(1) 600S200-54	BOT. CLIP L2"x2"x16ga, 3" LONG W/ 2-#10 EA. LEG	#8 E.S. EA. STUD	#8 E.S. EA. STUD	#8 E.S. EA. STUD	CRIPPLE BLK 6" LONG W/ 3-#8	0.157"ϕ PDF E.S. OF JAMB STUD @ MIN. 5" O.C. PER 5/S7.1	(2) 0.157"ϕ PDF @ MIN. 5" O.C. STAG. PER 4/S7.1
4'-0"	12'-0"		(1) 362T125-54		(2) 3625162-33		(2) 3625162-33							
	18'-0"		(1) 362T200-68		(2) 3625200-68		(2) 3625200-68							
6'-0"	12'-0"		(1) 3625200-68 (1) 362T125-33		(2) 3625162-33		(2) 3625162-33							
	18'-0"		(1) 3625200-68 (1) 362T125-33		(2) 3625200-68		(2) 3625200-68							

NOTES:
1. ALL MEMBERS NOTED ABOVE SHALL BE CONTINUOUS & FREE OF W/O SPLICES.
2. USE 50 KSI GRADE STEEL FOR 16 GAUGE (54 MILS) AND THICKER MEMBERS.
3. FOR BUILT-UP SECTIONS, SEE 12/S7.1.
4. DO NOT DAMAGE (E) SLAB REINF. DURING HOLE DRILLING OPERATION FOR POST-INSTALLED ANCHORS.
5. FOR ⅜"ϕ TITEN HD ANCHORS, PROVIDE MIN. 2½" EMBED & MIN. 3" SLAB EDGE DIST., & 9" SPACING.
6. FOR ¾"ϕ TITEN SCREWS, PROVIDE MIN. 1" & MAX. 1¼" EMBED, MIN. 1⅛" SLAB EDGE DIST., & 2¼" SPACING.

4 S7.1 FRAMING AROUND OPENINGS IN NON-BEARING WALLS

3/4" = 1'-0"



3 S7.1 BUILT-UP SECTIONS

3/4" = 1'-0"

TABLE A: EXTERIOR WALL

WALL DEPTH(2)	MAX. WALL HT.	STUD	TOP SLIP TRACK	BOTTOM TRACK
6"	10'-0"	600S162-43	600T250-54	600T150-43
	12'-0"	600S162-43	600T250-54	600T150-43
	15'-0"	600S250-54	600T250-54	600T150-43
	18'-0"	600S250-97	600T250-68	600T150-43

TABLE B: INTERIOR WALL

WALL DEPTH(2)	MAX. WALL HT.	STUD	TOP SLIP TRACK	BOTTOM TRACK
3⅝"	12'-0"	3625162-33	362T250-33	362T125-30
	18'-0"	3625200-68	362T250-33	362T125-30
6"	18'-0"	6005200-54	600T250-33	600T125-43

NOTES :
1. STUD SPACING SHALL BE 24" O.C., U.O.N.
2. STUDS SHALL BE LATERALLY BRACED W/ SHEATHING ON BOTH SIDES U.O.N. FOR UNSHEATHED WALLS, PROVIDE BRIDGING PER 14/S7.1.
3. SEE ARCH. WALL TYPES FOR STUD DEPTH.
4. WIDER FLANGE WIDTHS & HEADER MATERIAL THICKNESSES ARE PERMISSIBLE.
5. TOP TRACKS SHALL HAVE MIN. 1½" VERT. SLOTS & 4" HORIZ. SLOTS U.O.N.
6. INTERIOR WALL STUDS ARE SIZED ASSUMING COMPOSITE ACTION W/ GWB SHEATHING. PROVIDE MIN. ⅝" THICK GWB ON E.S. ATTACHED W/ MIN. #6 SPACED @ 12" O.C. MAX.
7. USE 50 KSI GRADE STEEL FOR 16 GAUGE (54 MILS) AND THICKER MEMBERS.

2 S7.1 WALL STUD SCHEDULE

3/4" = 1'-0"

MEMBER DEPTH:
(EXAMPLE: 6"= 600 x 1/100 INCHES)
ALL MEMBER DEPTHS ARE TAKEN IN 1/100 INCHES. FOR ALL "T" SECTIONS MEMBER DEPTH IS THE INSIDE TO INSIDE DIMENSION.

FLANGE WIDTH:
(EXAMPLE: 1⅝"=1.625" ≈162 x 1/100 INCHES)
ALL FLANGE WIDTHS ARE TAKEN IN 1/100 INCHES.

600 S 162 - 54

STYLE:
(EXAMPLE: STUD OR JOIST SECTION = S)
THE FOUR ALPHA CHARACTERS UTILIZED BY THE DESIGNATOR SYSTEM ARE:
S = STUD OR JOIST SECTIONS
T = TRACK SECTION
U = CHANNEL SECTIONS
F = FURRING CHANNELS SECTIONS

MATERIAL THICKNESS:
(EXAMPLE: 0.054 IN. = 54 MILS; 1 MIL = 1/1000 IN.)
MATERIAL THICKNESS IS THE MINIMUM BASE METAL THICKNESS IN MILS. MINIMUM BASE METAL THICKNESS REPRESENTS 95% OF THE DESIGN THICKNESS.

THICKNESS - STEEL COMPONENTS

MINIMUM THICKNESS (MILS)	DESIGN THICKNESS	GAGE
18	.0188	25
27	.0283	22
33	.0346	20
43	.0451	18
54	.0566	16
68	.0713	14
97	.1017	12

1 S7.1 NOMENCLATURE FOR LIGHT GAUGE METAL MEMBERS

3/4" = 1'-0"

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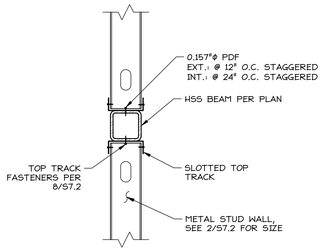
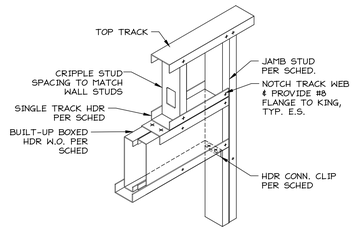
T□□ICAL LIGHT-GA□GE DETAILS

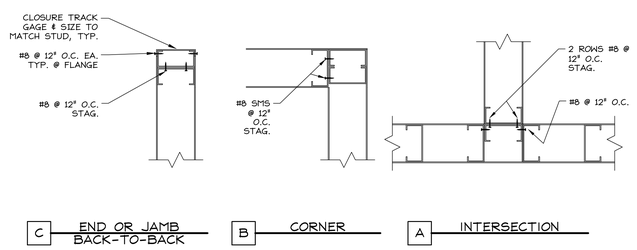
S7.1



10 / S7.2 METAL STUD WALL @ HSS BEAM 3/4" = 1'-0"



9 / S7.2 HEADER TO JAMB STUD CONN. 3/4" = 1'-0"

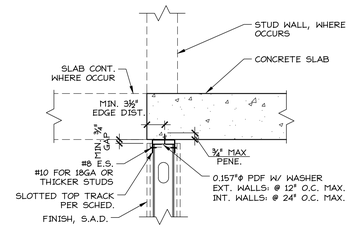


C END OR JAMB BACK-TO-BACK

B CORNER

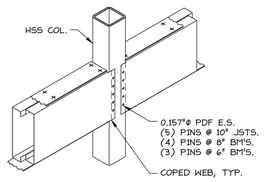
A INTERSECTION

8 / S7.2 WALL INTERSECTIONS PLAN VIEW 3/4" = 1'-0"

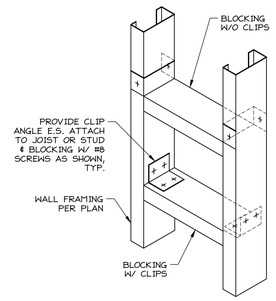


NOTE:
PROVIDE ADD'L FASTENERS ADJACENT TO JAMB STUDS PER SCHED.

7 / S7.2 SLOTTED TOP TRACK CONN. 3/4" = 1'-0"



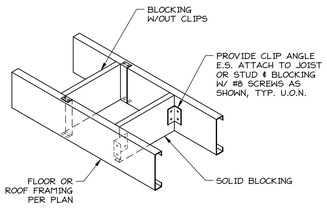
6 / S7.2 BOX BM. TO HSS COL. 3/4" = 1'-0"



B WALLS

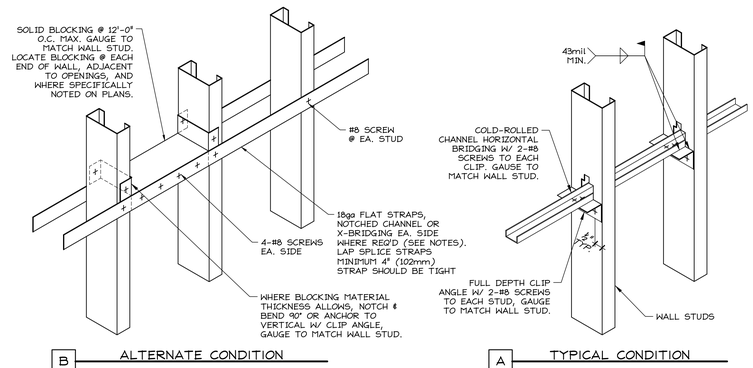
NOTE:

1. WHERE BLOCKING MATERIAL THICKNESS ALLOWS, NOTCH AND BEND TRACK 90° FOR CONNECTION.
2. BLOCKING AND CLIPS GA. TO MATCH STUDS OR JOISTS. UP TO 18ga MAX., U.O.N.



A JOISTS AND RAFTERS

5 / S7.2 BLOCKING 3/4" = 1'-0"



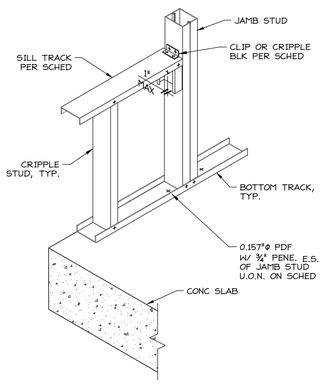
B ALTERNATE CONDITION

A TYPICAL CONDITION

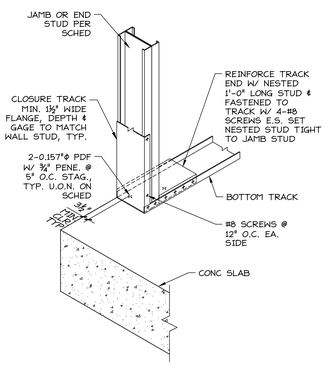
NOTE:

- WALL BRIDGING REQ'D FOR METAL STUDS HEAVIER THAN 16 GAUGE, PACO STUDS, AND AT ALL UNSHEATHED WALL SURFACES. BRIDGING SPACING NOT TO EXCEED 6'-0". ALL STUD BRIDGING SHALL BRACE BOTH STUD FLANGES.
- ALTERNATE BLOCKING ONLY ACCEPTABLE WHERE SPECIFICALLY CALLED OUT ON PLANS OR WHERE SUBSTITUTION APPROVED BY ARCHITECT (ALTERNATE BLOCKING HAS INFERIOR ACOUSTICAL PERFORMANCE)

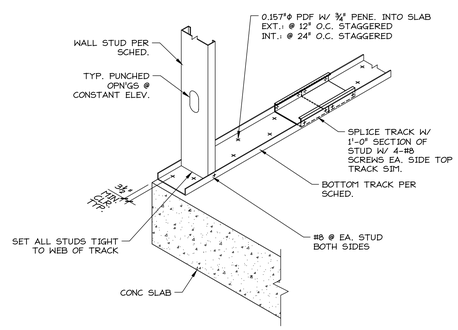
4 / S7.2 METAL STUD WALL BRIDGING 3/4" = 1'-0"



3 / S7.2 SILL TO JAMB STUD JAMB STUD TO BOTT. TRACK 3/4" = 1'-0"



2 / S7.2 END OR JAMB STUD TO BOTT. TRACK 3/4" = 1'-0"



1 / S7.2 BOTTOM TRACK CONNECTION 3/4" = 1'-0"

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JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

project number: 2017.016

scale: As Noted

date: -/--/17

T□□ICAL LIGHT-GA□GE DETAILS

S7.2

ABBREVIATIONS

AAV	AUTOMATIC AIR VENT
AC	AIR CONDITIONING
ACCEPT	ACCEPTANCE
ACU	AIR CONDITIONING UNIT
AD	ACCESS DOOR
ADD	ADDITION
AF	AFTER FILTER
AFF	ABOVE FINISHED FLOOR
AFMS	AIR FLOW MEASURING STATION
AG	AIR GAP
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLING UNIT
AMB	AMBIENT
A	AMPERE
AP	ACCESS PANEL
ARCH	ARCHITECT
ARI	AMERICAN REFRIGERATION INSTITUTE
AS	AIR SEPARATOR
AUTO	AUTOMATIC
AUX	AUXILIARY
B	BOILER
BAS	BUILDING AUTOMATION SYSTEM
BDD	BACKDRAFT DAMPER
BHP	BRAKE HORSEPOWER
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BFP	BACKFLOW PREVENTER
BTU	BRITISH THERMAL UNIT
BTUH	BTU PER HOUR
BV	BALL VALVE OR BALANCING VALVE
BYV	BUTTERFLY VALVE
C	COMMON, CONDENSATE OR CONDUIT
CA	CONTROL AIR
CAP	CAPACITY
CAV	CONSTANT AIR VOLUME
CB	CHILLED BEAM
CC	COOLING COIL OR CONTROLS CONTRACTOR
CEG	CEILING EXHAUST GRILLE
CER	CEILING EXHAUST REGISTER
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHWP	CHILLED WATER PUMP
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CH	CHILLER
CL	CENTERLINE
CLG	CEILING
CO	CLEANOUT
COMP	COMPRESSOR
COND	CONDENSATE
CONN	CONNECTION
CONT	CONTINUATION
COP	COEFFICIENT OF PERFORMANCE
CP	CONTROL PANEL OR CONDENSATE PUMP
CR	CONDENSATE RETURN
CRR	CEILING RETURN REGISTER
CRG	CEILING RETURN GRILLE
CSD	CEILING SUPPLY DIFFUSER
CTE	CONNECT TO EXISTING
CU FT	CUBIC FEET
CU IN	CUBIC INCH
CV	CONSTANT VOLUME OR CONTROL VALVE
CW	COLD WATER
CWP	CONDENSER WATER PUMP
CWR	CONDENSER WATER RETURN
CWS	CONDENSER WATER SUPPLY
D	DROP OR DRAIN
DBT	DRY BULB TEMPERATURE
DDC	DIRECT DIGITAL CONTROL
DEFL	DEFLECTION
DIA	DIAMETER
DIFF	DIFFERENCE
DP	DIFFERENTIAL PRESSURE
DPT	DEW POINT TEMPERATURE
DSD	DUCT SMOKE DETECTOR
DWG(S)	DRAWING(S)
DX	DIRECT EXPANSION
(E)	EXISTING
(ER)	EXISTING RELOCATED
EA	EXHAUST AIR OR EACH
EAD	EXHAUST AIR DAMPER
EAT	ENTERING AIR TEMPERATURE
EC	ELECTRICAL CONTRACTOR
EDB	ENTERING DRY BULB TEMPERATURE
EER	ENERGY EFFICIENCY RATING
EF	EXHAUST FAN
EFF	EFFICIENCY
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRICAL
ESP	EXTERNAL STATIC PRESSURE
ET	EXPANSION TANK
EWB	ENTERING WET BULB TEMPERATURE
EWT	ENTERING WATER TEMPERATURE
EXH	EXHAUST
EXT	EXTERNAL
F	FAHRENHEIT OR FILTER
FC	FLEXIBLE CONNECTION OR FAIL CLOSED
FCU	FAN COIL UNIT
FD	FIRE DAMPER
FF	FINAL FILTER OR FINISHED FLOOR
FO	FAIL OPEN
FPI	FINS PER INCH
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FSD	FIRE/SMOKE DAMPER
FT	FOOT OR FEET
G	GAS
GA	GAUGE, GAGE
GAL	GALLONS
GC	GAS COCK OR GENERAL CONTRACTOR
GPM	GALLONS PER MINUTE
GV	GATE VALVE
H	HEIGHT
HB	HOSE BIBB
HC	HEATING COIL
HD	HEAD
HOR	HORIZONTAL
HP	HORSEPOWER OR HEAT PUMP
HR	HOUR(S)
HV	HOSE VALVE
HVAC	HEATING, VENTILATING & AIR CONDITIONING
HW	HEATING WATER
HWP	HEATING WATER PUMP
HWR	HEATING WATER RETURN
HWS	HEATING WATER SUPPLY
HX	HEAT EXCHANGER
HZ	FREQUENCY (HERTZ)
ID	INSIDE DIAMETER
IN	INCH(ES)
IPLV	INTEGRATED PART LOAD VALUE
KW	KILOWATT
KWH	KILOWATT HOUR
L	LENGTH
LAT	LEAVING AIR TEMPERATURE
LBS	POUNDS
LDB	LEAVING DRY BULB
LF	LINEAR FEET
LWB	LEAVING WET BULB
LWT	LEAVING WATER TEMPERATURE
M	MOTOR
MA	MIXED AIR
MAD	MIXED AIR DAMPER
MAX	MAXIMUM
MBH	THOUSAND BTU PER HOUR
MC	MECHANICAL CONTRACTOR
MCA	MINIMUM CIRCUIT AMPACITY
MCC	MOTOR CONTROL CENTER
MD	MOTORIZED DAMPER
MECH	MECHANICAL
MERV	MINIMUM EFFICIENCY RATING VALUE
MFR	MANUFACTURER
MIN	MINIMUM
MOCP	MAXIMUM OVER CURRENT PROTECTION
MV	MANUAL AIR VENT
(N)	NEW
N/A	NOT APPLICABLE
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NOM	NOMINAL
NPSH	NET POSITIVE SUCTION HEAD
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OAD	OUTSIDE AIR DAMPER
OAT	OUTSIDE AIR TEMPERATURE
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER
OD	OUTSIDE DIAMETER
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED OWNER INSTALLED
OV	OUTLET VELOCITY
P	PUMP OR PRESSURE OR POLE
PC	PUMPED CONDENSATE
PD	PRESSURE DROP
PF	PREFILTER
PG	PIPE GUIDE OR PRESSURE GAUGE
PH	PHASE (ELECTRICAL)
PHC	PREHEAT COIL
POC	POINT OF CONNECTION
POD	POINT OF DISCONNECTION
PRV	PRESSURE REDUCING VALVE
PS	PRESSURE SENSOR
PSI	POUNDS PER SQUARE INCH
PSIA	PSI ABSOLUTE
PSIG	PSI GAUGE
QTY	QUANTITY
R	RISERS, RELOCATE OR RISE
RA	RETURN AIR
RAD	RETURN AIR DAMPER
RD	REFRIGERANT DISCHARGE OR ROOF DRAIN
REF	ROOFTOP EXHAUST FAN
REFRIG	REFRIGERATION
REQ'D	REQUIRED
REV	REVISE, REVISION OR REVOLUTIONS
RF	RETURN FAN
RH	RELATIVE HUMIDITY
RHC	REHEAT COIL
RPM	REVOLUTIONS PER MINUTE
RS	REFRIGERANT SUCTION
RTU	ROOFTOP UNIT
S	SUPPLY OR SLOPE
SA	SUPPLY AIR
SCFM	CFM, STANDARD CONDITIONS
SD	SMOKE DAMPER
SEER	SEASONAL ENERGY EFFICIENCY RATING
SEN	SENSIBLE
SF	SUPPLY FAN OR SQUARE FEET
SIU	SPLIT INDOOR UNIT
SOU	SPLIT OUTDOOR UNIT
SP	STATIC PRESSURE
SPD	SPLITTER DAMPER
SPEC	SPECIFICATIONS
SQ IN	SQUARE INCH
ST	STRAINER OR SOUND TRAP
STD	STANDARD
STRUCT	STRUCTURAL
SV	STEAM VENT
T	THERMOSTAT OR THERMOMETER
TDH	TOTAL DYNAMIC HEAD
TEMP	TEMPERATURE
TI	TENANT IMPROVEMENT
TRG	TRANSFER GRILLE
TS	TEMPERATURE SENSOR
TSP	TOTAL STATIC PRESSURE
TT	TEST TAP OR TEST TEE
TXV	THERMAL EXPANSION VALVE
(TYP)	TYPICAL
U	HEAT TRANSFER COEFFICIENT
UC	UNDER CUT DOOR
UON	UNLESS OTHERWISE NOTED
V	VENT OR VOLT OR VELOCITY
VAV	VARIABLE AIR VOLUME
VB	VACUUM BREAKER
VD	VOLUME DAMPER
VEL	VELOCITY
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VOL	VOLUME
VTR	VENT THROUGH ROOF
W	WASTE OR WIDTH OR WATTS
W/	WITH
W/O	WITHOUT
WB	WET BULB TEMPERATURE
WC	WATER COLUMN
WEG	WALL EXHAUST GRILLE
WG	WATER GAUGE
WL	WIRELESS
WP	WORKING PRESSURE
WPD	WATER PRESSURE DROP
WRR	WALL RETURN REGISTER
WSHP	WATER-SOURCE HEAT PUMP
WSR	WALL SUPPLY REGISTER
WT	WEIGHT
Z	ZONE
ZD	ZONE DAMPER

HVAC LEGEND

GENERAL

SYMBOL	DESCRIPTION
(N)	NEW WORK
(E)	EXISTING WORK TO REMAIN
	EXISTING WORK TO BE REMOVED
(RL)	RELOCATE EXISTING
	CENTER LINE
	POINT OF CONNECTION OR POINT OF DISCONNECTION
1 / M-1	DETAIL 1, DRAWING M-1
A / M-1	SECTION A, DRAWING M-1
1 / M-1	ELEVATION 1, DRAWING M-1
EXH 1	RISER IDENTIFICATION EXHAUST #1
HP 1	EQUIPMENT IDENTIFICATION HEAT PUMP UNIT #1
#	NUMBER OR QUANTITY
	KEYED NOTE
150 FPM 78°F	DIRECTION OF TRANSFER AIRFLOW (150 CFM) 78 DEGREES FAHRENHEIT

PIPING

SYMBOL	DESCRIPTION
	DIRECTION OF SLOPE
	DIRECTION OF FLOW
	PIPE UP
	PIPE DOWN
	PIPE DROP/PIPE RISE
	TOP CONNECTION – BRANCH LINE
	BOTTOM CONNECTION–BRANCH LINE
	PIPE ANCHOR
	TEE UP
	TEE DOWN
	STRAINER WITH HOSE BIBB DRAIN
	TEST TAP (PETE'S PLUG)
	MANUAL AIR VENT
	AUTOMATIC AIR VENT
	VACUUM BREAKER
	VENT THRU ROOF
	FLEXIBLE CONNECTOR
	UNION
	CAPPED OR PLUGGED TEE
	BLIND FLANGE, CAP
	CONCENTRIC REDUCER
	EXPANSION LOOP
	VALVE ON RISE
12"	PIPE SIZE (DIAMETER IN INCHES)

MISCELLANEOUS

SYMBOL	DESCRIPTION
RD	REFRIGERANT LIQUID/DISCHARGE
RS	REFRIGERANT SUCTION
A	AIR LINE
ST	SOUND TRAP
CC	COOLING COIL
HC	HEATING COIL
RHT	RADIANT HEATER
BHT	BASEBOARD HEATER
CB	CHILLED BEAM

VALVES & GAUGES

SYMBOL	DESCRIPTION
	BALL VALVE
	SOLENOID CONTROL VALVE
	PRESSURE AND TEMP. RELIEF VALVE
	BUTTERFLY VALVE
	MOTORIZED BUTTERFLY VALVE
	GATE VALVE
	BALANCING VALVE
	CHECK VALVE
	2-WAY CONTROL VALVE
	3-WAY CONTROL VALVE
	NON-SLAM WAFER CHECK VALVE
	PRESSURE REDUCING VALVE (PRV)
	PRESSURE GAUGE
	THERMOMETER

HYDRONIC

SYMBOL	DESCRIPTION
CHWS	CHILLED WATER SUPPLY
CHWR	CHILLED WATER RETURN
HWS	HEATING WATER SUPPLY
HWR	HEATING WATER RETURN
CWS	CONDENSER WATER SUPPLY
CWR	CONDENSER WATER RETURN

CONTROLS

SYMBOL	DESCRIPTION
WALL MOUNTED DEVICE: T	TEMPERATURE SENSOR
WALL MOUNTED DEVICE: WLT	TEMPERATURE SENSOR (WIRELESS)
WALL MOUNTED DEVICE: T	THERMOSTAT OR THERMOMETER
WALL MOUNTED DEVICE: CO2	CARBON DIOXIDE SENSOR
WALL MOUNTED DEVICE: OS	OCCUPANCY SENSOR
WALL MOUNTED DEVICE: H	HUMIDITY SENSOR OR HUMIDISTAT
WALL MOUNTED DEVICE: SP	STATIC PRESSURE SENSOR
WALL MOUNTED DEVICE: RS	REFRIGERANTSENSOR
WALL MOUNTED DEVICE: CO	CARBON MONOXIDE SENSOR
WALL MOUNTED DEVICE: H	HYDROGEN SENSOR
WALL MOUNTED DEVICE: DSD	DUCT SMOKE DETECTOR
WALL MOUNTED DEVICE: TS	TEMPERATURE SENSOR
WALL MOUNTED DEVICE: SP	STATIC PRESSURE SENSOR
WALL MOUNTED DEVICE: PS	PRESSURE SENSOR OR SWITCH
EQUIPMENT/SYSTEM MOUNTED DEVICE: DPS	DIFFERENTIAL PRESSURE SENSOR
EQUIPMENT/SYSTEM MOUNTED DEVICE: AFMS	AIR FLOW MONITORING STATION
EQUIPMENT/SYSTEM MOUNTED DEVICE: HS	HUMIDITY SENSOR
EQUIPMENT/SYSTEM MOUNTED DEVICE: FS	FLOW SENSOR OR SWITCH
EQUIPMENT/SYSTEM MOUNTED DEVICE: FM	FLOW METER
EQUIPMENT/SYSTEM MOUNTED DEVICE: CS	CURRENT SENSOR
EQUIPMENT/SYSTEM MOUNTED DEVICE: M	MOTOR
EQUIPMENT/SYSTEM MOUNTED DEVICE: A	ACTUATOR
EQUIPMENT/SYSTEM MOUNTED DEVICE: HM	HYDROGEN MONITOR
EQUIPMENT/SYSTEM MOUNTED DEVICE: RM	REFRIGERANT MONITOR
AI	ANALOG INPUT
AO	ANALOG OUTPUT
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
BAS	BUILDING AUTOMATION SYSTEM
PI	PULSING INPUT

DUCTWORK

SYMBOL (DOUBLE LINE)	DESCRIPTION	SYMBOL (SINGLE LINE)
	FLEXIBLE CONNECTION	
	FLEXIBLE DUCT RUNOUT TO DIFFUSER	
24x12	RECTANGULAR DUCT SIZE (WIDTH x DEPTH IN INCHES)	24x12
18ø	ROUND DUCT SIZE (DIAMETER IN INCHES)	18ø
24x12ø	OVAL DUCT SIZE (WIDTH x DEPTH IN INCHES)	24x12ø
	DUCT THROUGH BEAM PENETRATION	
R D	DUCT OFFSET (RISE OR DROP)	R D
VD RVD	VOLUME DAMPER OR REMOTE VOLUME DAMPER	VD RVD
FD SD FSD	FIRE, SMOKE OR FIRE/SMOKE DAMPER	FD SD FSD
	SUPPLY DUCT UP (CROSS SECTION)	
	SUPPLY DUCT DOWN	
	EXHAUST DUCT UP (CROSS SECTION)	
	EXHAUST DUCT DOWN	
	RETURN DUCT UP (CROSS SECTION)	
	RETURN DUCT DOWN	
	CROSS SECTION OF ROUND DUCT	
	DUCT ELBOW WITH TURNING VANES	
	SMOOTH RADIUS DUCT ELBOW WITHOUT TURNING VANES	
	CONICAL BRANCH FITTING	
	45 DEGREE BOOT LO-LOSS BRANCH FITTING	
	WYE BRANCH FITTING	24x16
12x6 M	ACOUSTICAL LINING DUCT DIMENSION IS INSIDE DIMENSION	M
M	MOTORIZED DAMPER INSIDE DUCT	
8'-11" BOD	INDICATES 8'11" TO BOTTOM OF DUCT ABOVE FINISHED FLOOR	8'-11" BOD
TAG NECK SIZE-CFM	RECTANGULAR OR ROUND SUPPLY DIFFUSER OR REGISTER (SEE SCHEDULE). 4-WAY THROW UNLESS INDICATED OTHERWISE. EXAMPLES: SB12X12-400 REFERS TO TAG SB WITH 12"X12" NECK AND 400 CFM OR SB10-250 REFER TO TAG SB WITH 10" ROUND NECK AND 250 CFM.	TAG NECK SIZE-CFM
TAG NECK SIZE-CFM	RECTANGULAR OR ROUND EXHAUST GRILLE OR REGISTER (SEE SCHEDULE)	TAG NECK SIZE-CFM
TAG NECK SIZE-CFM	RECTANGULAR OR ROUND RETURN GRILLE OR REGISTER (SEE SCHEDULE)	TAG NECK SIZE-CFM
TAG NECK SIZE-CFM	WALL SUPPLY GRILLE OR REGISTER (SEE SCHEDULE)	TAG NECK SIZE-CFM
TAG NECK SIZE-CFM	WALL RETURN GRILLE OR REGISTER (SEE SCHEDULE)	TAG NECK SIZE-CFM
TAG NECK SIZE-LENGTH-CFM	LINEAR SLOT DIFFUSER (SEE SCHEDULE FOR NUMBER OF SLOTS). 2-WAY THROW UNLESS INDICATED OTHERWISE. EXAMPLE: SN10-48-250 REFERS TO TAG SN WITH 10" ROUND NECK, 48" SLOT LENGTH AND 250 CFM.	TAG NECK SIZE-LENGTH-CFM

HVAC DRAWING LIST

M0.01	MECHANICAL COVER SHEET
M2.01	MECHANICAL HVAC PLAN
M2.02	MECHANICAL HVAC REFLECTED CEILING PLAN
M3.02	MECHANICAL ROOF PLAN

REFER TO 100% SCHEMATIC DESIGN MEP/LV BASIS OF DESIGN DOCUMENT FOR EQUIPMENT INFORMATION AND HVAC DESIGN CRITERIA.

ADD ALT. #1 – INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE AND STUB OUT FOR UTILITIES FOR KITCHEN, RESTROOMS, LAUNDRY, ETC.

ADD ALT. #2 – EXTERIOR SCOPE FOR NEW CONNECTING CONC. WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

NOTE: NOT ALL SYMBOLS OR ABBREVIATIONS ARE APPLICABLE TO THIS PROJECT. REFER TO DETAILS AND NOTES FOR MOUNTING HEIGHTS.

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COLLEGE OF MARIN IVC JONAS CENTER & BLDGS 18&19 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 10/2/2017 6:19:05 □M

scale: as noted

date:

MECHANICAL COVER SHEET

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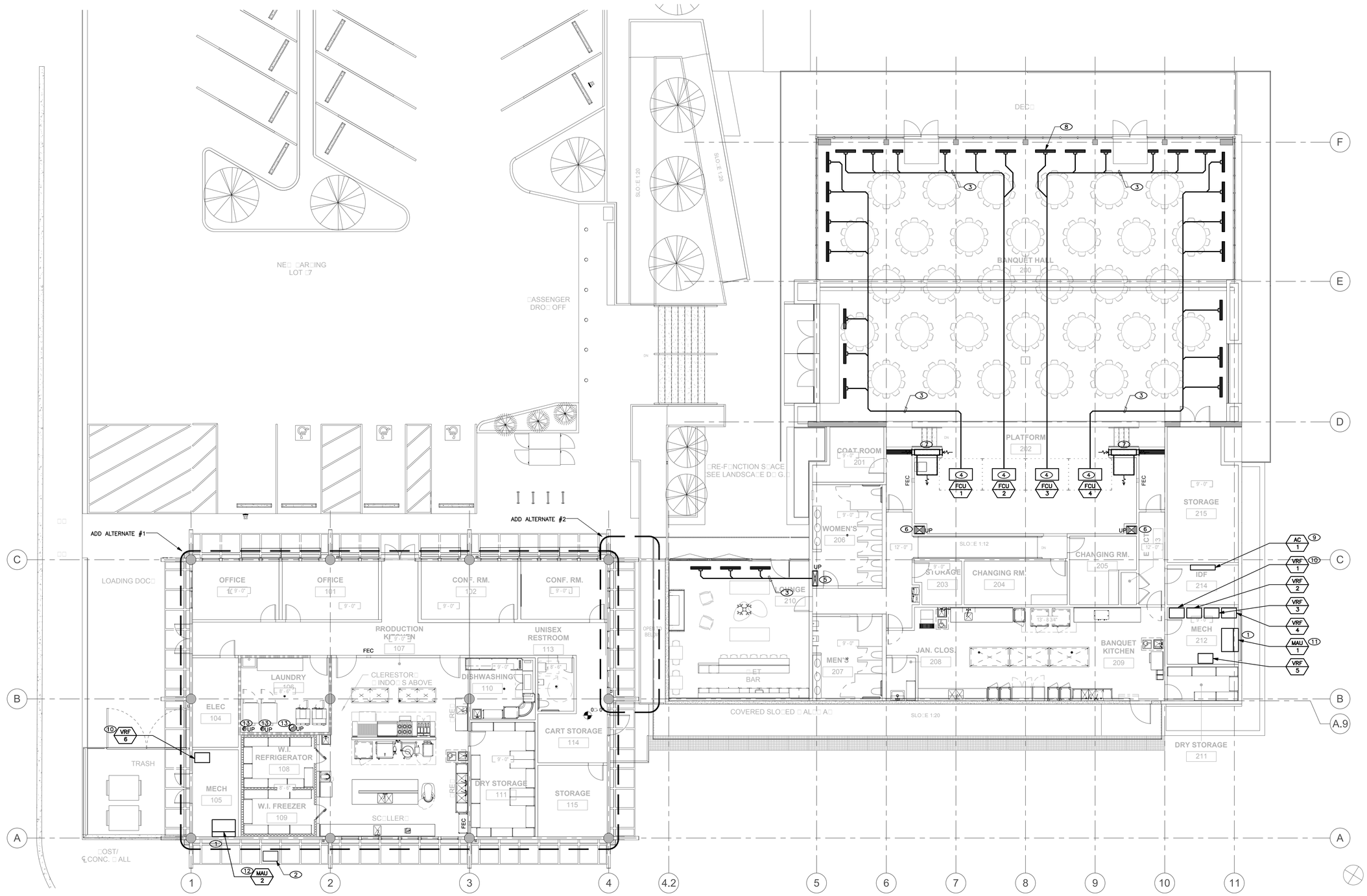

1 MECHANICAL HVAC PLAN
SCALE: 1/8"=1'-0"

SHEET NOTES

A. REFER TO 100% SCHEMATIC DESIGN MEP/LV BASIS OF DESIGN DOCUMENT FOR EQUIPMENT INFORMATION AND HVAC DESIGN CRITERIA.

B. ADD ALT. #1 – INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE, STUB OUT FOR UTILITIES

C. ADD ALT. #2 – EXTERIOR SCOPE FOR NEW CONNECTING CONC. WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

KEYED NOTES

1. MAKE UP AIR UNIT DUCTED TO OUTSIDE AIR LOUVER (6'x9", 50% NET FREE AREA).
2. 4'x3' PAD FOR MOUNTING OF OUTDOOR UNITS SERVING WALK-IN REFRIGERATOR AND WALK-IN FREEZER.
3. DUCT BELOW FLOOR.
4. FAN COIL UNIT IN RATED PLENUM BELOW PLATFORM.
5. SUPPLY DUCT UP TO CEILING PLENUM.
6. OA DUCT PROVIDING VENTILATION TO FAN COIL UNIT LOCATED IN RATED PLENUM BELOW PLATFORM.
7. LINED RETURN AIR DUCT TERMINATING IN RATED PLENUM BELOW PLATFORM.
8. TYPICAL FLOOR-MOUNTED LINEAR SLOT DIFFUSER.
9. WALL-MOUNTED AC UNIT COUPLED WITH OUTDOOR CONDENSING UNIT MOUNTED ON ROOF.
10. TYPICAL VRF MODULE TIED TO CAMPUS CONDENSER WATER SYSTEM.
11. MAKE UP AIR UNIT PROVIDING VENTILATION TO ALL ZONAL FAN COIL UNITS.
12. MAKE UP AIR UNIT PROVIDING AIR TO PRODUCTION KITCHEN.
13. VENTS SERVING LAUNDRY EQUIPMENT.

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JONAS CENTER & BLDGS 18&19 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

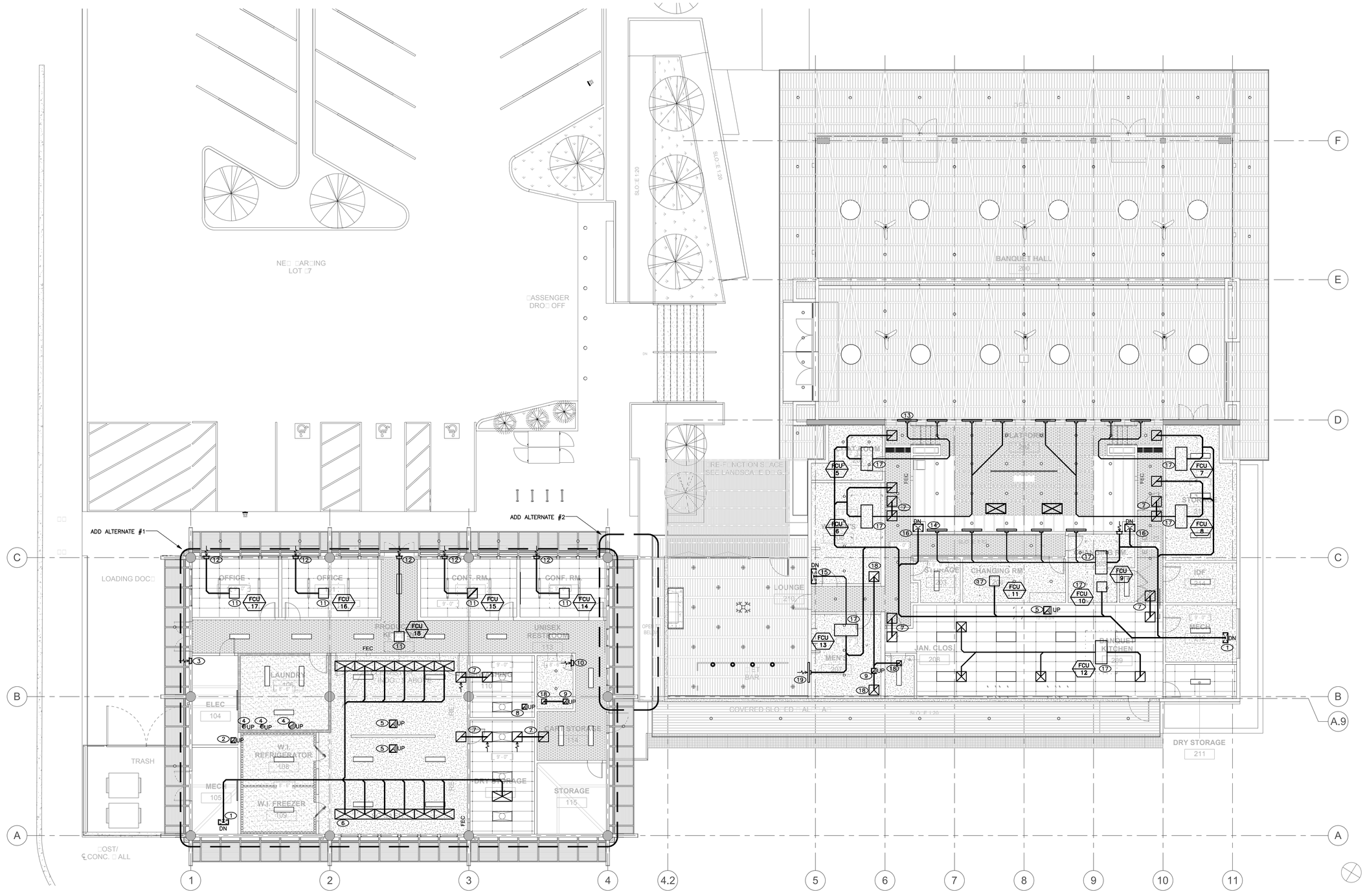
plot date: 10/2/2017 6:19:05 □M

scale: as noted

date:

MECHANICAL HVAC □LAN

M2.01



1 MECHANICAL HVAC REFLECTED CEILING PLAN
SCALE: 1/8"=1'-0"

SHEET NOTES

A. REFER TO 100% SCHEMATIC DESIGN MEP/LV BASIS OF DESIGN DOCUMENT FOR EQUIPMENT INFORMATION AND HVAC DESIGN CRITERIA.

B. ADD ALT. #1 – INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE, STUB OUT FOR UTILITIES

C. ADD ALT. #2 – EXTERIOR SCOPE FOR NEW CONNECTING CONC. WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

KEYED NOTES

1. OA DUCT DOWN TO MAU.
2. EXHAUST DUCT UP TO ROOF–MOUNTED EXHAUST FAN.
3. INTAKE GRILLE FOR ELECTRICAL ROOM.
4. VENTS FOR LAUNDRY EQUIPMENT UP TO ROOF.
5. GREASE DUCT EXHAUST UP TO ROOF–MOUNTED EXHAUST FAN.
6. TYPICAL HIGH–FLOW, LOW–VELOCITY SUPPLY DIFFUSER.
7. TYPICAL TRANSFER ASSEMBLY.
8. MOISTURE EXHAUST DUCT UP TO ROOF–MOUNTED DISHWASHER EXHAUST FAN.
9. EXHAUST DUCT UP TO ROOF–MOUNTED TOILET EXHAUST FAN.
10. SIGTH–PROOF DOOR GRILLE FOR INTAKE TO RESTROOM.
11. TYPICAL VRF ZONE FAN COIL UNIT WITH OUTSIDE AIR OBTAINED VIA PERIMETER WALL GRILLE.
12. TYPICAL OUTSIDE AIR INTAKE GRILLE.
13. TYPICAL WALL–MOUNTED LINEAR SLOT DIFFUSER DISCHARGING HORIZONTALLY TO SERVE BANQUET HALL.
14. TYPICAL LINEAR SLOT DIFFUSER DISCHARGING VERTICALLY TO SERVE PLATFORM.
15. SUPPLY AIR DUCT DOWN TO BELOW FLOOR.
16. SUPPLY DUCT DOWN TO RATED PLENUM BELOW PLATFORM.
17. TYPICAL VRF ZONAL FAN COIL UNIT LOCATED ABOVE CEILING.
18. TYPICAL EXHAUST GRILLE.
19. RETURN LINEAR SLOT DIFFUSER.

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COLLEGE OF MARIN IVC
JONAS CENTER & BLDGS 18&19 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

plot date: 10/2/2017 6:19:05 □M

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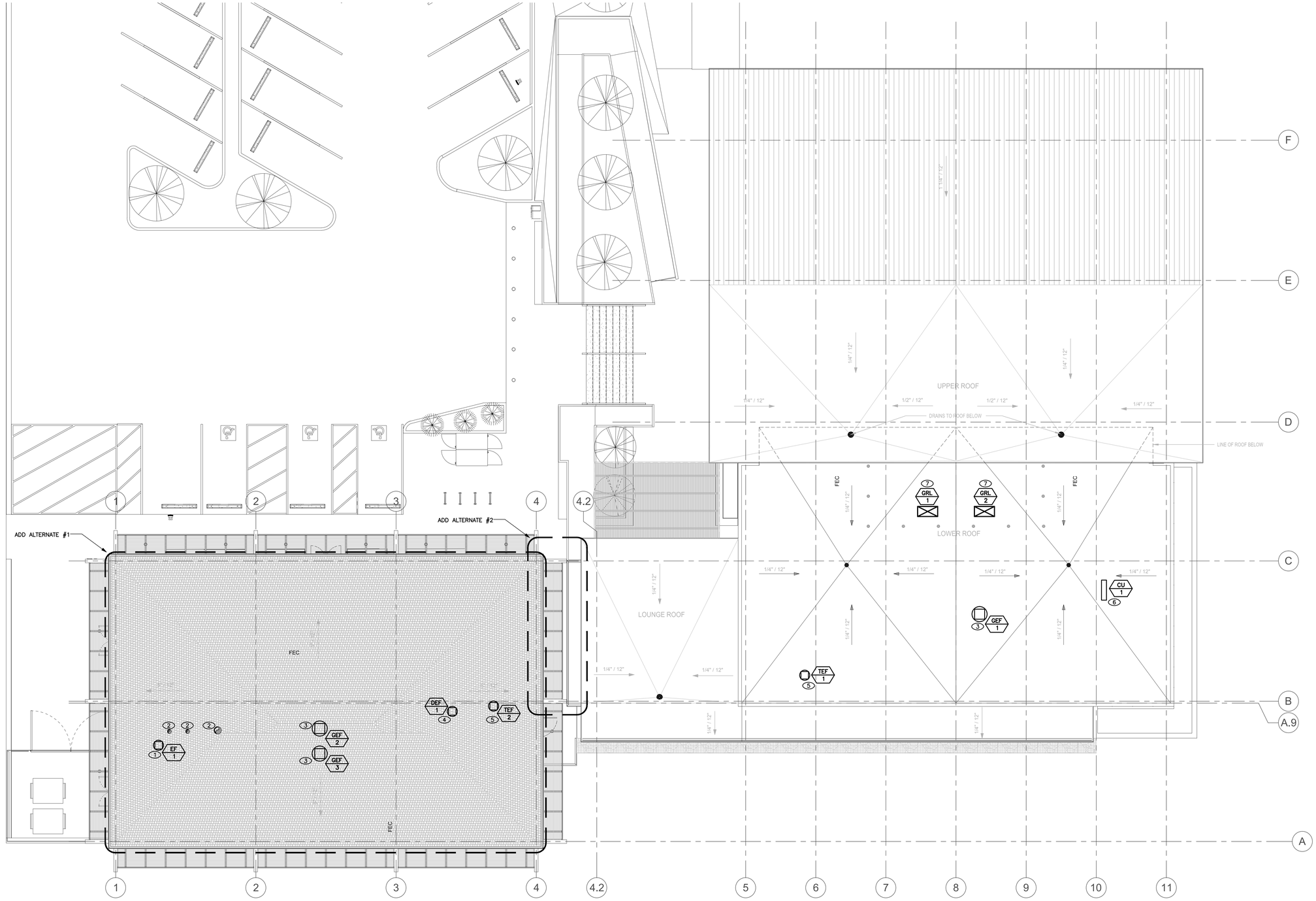
date:

MECHANICAL HVAC REFLECTED CEILING □LAN

M2.02



1 MECHANICAL ROOF PLAN
SCALE: 1/8"=1'-0"

SHEET NOTES

A. REFER TO 100% SCHEMATIC DESIGN MEP/LV BASIS OF DESIGN DOCUMENT FOR EQUIPMENT INFORMATION AND HVAC DESIGN CRITERIA.

B. ADD ALT. #1 – INTERIOR RENOVATION OF BUILDING 18, BASE BID TO INCLUDE INFRASTRUCTURE, STUB OUT FOR UTILITIES

C. ADD ALT. #2 – EXTERIOR SCOPE FOR NEW CONNECTING CONC. WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

KEYED NOTES

1. ELECTRICAL ROOM EXHAUST FAN.
2. LAUNDRY ROOM EQUIPMENT VENTS.
3. KITCHEN GREASE EXHAUST FAN.
4. DISHWASHER EXHAUST FAN.
5. TOILET EXHAUST FAN.
6. SPLIT SYSTEM ROOF–MOUNTED CONDENSING UNIT WITH CORRESPONDING WALL–MOUNTED UNIT LOCATED IN IDF ROOM.
7. RELIEF LOUVERED PENTHOUSE ASSEMBLY.

file: 17.07.03.16-148.04.ivc jonas center /detached.rvt

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MAIN FLOOR ROOF □LAN

M3.02

ELECTRICAL LEGEND

DISTRIBUTION & EQUIPMENT

SYMBOL	DESCRIPTION
	BRANCH CIRCUIT PANELBOARDS, SURFACE AND RECESS MOUNTED, SOLID= 120/208V, HATCHED= 277/480V. DASHED EQUIP. = FUTURE
	MOTOR CONTROL CENTER W/ CODE CLEARANCES SHOWN, DASHED EQUIP. = FUTURE
	TRANSFORMER WITH CODE CLEARANCES SHOWN
	SERVICE AND/OR DISTRIBUTION EQUIPMENT WITH CODE CLEARANCES SHOWN
	CONNECTION TO MOTOR PROVIDED BY OTHERS
VFD	CONNECTION TO MECHANICAL FURNISHED VARIABLE FREQUENCY DRIVE WITH INTEGRAL DISCONNECT ELECTRICAL TO INSTALL VFD EQUIPMENT
30A	DISCONNECT SWITCH, SIZE AS NOTED OR IF NOT SHOWN SIZE PER CONNECTED MOTOR SIZE AND MOTOR DISCONNECT SCHEDULE
	FUSED DISCONNECT SWITCH, SIZE AS NOTED. SIZE
	DISCONNECT W/ MAGNETIC MOTOR STARTER (CONTROLLER) OR CONTACTOR. SIZE PER LOAD SERVED. NEMA SIZE #1 MINIMUM.
	MAGNETIC MOTOR STARTER (CONTROLLER) OR CONTACTOR. SIZE PER LOAD SERVED. NEMA SIZE #1 MINIMUM.
	ELECTRICAL CONNECTION, EQUIPMENT PROVIDED BY OTHERS. SHADED = ON ALT. POWER SOURCE NOTED
	ELECTRICAL CONNECTION TO EQUIPMENT WITH INTEGRAL DISCONNECT THAT IS PROVIDED BY OTHERS. SHADED = ON ALT. POWER SOURCE NOTED
	EQUIPMENT OR TERMINAL ENCLOSURE AS NOTED, SURFACE AND RECESS MOUNTED
	BUILDING GROUND BUS, SEE DETAILS

REFERENCE SYMBOLS

SYMBOL	DESCRIPTION
12	KEYED NOTE REFERENCE
125.4	BRANCH CIRCUIT OR FEEDER NOMINAL AMPACITY & TYPE; REFER TO BRANCH CIRCUIT AND FEEDER SCHEDULES FOR WIRE AND CONDUIT SIZES & QTY.
1 / E4.1	REFER TO DETAIL NO. ON DRAWING INDICATED NOT ALL DETAIL REFERENCES ARE SHOWN. ALL DETAILS APPLY TO ALL APPLICABLE SITUATIONS, UON.
2 / E4.1	ELEVATION TAG: REFER TO ELEVATION NUMBER ON DRAWING INDICATED
CH 1	MECHANICAL EQUIPMENT IDENTIFICATION TAG

LIGHTING

SYMBOL	DESCRIPTION
	RECESSED LENSED LUMINAIRE (SIZE/SHAPE VARIES)
	SUSPENDED LUMINARE (SIZE/SHAPE VARIES)
	POINT SOURCE – SURFACE, RECESSED CEILING MTD.
	FLOOR OR GRADE MOUNTED BOLLARD
	RECESSED STEPLIGHT
	ADJUSTABLE POINT SOURCE – SURFACE CEILING, RECESSED CEILING MOUNTED.
	WALL MOUNTED FLOOD, POSSIBLY AIMABLE
	ILLUMINATED EXIT SIGN, SHADED QUADRANT INDICATES FACES, ARROWS AS SHOWN
	POLE MOUNTED LUMINAIRE– SINGLE OR DUAL HEAD
	POLE TOP MOUNTED LUMINAIRE
	STRIPLIGHT

WIRING

SYMBOL	DESCRIPTION
	WIRING CONCEALED IN CEILING OR WALL. LINE WEIGHT TOP TO BOTTOM= NEW, EXISTING TO REMAIN, FUTURE
	WIRING CONCEALED IN FLOOR OR UNDER GRADE OR ROUTED IN CEILING SPACE OF FLOOR BELOW. LINE WEIGHT TOP TO BOTTOM= NEW, EXISTING TO REMAIN, FUTURE
	WIRING EXPOSED, LINE WEIGHT TOP TO BOTTOM= NEW, EXISTING TO REMAIN, FUTURE
	CONDUIT RUN TURNED UP THROUGH FLOOR OR CEILING. CORE & FIREPROOF AS REQUIRED.
	CONDUIT RUN TURNED DOWN THROUGH FLOOR OR CEILING. CORE & FIREPROOF AS REQUIRED.
	CONDUIT STUBBED OUT AT LOCATION SHOWN. PROVIDE INSULATED BUSHING & PULLROPE.
	RACEWAY STUBBED OUT FOR FUTURE CONTINUATION; CAP, MARK AND RECORD LOCATION.
	TELEPHONE/DATA SLEEVE THROUGH WALL, ABOVE CEILING. EXTEND TO ACCESSIBLE TILE CLG. BOTH SIDES. TERMINATE WITH BUSHINGS. (1) 1.25" CO UON. COORDINATE LOCATIONS WITH CABLE INSTALLER(S) PRIOR TO ROUGH–IN.
J	JUNCTION BOXES, WALL, CEILING AND FLUSH FLOOR MOUNTED. 4" SQ. BOX MIN., LARGER IF REQUIRED
	WIRING EXTENSION POINT – CONDUIT TO MC CABLE OR MANUFACTURED WIRING SYSTEM J–BOX ABOVE ACCESSIBLE CEILINGS AREAS, OR EXTEND CONDUIT & WIRE IN EXPOSED OR "HARD" CEILING AREAS. SHADED= ON ALT. POWER SOURCE (EMERG,UPS,ETC.)
PB	PULL BOX, MIN. SIZE PER NEC., UON.

DIAGRAMS

SYMBOL	DESCRIPTION
	BUS BAR
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
	CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	FUSED VOLTAGE SENSE LEADS
M M	UTILITY CO. APPROVED SOCKET WITH METER INSTALLED. SQUARE = REMOTE MOUNTED
DMU	DIGITAL METER UNIT. REFER TO SPECIFICATIONS.
	DELTA CONNECTION
	GROUNDED WYE CONNECTION
	CONNECTION TO GROUND
100AT 225AF	CIRCUIT BREAKER, WITH TRIP & FRAME AMPERE RATING
225AF 200AS	FUSED SWITCH, WITH FUSE AND SWITCH AMPERE RATING
	INDIVIDUALLY MOUNTED CIRCUIT BREAKER
	GENERATOR
	TRANSFER SWITCH, SEE PLANS FOR TYPE AND POLES.

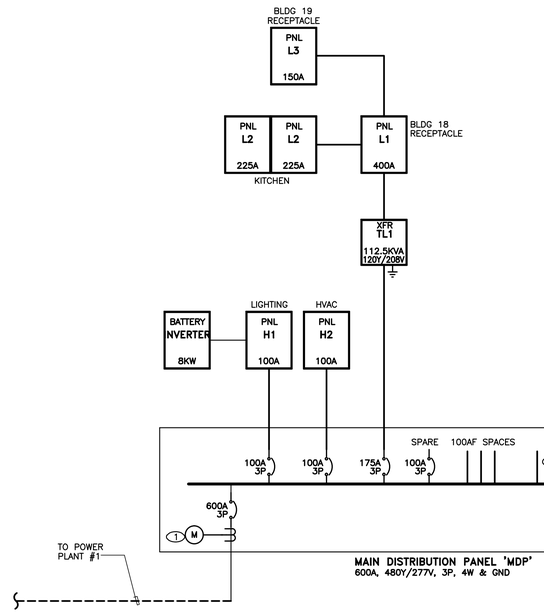
ABBREVIATIONS

(E)	EXISTING TO REMAIN	IES	ILLUMINATING ENGINEERING SOCIETY
(R)	EXISTING TO BE REMOVED	KCMIL	THOUSAND CIRCULAR MILS
A, AMP	AMPERES	KW	KILOWATTS
AFF	ABOVE FINISHED FLOOR	KVA	KILOVOLT–AMPERES
AIC	EQUIPMENT SHORT CIRCUIT INTERRUPT RATING (RMS SYM. AMPS)	LTG	LIGHTING
		LCP	LIGHTING CONTROL PANEL
AUX	AUXILIARY	MCA	MINIMUM CIRCUIT AMPERES
AWG	AMERICAN WIRE GAUGE	MIN	MINIMUM
BAT	BATTERY	MISC	MISCELLANEOUS
CAB	CONDUIT (CIRCULAR RACEWAY) CABINET	MLO	MAIN LUGS ONLY
		MTD	MOUNTED
CB	CIRCUIT BREAKER	MTR	MOTOR
CO	CONDUIT ONLY	NEC	NATIONAL ELECTRICAL CODE
CU	COPPER	NEMA	NATIONAL ELEC MFGR'S ASSOC.
DIA	DIAMETER	OC	ON CENTER
DIV	DIVISION	OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
DP	DISTRIBUTION PANEL	OFOI	OWNER FURNISHED, OWNER INSTALLED
DWG	DRAWING	P	POLE
E,EMERG	EMERGENCY	PH	PHASE
EF	EXHAUST FAN	PNL	PANEL
EMT	ELECTRICAL METALLIC TUBING	SUB	SUBSTATION
ENCL	ENCLOSURE	SWBD	SWITCHBOARD
EWH	ELECTRIC WATER HEATER	TEL	TELEPHONE
FA	FIRE ALARM	TYP	TYPICAL
FAA	FIRE ALARM ANNUNCIATOR	UL	UNDERWRITERS LAB
FC	FOOT CANDLES	UON	UNLESS OTHERWISE NOTED
FLA	FULL LOAD AMPERES	V	VOLTS
FSD	FIRE/SMOKE DAMPER	VA	VOLT–AMPERES
GEN	GENERATOR	VFD	VARIABLE FREQUENCY DRIVE
GFI	GROUND FAULT CIRCUIT INTERRUPTER	W	WATT
GND	GROUND	WP	WEATHERPROOF, SEE RECEPT. SYMBOL
HP	HORSEPOWER	XFR	TRANSFORMER
		", IN	INCHES
		', FT	FEET

ELECTRICAL DRAWING LIST

ADD ALTERNATE #1: INTERIOR RENOVATION OF BUILDING 18. BASE BID TO INCLUDE ELECTRICAL INFRASTRUCTURE AND STUB OUT FOR UTILITIES FOR KITCHEN, RESTROOMS, LAUNDRY, ETC.

ADD ALTERNATE #2: EXTERIOR SCOPE FOR NEW CONNECTING CONCRETE WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.



KEYED NOTES

1. PROVIDE SUBMETER AS REQUIRED BY THE 2016 ENERGY EFFICIENCY STANDARDS (T24), EMON DEMON OR EQUAL.
2. PROVIDE A RESERVED SPACE TO ALLOW FOR THE INSTALLATION OF A DOUBLE POLE CIRCUIT BREAKER FOR CONNECTION OF A FUTURE SOLAR ELECTRIC INSTALLATION AS REQUIRED BY THE 2016 BUILDING ENERGY EFFICIENCY STANDARDS (T24), 110.10(E). THE RESERVED SPACE SHALL BE PERMANENTLY MARKED AS "FOR FUTURE SOLAR ELECTRIC" AND POSITIONED AT THE OPPOSITE (LOAD END) FROM THE INPUT FEED LOCATION OF THE MAIN CIRCUIT BREAKER.

1 **SINGLE LINE DIAGRAM**
SCALE: NONE

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ELECTRICAL LEGEND, ABBREVIATIONS, AND SINGLE LINE DIAGRAM

E0.01

1 ELECTRICAL SITE PLAN
SCALE: 1/16"=1'-0"

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ELECTRICAL
SITE □LAN

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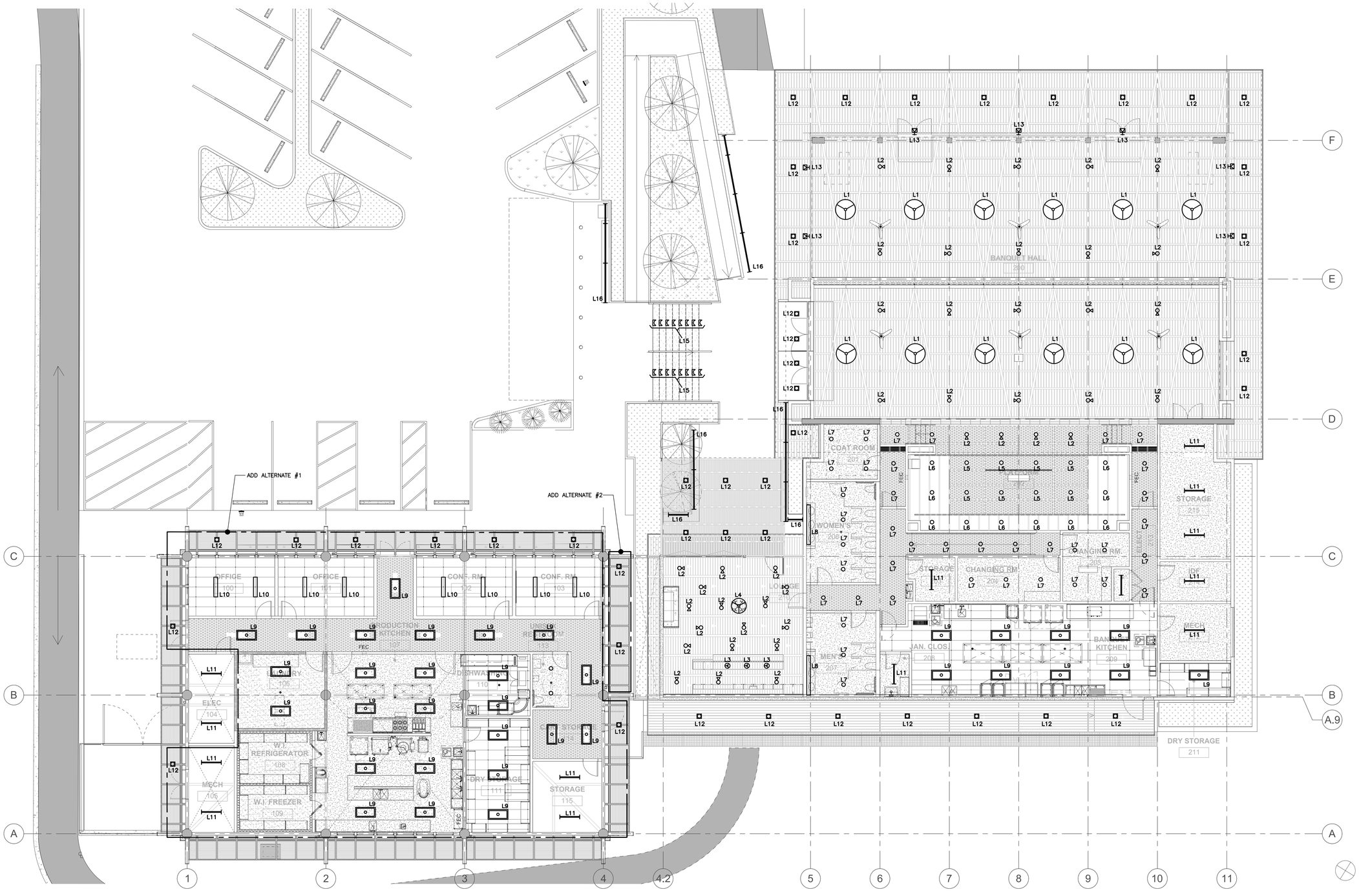

1 ELECTRICAL LIGHTING PLAN
SCALE: 1/8"=1'-0"

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ELECTRICAL LIGHTING □LAN

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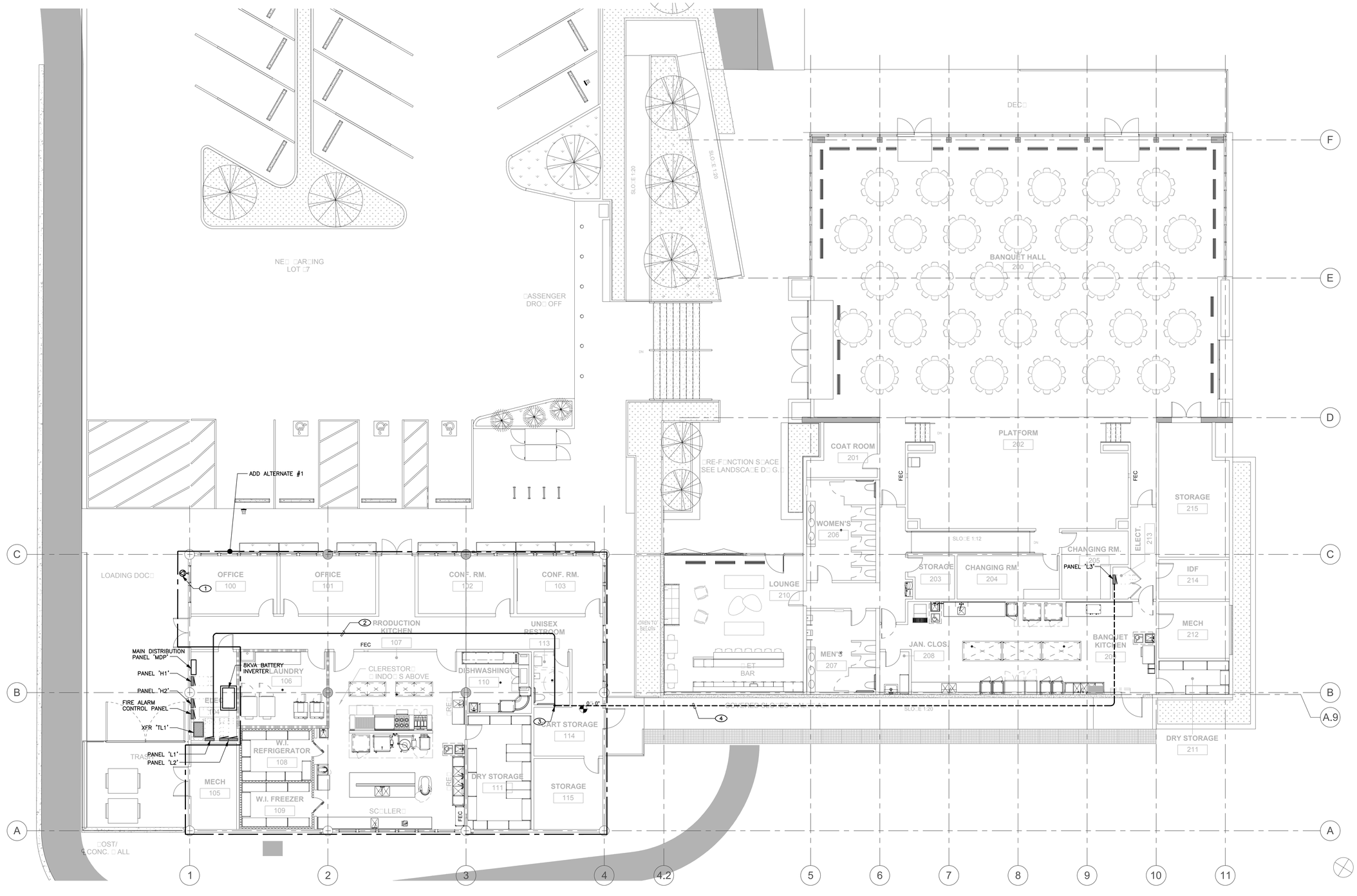

1 ELECTRICAL POWER PLAN
SCALE: 1/8"=1'-0"

KEYED NOTES

1. PROVIDE SPECIAL PURPOSE OUTLET FOR CONNECTION TO PORTABLE GENERATOR. CONFIRM EMERGENCY LOADS WITH DISTRICT TO CONFIRM SIZING OF GENERATOR AND ASSOCIATED OUTLET.
2. OVERHEAD CONDUIT.
3. TRANSITION TO UNDERFLOOR CONDUIT AT THIS LOCATION.
4. CONDUIT RUN BELOW WALKWAY AND INTO UNDERFLOOR AREA OF BUILDING 19 TO FEED PANELBOARD.

SHEET NOTES

A. ALL SCOPE FOR BUILDING #18 IS ADD ALTERNATE #1 EXCEPT FOR THE ELECTRICAL DISTRIBUTION SYSTEM FOR BUILDING #18 AND BUILDING #19, INCLUDING THE ELECTRICAL FEEDER AND CIRCUIT BREAKER FROM POWER PLANT #1.

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ELECTRICAL
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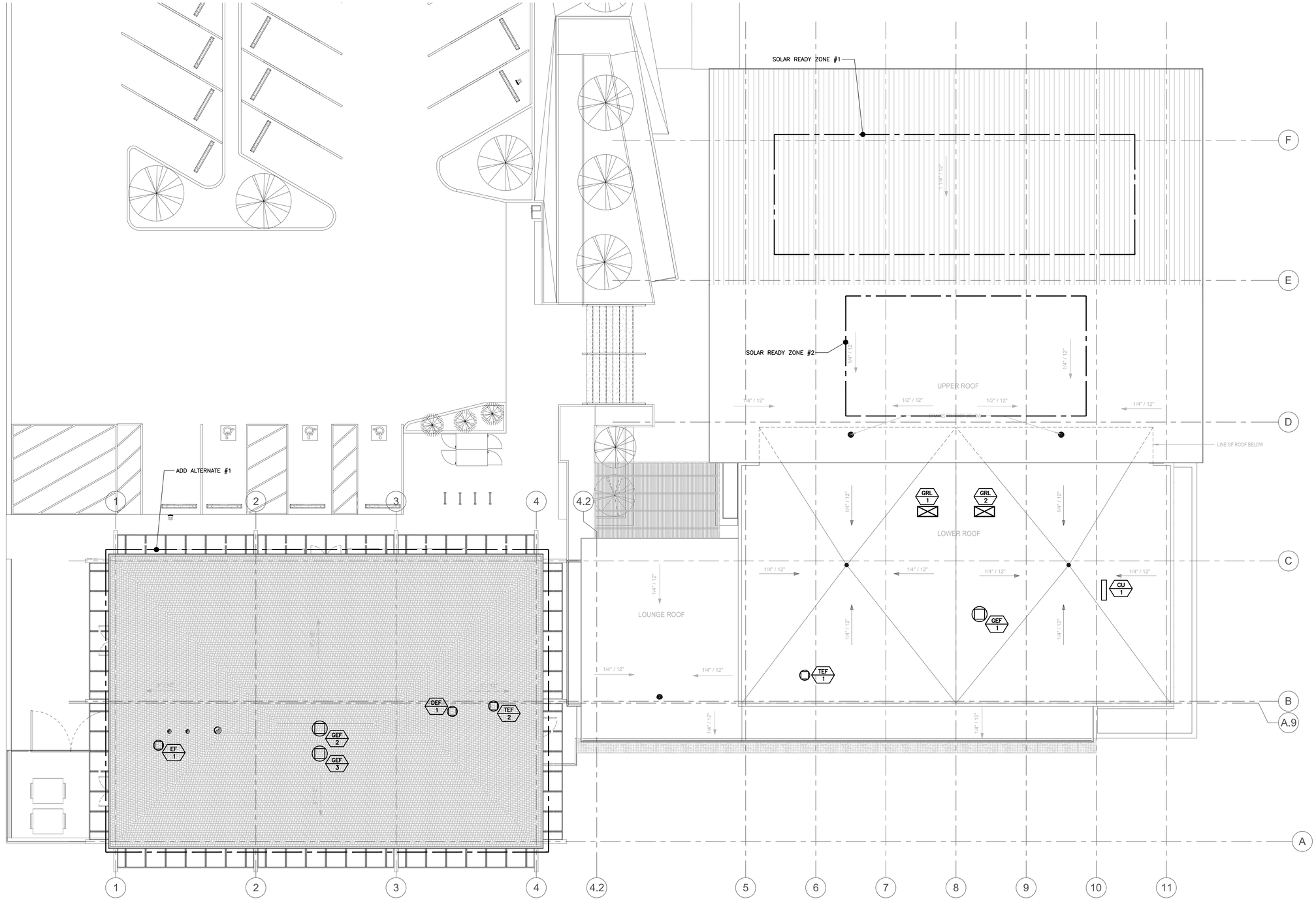

1 ELECTRICAL ROOF PLAN
SCALE: 1/8"=1'-0"

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ELECTRICAL ROOF LAN

E3.02

SCHEDULES

GAS WATER HEATER SCHEDULE

□NIT NO.	MAN□FACT□RER & MODEL NO.	LOCATION	STORAGE CA□ACIT□ GALLONS	O□TLET TEM□ °F.	RECOVER□ @ 90°ΔT G□H	GAS IN□□T MBH	THERMAL EFFICIENC□ □%	ELECT. S□EC.	O□ER □ EIGHT □O□NDS	REMAR□S
GWH-1	A.O. SMITH BTS 199	MECH RM BUILDING 18	50	140	253	199	96	-	600	NOTES 1 & 2
GWH-2	A.O. SMITH BTS 199	MECH RM BUILDING 18	50	140	253	199	96	-	600	NOTES 1 & 2
GWH-3	A.O. SMITH BTS 199	MECH RM BUILDING 19	50	140	253	199	96	-	600	NOTES 1 & 2
GWH-4	A.O. SMITH BTS 199	MECH RM BUILDING 19	50	140	253	199	96	-	600	NOTES 1 & 2

NOTES:
1. PROVIDE EXPANSION TANK AND CIRCULATION PUMP WITH TIMER AND AQUASTAT.
2. WATER HEATER SIZE SHOWN FOR REFERENCE ONLY. SHALL BE VERIFY WITH THE KITCHEN HOT WATER REQUIREMENTS

PLUMBING FIXTURE ROUGH-IN SCHEDULE

SYMBOL	DESCRIPTION	ROUGH-IN SIZE IN INCHES				MANUFACTURER & MODEL NUMBERS
		W	V	CW	HW	
WC-1	WATER CLOSET	4"	2"	1-1/4"	-	WATER CLOSET TO BE WALL MOUNTED, ELONGATED, 1.28 GPF FLUSHOMETER TOILET.
WC-2	WATER CLOSET (ADA)	4"	2"	1-1/4"	-	WATER CLOSET TO BE WALL MOUNTED, ELONGATED, 1.28 GPF FLUSHOMETER TOILET.
UR-1	URINAL	2"	1-1/2"	3/4"	-	URINAL TO BE 0.125 GPF , ULTRA HIGH EFFICIENCY PINT URINAL SYSTEM WITH 0.125 GPF URINAL FLUSH VALVE.
UR-2	URINAL (ADA)	2"	1-1/2"	3/4"	-	URINAL TO BE 0.125 GPF , ULTRA HIGH EFFICIENCY PINT URINAL SYSTEM WITH 0.125 GPF URINAL FLUSH VALVE.
L-1	LAVATORY (ADA)	2"	1-1/2"	1/2"	1/2"	LAVATORY TO BE OVAL UNDERCOUNTER LAVATORY WITH 0.5 GPM FAUCET
L-2	LAVATORY (ADA)	2"	1-1/2"	1/2"	1/2"	LAVATORY TO BE WALL HUNG LAVATORY WITH 0.5 GPM FAUCET
DF-1	DRINKING FOUNTAIN	2"	1-1/2"	1/2"	-	DRINKING FOUNTAIN TO BE WALL MOUNTED, FULLY EXPOSED, SLIMLINE, BARRIER-FREE ACCESS, HEAVY DUTY 14 GAUGE DRINKING FOUNTAIN.
SK	KITCHEN SINK	2"	1-1/2"	1/2"	1/2"	KITCHEN SINKS TO BE FOOD SERVICE FIXTURES. REFER TO FOOD SERVICE AND ARCHITECTURAL PLANS FOR SPECIFICATIONS AND DETAIL. CONTRACTOR TO ROUGH-IN, INSTALL AND MAKE FINAL CONNECTION TO ALL FIXTURES. VERIFY CONNECTION SIZE WITH FOOD SERVICE.
SSK-1	SERVICE SINK	2"	1-1/2"	1/2"	1/2"	SERVICE SINK TO BE FIAT TERRAZZO 36"X24" X 12 DEEP FLOOR MOP SERVICE BASIN WITH MODEL 830-AA SERVICE SINK FAUCET.
FD-1	FLOOR DRAIN	2"	1-1/2"	1/2"	-	FLOOR DRAIN TO BE ZURN Z-415B, DURA-COATED CAST IRON BODY WITH BOTTOM OUTLET, COMBINATION INVERTIBLE MEMBRANE CLAMP AND ADJUSTABLE COLLAR WITH SEEPAGE SLOTS AND TYPE B STRAINER
FS-1	FLOOR SINK	2"	1-1/2"	1/2"	-	FLOOR SINK TO BE ZURN Z-1900SANI-FLOR RECEPTOR, 12X12X6 DEEP CAST IRON BODY AND SQUARE LIGHT DUTY GRATE WITH 1/2 SLOT OPENING. WHITE ACID RESISTING PORCELAIN ENAMEL INTERIOR AND TOP. COMPLETE WITH WHITE ABS ANTI -SPLASH INTERIOR BOTTOM DOME STRAINER.

NOTE:
1. PROVIDE ALL MISCELLANEOUS APPURTENANCES AS REQUIRED FOR INSTALLATION OF A COMPLETE SYSTEM INCLUDING BUT NOT LIMITED TO: CARRIERS, BACKING PLATES, STOPS, TRAPS, DRAINS, ETC.
2. REFER TO THE ARCHITECTURAL PLANS FOR LOCATIONS OF ADA FIXTURES. INSTALL ADA FIXTURES PER THE ADA STANDARDS
3. ALL FIXTURE FLOW RATES TO COMPLY WITH THE REQUIREMENTS OF CALGREEN WASTE WATER REDUCTION MANDATORY MEASURES.

PLUMBING EQUIPMENT SCHEDULE

SYMBOL	DESCRIPTION	MANUFACTURER & MODEL NUMBERS
HB-1	HOSE BIBB	WOODFORD MODEL 24 ANTI-SIPHON VACUUM BREAKER PROTECTED WALL FAUCET
TP-1	TRAP PRIMER	PRECISION PLUMBING PRODUCT, MODEL NO. P0.500 PROVIDE ACCESS PANEL
WHA	WATER HAMMER ARRESTORS	PRECISION PLUMBING PRODUCTS SCS SERIES, SIZE PER PDI STANDARDS, PROVIDE ACCESS PANEL AND SHUT-OFF VALVE
RCP-1	HOT WATER CIRC. PUMP	BELL & GOSSETT LR20BF, BRONZE BODY, 1" NPT FLANGE CONNECTIONS, 1/20 HP MOTOR, 115V/1PH. DIGITAL 7-DAY PROGRAMMABLE TIMER TO BE PROVIDED BY ELECTRICAL.

NOTES:
1. PROVIDE ALL MISCELLANEOUS APPURTENANCES AS REQUIRED FOR A COMPLETE INSTALLATION OF ALL ITEMS ABOVE.

ABBREVIATIONS

ABV	ABOVE
AD	ACCESS DOOR
ADA	AMERICANS WITH DISABILITIES ACT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AP	ACCESS PANEL
ARCH	ARCHITECT
ASR	AUTO FIRE SPRINKLER RISER
BEL	BELOW
BFV	BUTTERFLY VALVE
BHP	BRAKE HORSEPOWER
BTU	BRITISH THERMAL UNIT
BV	BALL VALVE
BWV	BACKWATER VALVE
CA	COMPRESSED AIR
CD	CONDENSATE DRAIN
CFF	CAP FOR FUTURE
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CI	CAST IRON
CLG	CEILING
CO	CLEANOUT
CONC	CONCRETE
CONN	CONNECTION
CONTR	CONTRACTOR
CONT	CONTINUATION
CS	CIRCUIT SETTER
CV	CHECK VALVE
CW	COLD WATER
CW(FU)	COLD WATER FIXTURE UNIT
DN	DOWN
DCVA	DOUBLE CHECK VALVE ASSEMBLY
DDCVA	DOUBLE DETECTOR CHECK VALVE ASSEMBLY
DFU	DRAINAGE FIXTURE UNIT
HWR	HOT WATER RECIRC
DIA	DIAMETER
DSN	DOWNSPOUT NOZZLE
D	DRAIN
DWG	DRAWING
DWV	DRAINAGE WASTE AND VENT
EXIST	EXISTING
ELEC	ELECTRICAL
FA	FLOW ALARM
FC	FLEXIBLE CONNECTION
FCO	FLOOR CLEANOUT
FDV	FIRE DEPARTMENT VALVE
FDVC	FIRE DEPARTMENT VALVE CABINET
FFE	FINISHED FLOOR ELEVATION
FH	FIRE HYDRANT
FHV	FIRE HOSE VALVE
FIN	FINISHED
FLR	FLOOR
FLSW	FLOW SWITCH
FO	FUEL OIL
FPS	FEET PER SECOND
FRM	FROM
FT	FEET
FT	FLUSH TANK
(FU)	FIXTURE UNIT
FUT	FUTURE
FV	FLUSH VALVE
G	GAS
GAL	GALLONS
GC	GAS COCK
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HD	HUB DRAIN
HP	HORSEPOWER
HW	HOT WATER
HWFU	HOT WATER FIXTURE UNIT
IAPMO	INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
ICBO	INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS
I.E.	INVERT ELEVATION
I.R.R.	IRRIGATION
LAV	LAVATORY
LBS	POUNDS (UNIT OF FORCE)
LP	LUBRICATED PLUG VALVE
MAX	MAXIMUM
MBH	THOUSANDS BTU/HR
MECH	MECHANICAL
MFR	MANUFACTURER
MIN	MINIMUM
MH	MANHOLE
N.C.	NORMALLY CLOSED
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NO.	NUMBER
N.O.	NORMALLY OPEN
NIC	NOT IN CONTRACT
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OW	OIL WASTE
POC	POINT OF CONNECTION
PLBG	PLUMBING
PRV	PRESSURE REDUCING VALVE
PS	PRESSURE SWITCH
PSI	POUNDS PER SQUARE INCH
PT	PRESSURE TEMPERATURE TAP (PETE'S PLUG)
PV	PROCESS VENT
PV	PLUG VALVE
RI&C	ROUGH IN AND CONNECT
RPBFP	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER
RPM	REVOLUTIONS PER MINUTE
RV	RELIEF VALVE
SD	STORM DRAIN
SF	SQUARE FEET
SHT	SHEET
SN	SHEET NOTE
SOV	SHUT-OFF VALVE
SPR	SPRINKLER
S.S.	STAINLESS STEEL
SV	SOLENOID VALVE
TB	THRUST BLOCK
TP	TRAP PRIMER
TS	TAMPER SWITCH
TT	TEST TEE
TYP	TYPICAL
U	URINAL
UN	UNION
VB	VACUUM BREAKER
V	VENT
VTR	VENT THROUGH ROOF
W	WASTE
WC	WATER CLOSET
WHA	WATER HAMMER ARRESTOR
WCO	WALL CLEANOUT
W/	WITH
WGT	WEIGHT
Y.B.	YARD BOX

PLUMBING LEGEND

SYMBOL	DESCRIPTION
1% SLOPE	DIRECTION OF SLOPE
	DIRECTION OF FLOW
	PIPE UP OR UP & DN
	PIPE DOWN
	PIPE DROP
	TOP CONNECTION – BRANCH LINE
	BOTTOM CONNECTION – BRANCH LINE
	COLD WATER
	HOT WATER (120°F)
	HOT WATER CIRC (110°F)
SAN	SANITARY SEWER, WASTE OR SOIL BELOW GRADE OR FLOOR
SD	STORM DRAIN
	PIPING BELOW GRADE
	WASTE, OR SOIL ABOVE GRADE OR FLOOR
	VENT
RD	ROOF DRAIN PIPING, THE PIPES FROM ROOF DRAIN SD (STORM DRAIN)
OD	OVERFLOW DRAIN PIPING
PD	PUMPED DISCHARGE
D	DRAIN LINE
IW	INDIRECT WASTE
GW	GREASE WASTE
G	NATURAL GAS (7"W.C.)
MG	MEDIUM PRESSURE GAS (2 PSIG TO 5 PSIG)
LG	LOW PRESSURE GAS
	EXISTING TO BE REMOVED
	TRAP PIMER
	BALL VALVE
	BUTTERFLY VALVE
	GATE VALVE
	BALANCING VALVE
	SHUT OFF VALVE IN CONCRETE YARD BOX
	ANGLE GATE VALVE
TS	OS & Y GATE VALVE (OUTSIDE SCREW & YOKE GATE VALVE)
TS	OS & Y GATE VALVE WITH TAMPER SWITCH
	SOLENOID VALVE
	LUBRICATED PLUG VALVE
	CHECK VALVE
	PRESSURE REDUCING VALVE
	RELIEF VALVE
	VACUUM RELIEF VALVE
	PRESSURE & TEMPERATURE RELIEF VALVE
	AUTOMATIC AIR VENT
	CIRCUIT SETTER
	BACKWATER VALVE
DDCV	DOUBLE DETECTOR CHECK VALVE ASSEMBLY
DCV	DOUBLE CHECK VALVE ASSEMBLY
RPBFP	REDUCED PRESSURE BACKFLOW PREVENTER
	UNION
	STRAINER
	STRAINER WITH BLOW OFF
	PIPE ANCHOR
	PIPE ALIGNMENT GUIDE
	EXPANSION JOINT
	FLEXIBLE CONNECTOR
	CAP OR PLUG
	BLIND FLANGE
	CONCENTRIC REDUCER
	ECCENTRIC REDUCER
	AQUASTAT
WHA	WATER HAMMER ARRESTOR
PG	PRESSURE GAUGE WITH COCK
T	THERMOMETER
CO/WCO	CLEANOUT/WALL CLEANOUT
FCO	FLOOR CLEANOUT
GCO/YCO	GRADE/YARD CLEANOUT
TT	TEST TEE
WH	WALL HYDRANT
HB	HOSE BIBB
FD	FLOOR DRAIN
	ROOF DRAIN
	OVERFLOW DRAIN
	PLUMBING EQUIPMENT
#	SHEET NOTE
1 / P2	DETAIL NO. / SHEET NO.
	POINT OF CONNECTION

NOTE: NOT ALL SYMBOLS OR ABBREVIATIONS ARE NECESSARILY USED ON THIS PROJECT.

PLUMBING DESIGN CRITERIA

1. CODES AND STANDARDS
   A. AMERICANS WITH DISABILITIES ACT, (ADA)
   B. BUILDING CODES ENFORCED BY THE AUTHORITY HAVING JURISDICTION IN CALIFORNIA:
      1. 2016 CALIFORNIA PLUMBING CODE (CPC) BASED ON 2015 UNIFORM PLUMBING CODE (UPC) WITH STATE & CITY AMENDMENTS.
      2. 2016 CALIFORNIA BUILDING CODE (CBC) BASED ON 2016 UNIFORM BUILDING CODE (UBC) WITH STATE & CITY AMENDMENTS.
      3. 2016 CALIFORNIA ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS
      4. 2016 CALIFORNIA GREEN BUILDING CODE (CALGREEN)

2. SANITARY WASTE, CONDENSATE DRAIN AND VENT SYSTEM
   A. HORIZONTAL DRAINAGE PIPING SHALL BE RUN IN PRACTICAL ALIGNMENT AND A UNIFORM SLOPE OF NOT LESS THAN ONE–FOURTH (1/4) INCH PER FOOT OR 2 PERCENT TOWARD THE POINT OF DISPOSAL PROVIDED THAT, WHERE IT IS IMPRACTICAL DUE TO THE DEPTH OF THE STREET SEWER, TO THE STRUCTURAL FEATURES, OR TO THE ARRANGEMENT OF ANY BUILDING OR STRUCTURE TO OBTAIN A SLOPE OF ONE–FOURTH (1/4) OF AN INCH PER FOOT OR 2 PERCENT, ANY SUCH PIPE OR PIPING FOUR (4) INCHES OR LARGER IN DIAMETER MAY HAVE A SLOPE OF NOT LESS THAN ONE–EIGHTH (1/8) OF AN INCH PER FOOT OR 1 PERCENT, WHEN FIRST APPROVED BY THE AUTHORITY HAVING JURISDICTION.
   B. ALL VENT PIPING SHALL BE LEVEL OR SHALL BE SO GRADED AND CONNECTED AS TO DRIP BACK BY GRAVITY TO THE DRAINAGE PIPE IT SERVED.
   C. PROVIDE CLEANOUTS ON ALL SANITARY SEWER AND STORM DRAIN PIPES PER CPC 707.

3. DOMESTIC WATER SYSTEM
   A. PIPE SIZING CRITERIA BASED ON THE REQUIREMENTS OF THE 2016 STATE OF CALIFORNIA PLUMBING CODE, 2015 EDITION OF THE UNIFORM PLUMBING CODE, WITH CITY AMENDMENTS.
   B. THE MINIMUM WATER PRESSURE SUPPLIED TO THE MOST REMOTE FIXTURE. WHICH SHALL NOT BE LESS THAN 25 PSI OR THE FIXTURE REQUIREMENTS, WHICHEVER IS IS HIGHER PER CPC 608.1.
   C. WHERE QUICK ACTING VALVES ARE INSTALLED WATER HAMMER ARRESTERS ARE TO INSTALLED PER CPC 609.10.
   D. TEST OF WATER PIPING SHALL BE A NOT LESS THAN THE WORKING PRESSURE TO BE USED AND SHALL WITHSTAND THE TEST FOR NOT LESS THAN 15 MINUTES PER CPC609.4.

4. FUEL GAS SYSTEM
   A. PIPE SIZING CRITERIA BASED ON THE REQUIREMENTS OF THE CALIFORNIA PLUMBING CODE.
   B. PIPE SIZES ARE CALCULATED BASED ON CPC TABLE 12–8 MAXIMUM DELIVERY CAPACITY OF CUBIC FEET OF GAS PER HOUR OF SCHEDULE 40 METALLIC PIPE CARRYING NATURAL GAS OF SPECIFIC GRAVITY BASED ON PRESSURE DROP OF 0.5 INCH WATER COLUMN.

GENERAL NOTES

1. ALL WORK SHALL BE IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, FEDERAL CODES, LAWS AND REGULATIONS.
2. CONTRACTOR SHALL VISIT SITE AND BE FULLY COGNIZANT OF ALL CONDITIONS PRIOR TO SUBMITTING PROPOSAL.
3. CONTRACTOR SHALL OBTAIN AND PAY FOR ALL REQUIRED PERMITS, FEES AND INSPECTIONS.
4. COORDINATE ALL WORK WITH ARCHITECTURAL, MECHANICAL, ELECTRICAL, AND STRUCTURAL MEMBERS. NO ITEM SUCH AS PIPE, DUCT, ETC., TO BE IN CONTACT WITH ANY EQUIPMENT.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CUTTING AND PATCHING.
6. FURNISH AND INSTALL ALL MATERIALS, EQUIPMENT, AND LABOR AS SHOWN AND AS NECESSARY FOR A COMPLETE AND WORKABLE SYSTEM.
7. GUARANTEE ALL WORK AND MATERIALS FOR ONE (1) YEAR FROM DATE OF FILING NOTICE OF COMPLETION.
8. RESTORE ALL DAMAGE RESULTING FROM WORK OF THIS TRADE AND LEAVE PREMISES IN CLEAN CONDITION AT END OF EACH WORKING DAY.
9. VERIFY SIZE AND LOCATION OF ALL EXISITNG SERVICES IN FIELD.
10. ALL ASPECTS OF THE PLUMBING SYSTEM SHALL COMPLY WITH THE LEAD FREE ORDINANCE AB 1953. (CALIFORNIA HEALTH AND SAFETY CODE SECTION 116875)
11. THE PLANS ARE DIAGRAMMATIC AND SHOW GENERALLY THE LOCATIONS OF THE FIXTURES, EQUIPMENT, AND PIPE LINES AND ARE NOT TO BE SCALED; ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AT THE BUILDING AND VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH WORK.

PLUMBING DRAWING LIST

ADD ALTERNATE #1: INTERIOR RENOVATION OF BUILDING 18. BASE BID TO INCLUDE INFRASTRUCTURE AND STUB OUT FOR UTILITIES FOR KITCHEN, RESTROOMS, LAUNDRY, ETC.

ADD ALTERNATE #2: EXTERIOR SCOPE FOR NEW CONNECTING CONCRETE WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

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NOT FOR CONSTRUCTION

rev	date	issue
	11/21/17	100% SD
	06/16/17	50% SD

COLLEGE OF MARIN IVC
JONAS CENTER & BLDGS 18&19 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

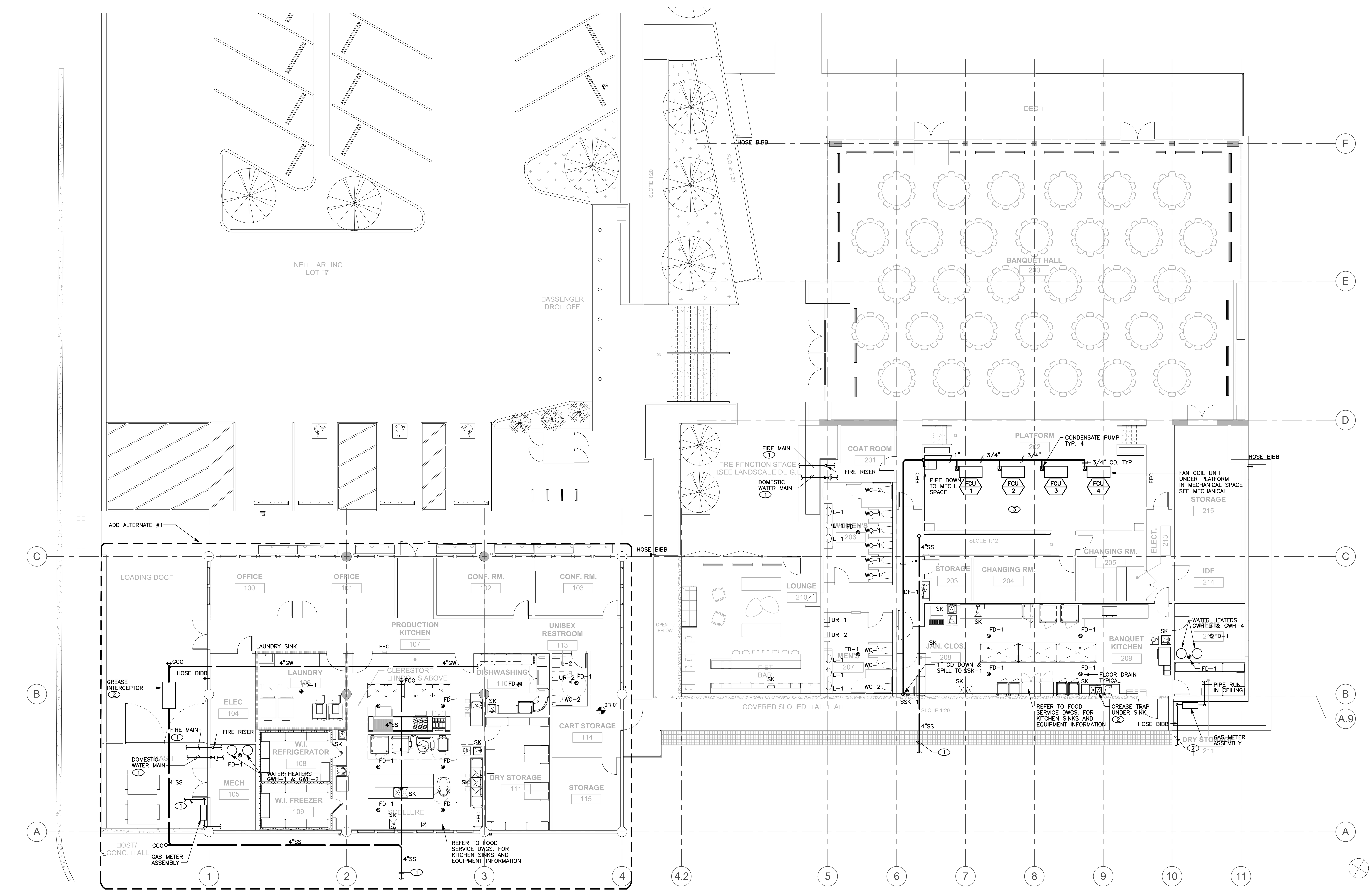
plot date: 10/2/2017 6:19:05 □M

scale: as noted

date:

□L□MBING COVER SHEET

P0.0



1 PLUMBING PLAN

SCALE: 1/8"=1'-0"

SHEET NOTES :

1. REFER TO THE ARCHITECTURAL DRAWINGS FOR EXACT LOCATIONS AND ELEVATION OF ALL PLUMBING FIXTURES.
2. REFER TO THE ARCHITECTURAL DRAWINGS AND FOOD SERVICE DRAWINGS FOR EXACT LOCATIONS AND ELEVATION OF ALL KITCHEN FIXTURES.
3. PROVIDE AND INSTALL FLOOR SINKS FOR INDIRECT WASTE DRAINAGE IN KITCHEN AS SHOWN ON FOOD SERVICE DRAWINGS.

KEYED NOTES

1. REFER TO THE CIVIL DRAWINGS FOR CONTINUATION OF ALL UTILITY LINES, LOCATIONS OF WATER METERS AND BACKFLOW PREVENTERS.
2. PROVIDE GREASE INTERCEPTOR AND GREASE TRAP AT LOCATIONS AS SHOWN. GREASE INTERCEPTOR AND GREASE TRAP SHALL BE SIZED IN ACCORDANCE WITH CPC 2016 CHAPTER 10 REQUIREMENTS.
3. PROVIDE CONDENSATE PUMP FOR 4 FAN COIL UNITS IN THE MECHANICAL SPACE UNDER THE PLATFORM. CONNECT PUMPED CONDENSATE DRAINS, AND ROUTE TO SERVICE SINK IN JANITOR CLOSET.

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indian valley campus, novato ca

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PLUMBING PLAN

P2.01

TECHNOLOGY LEGEND

NOTE: NOT ALL SYMBOLS OR ABBREVIATIONS ARE APPLICABLE TO THIS PROJECT. REFER TO DETAILS AND NOTES FOR MOUNTING HEIGHTS.

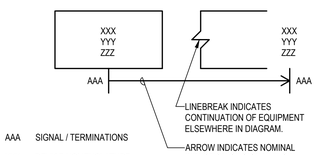
COMMUNICATIONS DEVICES

SYMBOL	DESCRIPTION
W	TERMINAL/MOUNTING BOARD, 8' HIGH, 3/4"x4'x WIDTH AS SHOWN, FIRE RETARDANT TREATED PLYWOOD.
	SIGNAL SYSTEM EQUIPMENT ENCLOSURES AS NOTED- SURFACE, RECESSED MOUNTED
X	COMBO TELEPHONE/DATA OUTLET - WALL X INDICATES QUANTITY OF CABLE/JACKS
X W	TELEPHONE OUTLET - WALL, W = USE HIGHER MOUNTING HEIGHT PER MOUNTING HEIGHT DETAIL X INDICATES QUANTITY OF CABLE/JACKS
X	DATA OUTLET - WALL X INDICATES QUANTITY OF CABLE/JACKS
H	RF COAX CABLE OUTLET
H	COMBINATION RF COAX CABLE AND DATA OUTLET
S X S	AUDIO LOUDSPEAKER - WALL, CEILING, X = WIRING ZONE
V	VOLUME CONTROL - WALL
B	BELL
	BUZZER
	CHIME
C C	SYSTEM CLOCK - WALL , CEILING
M E	INTERCOM STATION - WALL, DESK E = IBC 1007.8 COMPLIANT 2-WAY COMMUNICATIONS CALL STATION M = MASTER STATION
M M	MICROPHONE JACK - WALL, FLOOR
	PUSHBUTTON OR PUSHBUTTONS
AV	AUDIOVISUAL WALL PLATE
X	FLUSH FLOOR DEVICE - DEVICE TYPE PER SYMBOLS ABOVE X INDICATES QUANTITY OF CABLE/JACKS
X	PEDESTAL FLOOR DEVICE - DEVICE TYPE PER SYMBOLS ABOVE X INDICATES QUANTITY OF CABLE/JACKS
	WIRELESS ACCESS POINT LOCATION - CEILING MOUNTED

AUDIOVISUAL SYMBOLS

SYMBOL	DESCRIPTION
AV Y	AUDIOVISUAL JUNCTION BOX, WALL-MOUNTED. REFER TO AUDIOVISUAL ROUGH-IN SCHEDULE FOR MORE INFORMATION. WHEN AUDIOVISUAL JUNCTION BOX IS VOLUME CONTROLLER, SUBSCRIPT INDICATES SPEAKER ZONE.
CM	AUDIOVISUAL JUNCTION BOX, CEILING-MOUNTED. REFER TO AUDIOVISUAL ROUGH-IN SCHEDULE FOR MORE INFORMATION.
FM	AUDIOVISUAL JUNCTION BOX, FLOOR MOUNTED. REFER TO AUDIOVISUAL ROUGH-IN SCHEDULE FOR MORE INFORMATION.
X S #	SPEAKER - CEILING MOUNTED. X INDICATES ZONE. # INDICATES SPEAKER TYPE. REFERENCE AUDIOVISUAL EQUIPMENT SCHEDULE.

AUDIOVISUAL DIAGRAM LEGEND:



AAA	SIGNAL / TERMINATIONS
XXX	DEVICE NOMENCLATURE
YYY	DEVICE LOCATION
ZZZ	DEVICE IDENTIFIER

WIRING

SYMBOL	DESCRIPTION
	NEW WORK
	WIRING CONCEALED IN FLOOR OR UNDER GRADE OR ROUTED IN CEILING SPACE OF FLOOR BELOW.
(E)	EXISTING WORK TO REMAIN
(D)	EXISTING WORK TO BE REMOVED
(F)	FUTURE WORK
	HOME RUN CONDUIT OR WIRING TO INDICATED DESTINATION
	CONDUIT RUN TURNED UP THROUGH FLOOR OR CEILING. CORE & FIREPROOF AS REQUIRED.
	CONDUIT STUBBED OUT AT LOCATION SHOWN. PROVIDE INSULATED BUSHING & PULLROPE.
	TELEPHONE/DATA SLEEVE THROUGH WALL, ABOVE CEILING. EXTEND TO ACCESSIBLE TILE CLG. BOTH SIDES. TERMINATE WITH BUSHINGS.
	BASKET TYPE CABLE TRAY WITH 90 DEGREE ELBOW SHOWN
	LADDER TYPE CABLE TRAY WITH 90 DEGREE ELBOW SHOWN
	JUNCTION BOXES, WALL, CEILING AND FLUSH FLOOR MOUNTED. 4" SQ. BOX MIN., LARGER IF REQUIRED
T	TELECOMMUNICATIONS J-BOX
T X	TELECOMMUNICATIONS J-BOX WITH FURNITURE FEED X INDICATES QUANTITY OF CABLE
	PULL BOX, MIN. SIZE PER NEC., UON.
J	J-HOOK PATHWAY

GENERAL NOTES

A WHERE POSSIBLE, BOXES FOR COMMUNICATIONS OUTLETS SHALL BE IN SEPARATE STUD SPACES FROM BOXES SERVING OTHER ROOMS TO MINIMIZE SOUND TRANSFER.

B REFER TO ARCHITECTURAL FLOOR PLANS, INTERIOR ELEVATIONS AND DETAIL DRAWINGS PRIOR TO ROUGH-IN FOR EXACT LOCATION OF RECEPTACLES, FLOOR BOXES, AND OUTLETS. INFORM ENGINEER OF CONFLICTS VIA REQUEST-FOR-INFORMATION (RFI).

C COORDINATE LOCATIONS OF WALL-MOUNTED DEVICES WITH ARCHITECTURAL INTERIOR ELEVATIONS. WHERE DEVICES ARE LOCATED ADJACENT TO ELECTRICAL DEVICES, LOCATE BOTH DEVICES WITHIN 6-INCHES OF ONE ANOTHER. ALIGN DEVICES VERTICALLY.

D CONTRACTOR IS RESPONSIBLE TO REVIEW ARCHITECTURAL DRAWINGS TO CONFIRM CEILING TYPES IN ALL ROOMS (ACCESSIBLE, EXPOSED, OR "HARD") AND TO USE APPROPRIATE ROUTING METHOD FOR EACH DEVICE.

E COMMUNICATION OUTLETS HEIGHTS SHOWN ARE MEASURED FROM THE FINISH FLOOR TO THE CENTERLINE OF THE OUTLET UNLESS OTHERWISE NOTED.

F EACH ELEVATOR SHALL HAVE AN INDEPENDENT DEDICATED TELEPHONE LINE NOT SHARED WITH OTHER ELEVATOR PHONES. ELEVATOR PHONE SHALL BE ADA COMPLIANT (PUSH BUTTON).

G NO CONDUIT RUN TO EXCEED 100' WITHOUT THE INSTALLATION OF A PULL BOX.

H CONDUIT BENDS SHALL NOT EXCEED (2) 90 DEGREE BENDS OR 180 DEGREES WITHOUT THE INSTALLATION OF A PULL BOX.

I COORDINATE REQUIREMENTS FOR ACCESS CONTROL DOORS WITH DIVISION 08 SPECIFICATIONS FOR DOOR HARDWARE.

J PERFORM ALL WORK IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, AND FEDERAL CODES, LAWS, AND REGULATIONS.

K ALL MATERIALS AND EQUIPMENT SHALL BE LISTED BY THE UNDERWRITER'S LABORATORIES (UL).

L ALL EXTERIOR DEVICES ARE REQUIRED TO BE PAINTABLE TO MATCH BUILDING FINISHES. COORDINATE FINISH COLORS WITH ARCHITECT PRIOR TO INSTALLATION.

M PROVIDE PULL STRING IN ALL CONDUITS AT TIME OF CONDUIT INSTALLATION AND AGAIN AT TIME OF CABLE INSTALLATION.

N FOR CABLE INSTALLED IN OUTDOOR ENVIRONMENTS, OR INSTALLED BELOW SLAB ON GRADE, PROVIDE CABLE RATED FOR INDOOR/OUTDOOR USE.

O COMMUNICATIONS EQUIPMENT ROOMS INCLUDE ALL OF THE FOLLOWING ROOM TYPES AND ROOM NAMES: MDF, BDF, IDF, IT ROOM, DATA ROOM, TELEPHONE ROOM, MPOE, MPOP.

P COORDINATE WITH ALL OTHER TRADES TO ENDURE INSTALLED VIDEO SURVEILLANCE CAMERAS HAVE AND UNOBSTRUCTED FIELD OF VIEW.

SECURITY SYSTEM

SYMBOL	DESCRIPTION
	ACCESS CONTROL SYSTEM:
ACP	ACCESS CONTROL PANEL(S)
PS-X	ELECTRIFIED PANIC HARDWARE POWER SUPPLY
CR	CARD READER - WALL MOUNTED
EL	ELECTRIFIED LOCK HARDWARE
ES	ELECTRIC STRIKE CONNECTION
MN	MAGNETIC LOCK CONNECTION
RX	REQUEST TO EXIT (WIRING TO ELECTRIFIED PANIC HARDWARE)
RX IR	REQUEST TO EXIT (WALL MOUNTED IR DETECTOR ABOVE DOOR)
ER	EMERGENCY DOOR RELEASE BUTTON
	INTRUSION DETECTION SYSTEM:
KP	INTRUSION DETECTION KEYPAD- WALL MOUNTED
DI	DOOR POSITION MONITOR SWITCH
GB	GLASS BREAK SENSOR
	MOTION DETECTOR
DS	DURESS PUSHBUTTON STATION
	VIDEO SURVEILLANCE:
	FIXED CAMERA - WALL,CEILING
DM	DOME CAMERA - WALL/CEILING

ABBREVIATIONS

(E)	EXISTING TO REMAIN	NC	NORMALLY CLOSED
(F)	FUTURE	NEC	NATIONAL ELECTRICAL CODE
(R)	EXISTING TO BE REMOVED	NEMA	NATIONAL ELECTRICAL MFGR'S ASSOC.
(RL)	EXISTING TO BE RELOCATED	NO	NORMALLY OPEN
AB	ABOVE COUNTER BACKSPLASH	NTS	NOT TO SCALE
AC	ALTERNATING CURRENT	OC	ON CENTER
A, AMP	AMPERES	OD	OUTSIDE DIAMETER
AFF	ABOVE FINISHED FLOOR	OFCI	OWNER-FURNISHED CONTRACTOR-INSTALLED
AFG	ABOVE FINISHED GRADE	OFNP	OPTICAL FIBER NONCONDUCTIVE PLENUM
AHJ	AUTHORITY HAVING JURISDICTION	OFNR	OPTICAL FIBER NONCONDUCTIVE RISER
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE	OFOI	OWNER-FURNISHED OWNER-INSTALLED
AUX	AUXILIARY	OSP	OUTSIDE PLANT
AWG	AMERICAN WIRE GUAGE	PBX	PRIVATE BRANCH EXCHANGE
BNC	VIDEO CONNECTOR	PNL	PANEL
BG	BELOW GRADE	POE	POWER OVER ETHERNET
C	CONDUIT	PTZ	PAN TILT ZOOM
CATV	COMMUNITY ACCESS TELEVISION	PVC	POLYVINYL CHLORIDE
CLG	CEILING	QTY	QUANTITY
CO	CONDUIT ONLY	REQD	REQUIRED
CU	COPPER	RF	RADIO FREQUENCY
DC	DIRECT CURRENT	RFI	REQUEST FOR INFORMATION
DIA	DIAMETER	RGB	RED GREEN BLUE
DIAG	DIAGONAL	RNC	RIGID NON-METALLIC CONDUIT (PVC)
DIV	DIVISION	SATV	SATELLITE TELEVISION
DPDT	DOUBLE POLE DOUBLE THROW	SC	SUBSCRIBER CONNECTOR (FIBER CONNECTOR)
DPST	DOUBLE POLE SINGLE THROW	ScTP	SCREENED TWISTED PAIR
DVI	DIGITAL VIDEO INTERFACE	SPDT	SINGLE POLE DOUBLE THROW
DWG	DRAWING	SPST	SINGLE POLE SINGLE THROW
EIA	ELECTRONICS INDUSTRY ALLIANCE	ST	STRAIGHT TIP (FIBER CONNECTOR)
EMT	ELECTRICAL METALLIC TUBING	STP	SHEILDED TWISTED PAIR
ENT	ELECTRICAL NONMETALLIC TUBING	TBB	TELECOMMUNICATIONS BONDING BACKBONE
EOL	END OF LINE	TBD	TO BE DETERMINED
FA	FIRE ALARM	TGB	TELECOMMUNICATIONS GROUNDING BUSBAR
FACP	FIRE ALARM CONTROL PANEL	TIA	TELECOMMUNICATIONS INDUSTRY ASSOCIATION
FBO	FURNISHED BY OTHERS	TMGB	TELECOMMUNICATIONS MAIN GROUNDING
FC	FOOT CANDLES	TYP	TYPICAL
FDU	FIBER DISTRIBUTION UNIT	UF	UNDERFLOOR
FSD	FIRE SMOKE DAMPER	UG	UNDERGROUND
FTP	FOIL TWISTED PAIR	UL	UNDERWRITER'S LAB
G, GND	GROUND	UON	UNLESS OTHERWISE NOTED
GRC	GALVANIZED RIGID STEEL CONDUIT	UPS	UNINTERRUPTIBLE POWER SUPPLY
HDMI	HIGH DEFINITION MULTIMEDIA INTERFACE	UTP	UNSHEILDED TWISTED PAIR
HZ	HERTZ (CYCLES PER SECOND)	VGA	VIDEO GRAPHICS ARRAY
ID	INSIDE DIAMETER	V	VOLTS
IDF	INTERMEDIATE DISTRIBUTION FRAME	W	WATTS
IG	ISOLATED GROUND	W/	WITH
IMC	INTERMEDIATE METAL CONDUIT	W/O	WITHOUT
IP	INTERNET PROTOCOL	WAN	WIDE AREA NETWORK
IT	INFORMATION TECHNOLOGY	WAO	WORK AREA OUTLET
KCMIL	THOUSAND CIRCULAR MILS	WAP	WIRELESS ACCESS POINT
KO	KNOCK OUT	WP	WEATHERPROOF
LAN	LOCAL AREA NETWORKK	XFR	TRANSFORMER
LC	LUCENT CONNECTOR (FIBER CONNECTOR)	XLR	MICROPHONE CONNECTOR
LCD	LIQUID CRYSTAL DISPLAY	", IN	INCHES
LED	LIGHT EMITTING DIODE	', FT	FEET
MAX	MAXIMUM	>	GREATER THAN
MDF	MAIN DISTRIBUTION FRAME	<	LESS THAN
MDU	MEDIA DISTRIBUTION UNIT	≥	GREATER THAN OR EQUAL TO
MFR	MANUFACTURER		
MIN	MINIMUM		
MISC	MISCELLANEOUS		
MTD	MOUNTED		
MUTOA	MULTI-USER TELECOM. OUTLET ASSEMBLY		

TECHNOLOGY DRAWING LIST

TOTAL SHEETS: 5

ADD ALTERNATE #1: INTERIOR RENOVATION OF BUILDING 18. BASE BID TO INCLUDE INFRASTRUCTURE AND STUB OUT FOR UTILITIES FOR KITCHEN, RESTROOMS, LAUNDRY, ETC.

ADD ALTERNATE #2: EXTERIOR SCOPE FOR NEW CONNECTING CONCRETE WALKWAY, ASSOCIATED GUARDRAIL AND HANDRAIL.

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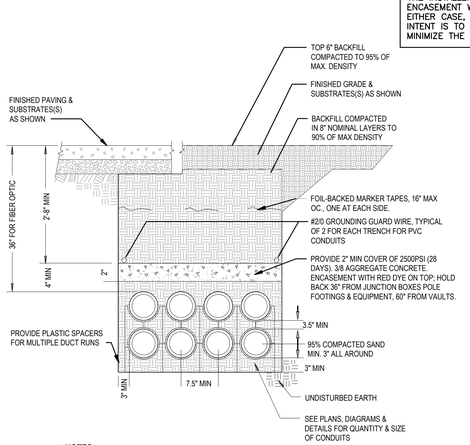
TECHNOLOG□ LEGEND AND ABBREVIATIONS

T0.0

GROUNDING AND LIGHTNING PROTECTOR DEVICES AT EACH COPPER CIRCUIT TERMINATION ARE REQUIRED BY STANDARD INDUSTRY PRACTICE AND THE NATIONAL ELECTRICAL CODE. PROVIDE ADDITIONAL LIGHTNING PROTECTION BY PLACING A BARE COPPER CONDUCTOR ABOVE THE DUCTBANK, PREFERABLY CAST WITHIN ANY CONCRETE ENCASEMENT. THE CONDUCTOR MUST BE CONTINUOUS AND BONDED TO THE NEAREST BUILDING ELECTRICAL SERVICE ENTRANCE GROUND AT EACH END.

THE INSTALLER CAN LAY THE GROUND CONDUCTOR ON TOP OF THE CONDUIT FOR ENCASEMENT WITHIN THE CONCRETE, OR PLACE THE CONDUCTOR WITHIN THE FILL. IN EITHER CASE, THE CONDUCTOR MUST BE SECURED AT CURVES OR TRANSITIONS. THE INTENT IS TO PROVIDE AN ELECTRICAL PATH, AS WELL AS A "CONE OF PROTECTION," TO MINIMIZE THE DIFFERENCE IN ELECTRICAL POTENTIAL CAUSED BY A LIGHTNING STRIKE.



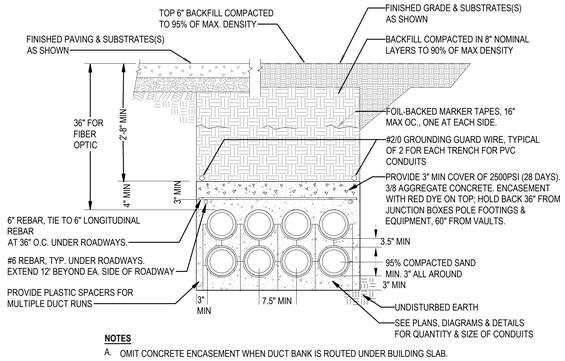
NOTES

A. OMIT CONCRETE WHEN DUCT BANK IS ROUTED UNDER BUILDING SLAB.

B. OMIT GUARD WIRES ON DUCT BANKS THAT ARE ROUTED ENTIRELY UNDER BUILDING SLABS.

C. OMIT CONCRETE AND GUARD WIRES OVER SITE SECURITY AND SITE LIGHTING CONDUITS.

2 WELL-TAMPED EARTH DUCT BANK
SCALE: 1/8"=1'-0"



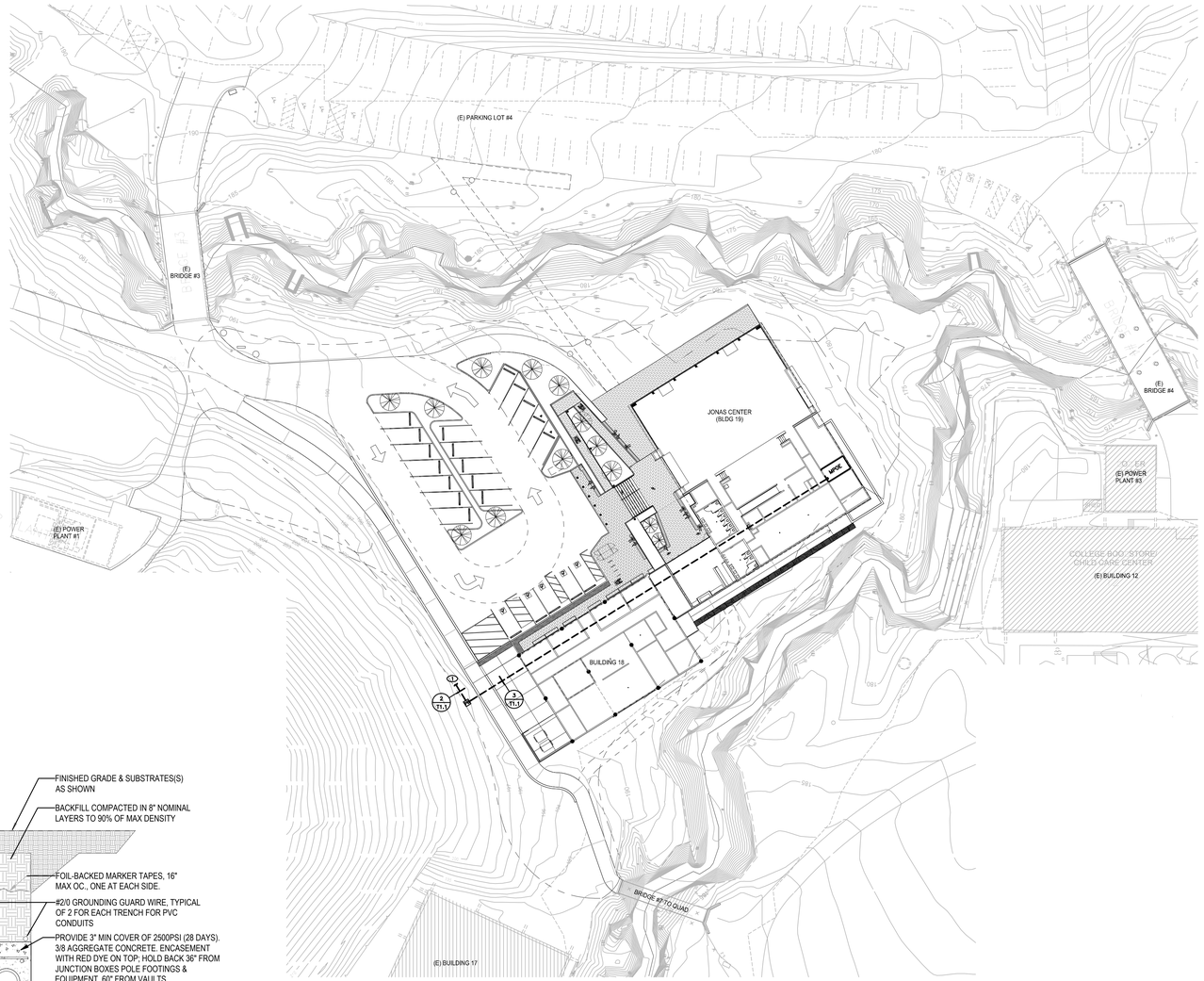
NOTES

A. OMIT CONCRETE ENCASEMENT WHEN DUCT BANK IS ROUTED UNDER BUILDING SLAB.

B. OMIT GUARD WIRES ON DUCT BANKS THAT ARE ROUTED ENTIRELY UNDER BUILDING SLABS.

C. OMIT CONCRETE ENCASEMENT AND GUARD WIRES OVER SITE SECURITY AND SITE LIGHTING CONDUITS.

3 CONCRETE ENCASED DUCT BANK
SCALE: 1/8"=1'-0"



1 TECHNOLOGY SITE PLAN
SCALE: 1/32"=1'-0"

SHEET NOTES

A. LOCATION OF TECHNOLOGY DEVICES INDICATED ON THE ARCHITECTURAL INTERIOR ELEVATIONS PLANS AND RCPs TAKE PRECEDENCE OVER LOCATIONS INDICATED ON THE TECHNOLOGY DRAWINGS.

B. PROVIDE FIRE RATED PATHWAY THROUGH ALL FIRE RATED WALLS PENETRATIONS, OCCUPANCY SEPARATION WALLS AND SMOKE COMPARTMENT WALLS ABOVE SUSPENDED CEILING HEIGHT TO ACCOMMODATE CABLES FROM IT ROOMS TO DISTRIBUTION. QUANTITY TO EQUAL CAPACITY OF ASSOCIATED CABLE TRAY OR J-HOOK PATHWAY FOR RATED WALLS.

C. CONTRACTOR TO PROVIDE CONDUIT FOR CABLING DISTRIBUTION SPANNING ALL HARD CEILING AREAS AND SOFFITS TO ACCESSIBLE CEILINGS (WHERE/AS NECESSARY). REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND COORDINATE WITH MEP PRIOR TO CONDUIT ROUTING AND PENETRATIONS.

D. CONTRACTOR TO CONFIRM ALL CABLING ROUTING WITH IT DEPARTMENT/OWNER.

E. CONTRACTOR TO COORDINATE DECK PENETRATIONS WITH ARCHITECT, STRUCTURAL AND MEP ENGINEERS PRIOR TO ANY CORING.

KEYED NOTES

1. CONNECT TO AND REUSE EXISTING CONDUIT PATHWAYS WHEREVER POSSIBLE. PROVIDE NEW CONDUIT AS REQUIRED. STUB OUT (1) 4" C. FROM (N)PULLBOX A MINIMUM OF 5' BEYOND BUILDING FOR CABLE AND DATA SERVICE PROVIDERS. PULL ALL NEW TELECOM CONNECTIONS TO MPOE FOR NEW CONSTRUCTION SCOPE.

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COLLEGE OF MARIN IVC
JONAS CENTER & BLDGS 18&19 ALTERATIONS

indian valley campus, novato ca

project number: 16-148.04

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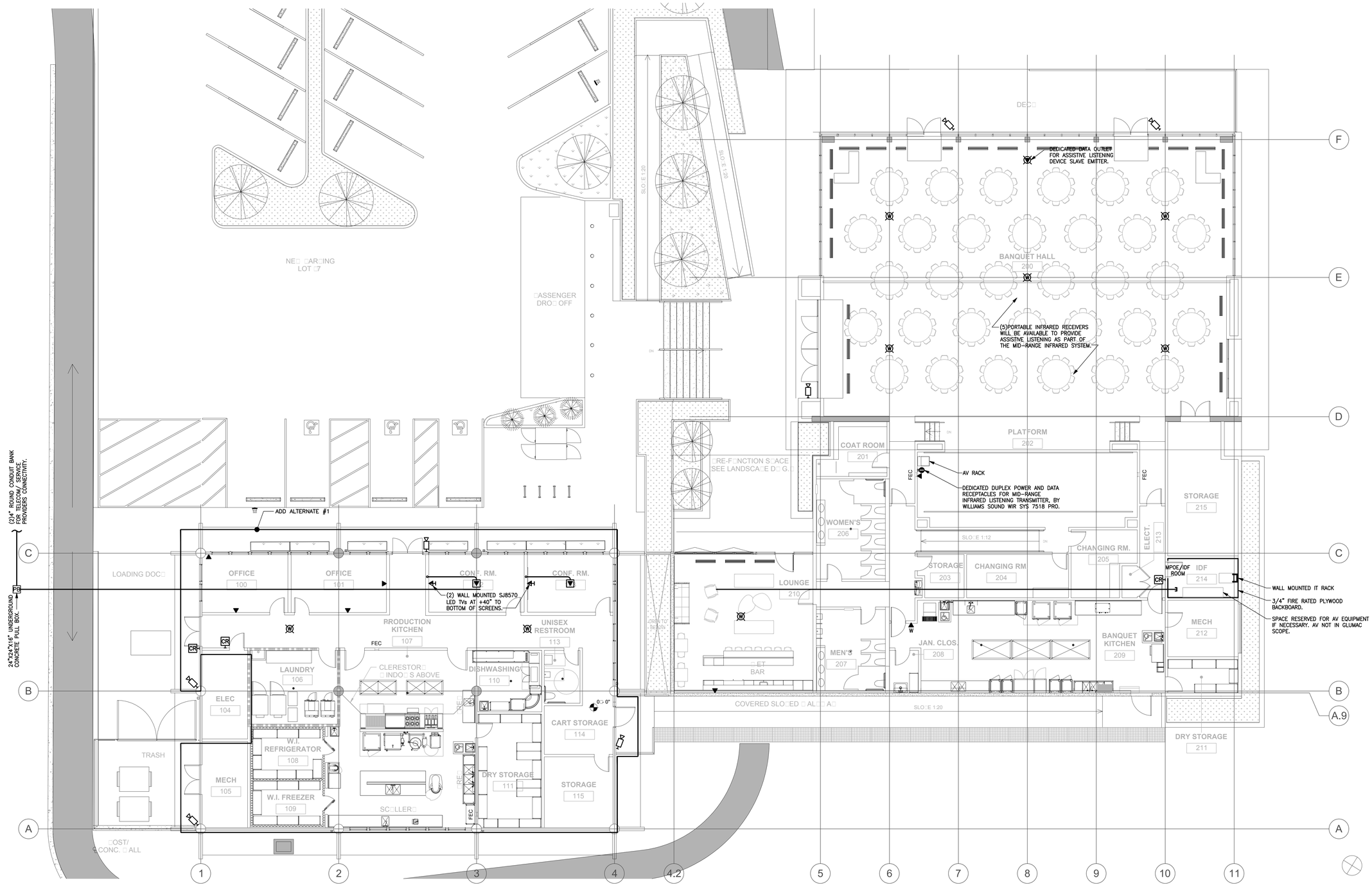

1 TECHNOLOGY PLAN
SCALE: 1/8"=1'-0"

SHEET NOTES

A. PLENUM-RATED CABLE REQUIRED.

B. LOCATION OF TECHNOLOGY DEVICES INDICATED ON THE ARCHITECTURAL INTERIOR ELEVATIONS PLANS AND RCPs TAKE PRECEDENCE OVER LOCATIONS INDICATED ON THE TECHNOLOGY DRAWINGS.

C. CONTRACTOR TO COORDINATE DECK PENETRATIONS WITH STRUCTURAL ENGINEER AND MEP ENGINEER PRIOR TO CONSTRUCTION.

D. PROVIDE FIRE RATED SLEEVES THROUGH ALL FIRE RATED WALLS PENETRATIONS, OCCUPANCY SEPARATION WALLS AND SMOKE COMPARTMENT WALLS ABOVE SUSPENDED CEILING HEIGHT. TO ACCOMMODATE CABLES FROM IT ROOMS TO DISTRIBUTION. QUANTITY TO EQUAL CAPACITY OF ASSOCIATED CABLE TRAY. REFER TO LIFE AND SAFETY PLANS (BY OTHERS) FOR RATED WALLS LOCATIONS.

E. CONTRACTOR TO PROVIDE CONDUIT FOR CABLING DISTRIBUTION SPANNING ALL HARD CEILING GREATER THAN 5' IN LENGTH AND SOFFITS TO ACCESSIBLE CEILINGS (WHERE NECESSARY). REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND COORDINATE WITH MEP PRIOR TO CONDUIT ROUTING AND PENETRATIONS.

F. PROVIDE PROPER BONDING TO ALL TELECOMMUNICATION ELEMENTS PER TIA-607-B.

G. CONTRACTOR TO CONFIRM ALL CABLING ROUTING WITH IT DEPARTMENT.

KEYED NOTES

1. HORIZONTAL NETWORK CABLING DISTRIBUTION OUTSIDE OF THE IT ROOM SHALL BE DONE VIA CABLE TRAY. DO NOT EXCEED CABLE TRAY CAPACITY PER MANUFACTURERS RECOMMENDATION. SECONDARY PATHWAYS TO BE DETERMINED BY LV CONTRACTOR.
2. PROVIDE 1" CONDUIT TO 3 AND 4 CABLES DATA OUTLETS. PROVIDE 3/4" CONDUIT TO 1 AND 2 CABLES DATA OUTLETS. ON BOTH CONDITIONS STUB CONDUIT 6" ABOVE ACCESSIBLE CEILING SPACE WITH 90° ELBOW AT TOP. VERIFY CONDUIT FILL RATIO WITH TENANT CABLING VENDOR PRIOR TO INSTALLATION. PROVIDE INSULATING BUSHINGS. PROVIDE PULL STRING TO EACH CONDUIT.
3. PROVIDE (2) EZ-PATH SERIES 33 FROM MDF ROOM. COORDINATE WITH MEP TRADES PRIOR TO INSTALLATION.
4. REFER TO SHEET T9.01 FOR MDF ROOM REQUIREMENTS. VERIFY ALL ITEMS AND EQUIPMENT LOCATIONS WITH TENANT IT VENDOR PRIOR TO INSTALLATION.
5. PROVIDE NEW TELEPHONE BACKBOARD. REFER TO DETAIL 3/T9.02 FOR PLACEMENT. BACKBOARD TO BE A/C GRADE, VOID-FREE, FIRE RATED PLYWOOD WITH A-SIDE EXPOSED. PROVIDE (2) COATS OF FIRE-RESISTANT COLOR TO MATCH WALL. FIRE RATING LABEL SHALL BE ON EXPOSED SIDE OF PLYWOOD AND NOT PAINTED.
6. ALL DATA OUTLETS MUST BE LOCATED 12" MAX. FROM A POWER RECEPTACLE INSTALLED AT THE SAME HEIGHT.
7. LEGRAND EVOLUTION SERIES 8" SHARED POWER, DATA AND AV POKE THRU. PROVIDE (1) 1-1/4" CONDUIT FROM THE POKE THRU TO ACCESSIBLE CEILING VIA THE NEAREST INTERIOR WALL. PROVIDE CAT 6 CABLES AS INDICATED. INSTALL PER MANUFACTURER RECOMMENDATIONS.
8. PROVIDE (1) 1-1/4" CONDUIT FROM THE POKE THRU TO THE TV BACKBOX FOR HDMI CABLE DIRECT ROUTING. PROVIDE AN AV FACEPLATE FOR (1) HDMI AND RJ45 DATA JACK BEHIND THE TV.
9. PROVIDE (1) CAT 6 CABLE FROM THE MDF ROOM TV HEADEND EQUIPMENT FOR TV SERVICE. TERMINATE THE CABLES AT THE AV FACEPLATE BEHIND TV.
10. PROVIDE A CARD READER WITH ASSOCIATED CONDUIT AND LV CABLING. PROVIDE CONNECTIVITY TO SERVING ACCESS CONTROL PANEL. INSTALL PER MANUFACTURER'S SPECIFICATIONS.
11. PROVIDE (1) CAT 6 CABLE TO EACH CUSTOMER PROVIDED WAP USING CUSTOMER PROVIDED MOUNTING CLIPS ON DROP CEILING CONDITIONS.
12. DATA OUTLET DEDICATED FOR AV RACK.
13. PROVIDE (1) CAT 6 DATA OUTLET FOR NETWORK BASED AIPHONE INTERCOM SYSTEM.
14. SYSTEMS FURNITURE DATA PORT SHOWN FOR REFERENCE ONLY. COORDINATE FINAL INSTALLATION AND REQUIREMENTS WITH SYSTEMS FURNITURE VENDOR AND MANUFACTURER. CONTRACTOR IS RESPONSIBLE FOR FULL AND COMPLETE SYSTEM.
15. LEGRAND EVOLUTION SERIES 6" SHARED POWER, DATA AND AV POKE THRU. PROVIDE (1) 1" CONDUIT FROM THE POKE THRU TO ACCESSIBLE CEILING VIA THE NEAREST INTERIOR WALL. PROVIDE CAT 6 CABLES AS INDICATED. INSTALL PER MANUFACTURER RECOMMENDATIONS.
16. TELECOM CONDUIT STUB UP. PROVIDE (1) 1-1/4" CONDUIT ROUTED TO THE NEAREST INTERIOR WALL WITH ACCESSIBLE CEILING.
17. AV WALL PLATE. SEE DETAIL 1/T9.3
18. WALL MOUNTED TELECOM JUNCTION BOX. PROVIDE FACEPLATE WITH GROMMET AND 1-1/2" FLEXIBLE CONDUIT TO SYSTEM FURNITURE FEED.
19. PROVIDE A 24"x24"x8" TELECOM PULLBOX FOR DATA DISTRIBUTION OVERHEAD.

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JONAS CENTER & BLDGS 18&19 ALTERATIONS

indian valley campus, novato ca

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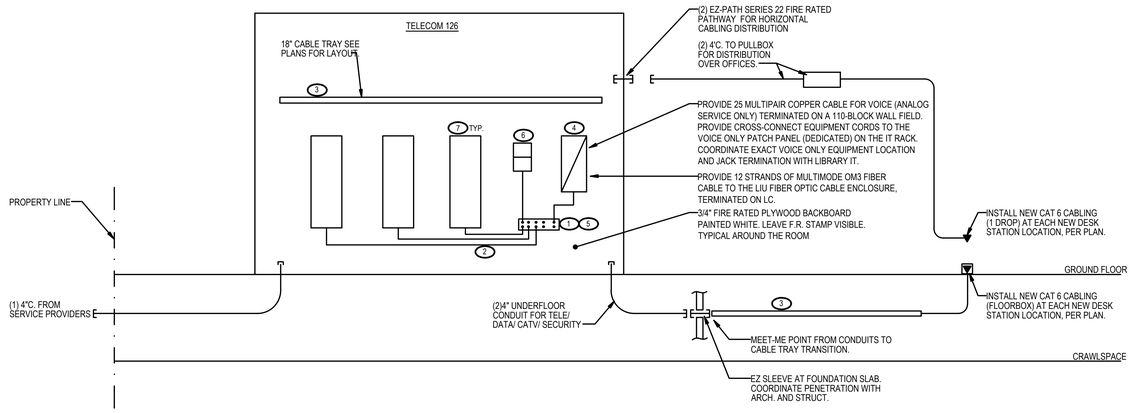

1 TELECOM RISER DIAGRAM

SCALE: NONE

SHEET NOTES

A. PLENUM-RATED CABLE REQUIRED.

B. LOCATION OF TECHNOLOGY DEVICES INDICATED ON THE ARCHITECTURAL INTERIOR ELEVATIONS PLANS AND RCPs TAKE PRECEDENCE OVER LOCATIONS INDICATED ON THE TECHNOLOGY DRAWINGS.

C. CONTRACTOR TO COORDINATE DECK PENETRATIONS WITH STRUCTURAL ENGINEER AND MEP ENGINEER PRIOR TO CONSTRUCTION.

D. PROVIDE FIRE RATED SLEEVES THROUGH ALL FIRE RATED WALLS PENETRATIONS, OCCUPANCY SEPARATION WALLS AND SMOKE COMPARTMENT WALLS ABOVE SUSPENDED CEILING HEIGHT. TO ACCOMMODATE CABLES FROM IT ROOMS TO DISTRIBUTION. QUANTITY TO EQUAL CAPACITY OF ASSOCIATED CABLE TRAY. REFER TO LIFE AND SAFETY PLANS (BY OTHERS) FOR RATED WALLS LOCATIONS.

E. CONTRACTOR TO PROVIDE CONDUIT FOR CABLING DISTRIBUTION SPANNING ALL HARD CEILING GREATER THAN 5' IN LENGTH AND SOFFITS TO ACCESSIBLE CEILINGS (WHERE NECESSARY). REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND COORDINATE WITH MEP PRIOR TO CONDUIT ROUTING AND PENETRATIONS.

F. PROVIDE PROPER BONDING TO ALL TELECOMMUNICATION ELEMENTS PER TIA-607-B.

G. CONTRACTOR TO CONFIRM ALL CABLING ROUTING WITH IT DEPARTMENT.

KEYED NOTES

1. PROVIDE 1#3/0 GREEN INSULATED GROUND WIRE (TELECOMMUNICATIONS BONDING BACKBONE) IN GROUNDING RISER METALLIC CONDUIT. ALL CONNECTIONS SHALL BE SIZED PER J-STD- 607-B. CONDUIT SHALL BE BONDED WITH AWG TO TGB AND TMGB AT EVERY JUNCTION.
2. BOND I.T. RACK, CABINET AND CABLE RUNWAY TO TELECOM GROUND BUS BAR, AWG RHW INSULATED GREEN WIRE BETWEEN I.T. EQUIPMENT AND TELECOM ROOM GROUND BUS BAR.
3. BOND 18" UNIVERSAL CABLE RUNWAY CONTINUOUSLY.
4. PROVIDE #6 AWG TO ELECTRICAL PANEL BOARD.
5. TGB - TELECOMMUNICATIONS GROUNDING BUSBAR.
6. 110 BLOCKS
7. 2 POST RACKS 19"x23"x7'

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COLLEGE OF MARIN IVC JONAS CENTER & BLDGS 18&19 ALTERATIONS

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TELECOM RISER DIAGRAM

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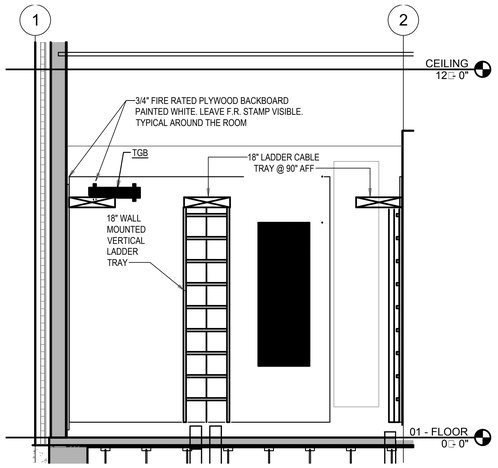
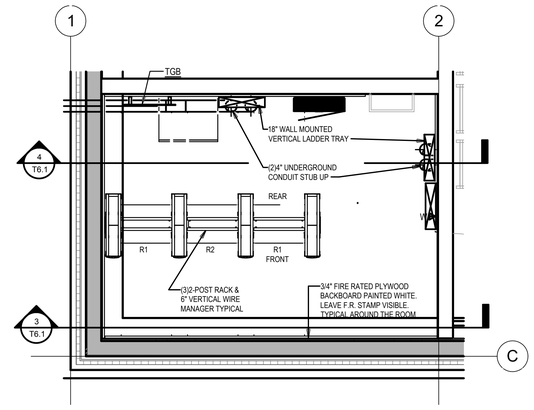


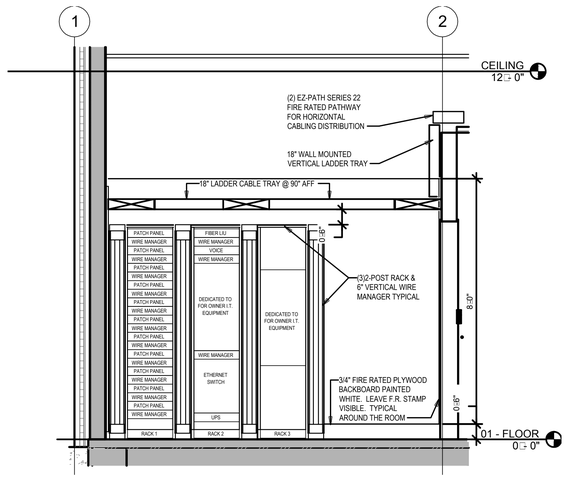
4 MDF WALL ELEVATION

SCALE: 1/2" = 1'-0"



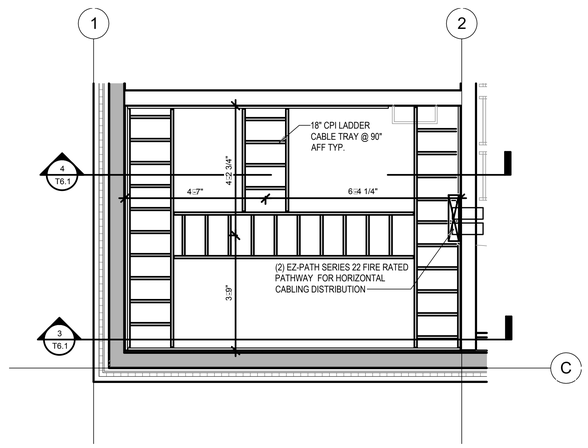
2 MDF RACK ELEVATION

SCALE: 1/2" = 1'-0"



3 MDF RACK ELEVATION

SCALE: 1/2" = 1'-0"



1 ENLARGED MDF TRAY PLAN

SCALE: 1/2" = 1'-0"

SHEET NOTES

KEYED NOTES

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GENERAL NOTES

1 THESE PLANS ARE A GENERAL ARRANGEMENT OF EQUIPMENT FOR THE CONVENIENCE OF CONTRACTORS AND IS MADE FROM AVAILABLE INFORMATION. WEBB FOODSERVICE DESIGN ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE MEASUREMENTS. FABRICATORS, CONTRACTORS, AND OTHERS UTILIZING THESE PLANS IN CONNECTION WITH THIS JOB ARE RESPONSIBLE FOR SECURING THEIR OWN MEASUREMENTS FOR PREPARATION OF SUBMITTALS AND CONSTRUCTION. PLUMBING AND ELECTRICAL INFORMATION INDICATED ON THESE PLANS ARE GENERALLY FOR FOOD SERVICE EQUIPMENT AND ARE INTENDED AS REFERENCE ONLY. WEBB FOODSERVICE DESIGN IS NOT RESPONSIBLE FOR THE ENGINEERING THEREOF OR FOR ANY PLUMBING OR ELECTRICAL FITTINGS, WORK, AND/OR CONNECTIONS UNLESS SPECIFICALLY PROVIDED FOR IN THE SPECIFICATIONS. WEBB FOODSERVICE DESIGN ASSUMES NO RESPONSIBILITY FOR THE WORK DONE BY THE CONTRACTORS NOR FOR ANY CHANGES MADE NECESSARY BY THE LOCAL BUILDING CODES, ORDINANCES, STRUCTURAL CONDITIONS, OR BY THE SUBSTITUTION OR CHANGES MADE NECESSARY IN EQUIPMENT SHOWN ON THIS PLAN. CONTRACTORS ARE TO MAKE ALLOWANCE FOR ELBOWS, TRAPS, ETC. AND ARE TO MAKE FINAL CONNECTIONS ON THE JOB, SUPPLYING ALL NECESSARY VALVES, TRAPS, STEAM TRAPS, FAUCETS, STARTING SWITCHES FOR MOTORS, ETC. EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE IN THE WRITTEN SPECIFICATIONS. THESE PLANS AND DESIGNS CONTAINED HEREIN ARE THE PROPERTY OF WEBB FOODSERVICE DESIGN AND MAY NOT BE REPRODUCED OR USED BY ANYONE, EITHER ALL OR IN PART, WITHOUT FIRST SECURING THE WRITTEN PERMISSION OF WEBB FOODSERVICE DESIGN.

2 ANY DISCREPANCIES BETWEEN PLANS, BUILDING, AND LOCAL CODE REQUIREMENTS THAT MAY AFFECT THE INSTALLATION, FABRICATION, OR OVERALL WORK IN ANY WAY SHALL BE BROUGHT TO THE ATTENTION OF THE FOOD SERVICE EQUIPMENT CONTRACTOR IMMEDIATELY.

3 IT SHALL BECOME THE RESPONSIBILITY OF THE OWNER, ARCHITECT, ENGINEERS, AND/OR GENERAL CONTRACTOR TO INSURE THAT THE FOOD SERVICE EQUIPMENT CONTRACTOR RECEIVES COPIES OF ALL ADDENDUMS AND CHANGES TO THE BUILDING PLANS, PRIOR TO, OR DURING CONSTRUCTION WHEREAS, ADDENDUMS AND/OR CHANGES AFFECT ANY AREAS PERTINENT TO THE FOOD AND BEVERAGE PORTION OF THE PROJECT.

4 IF THERE ARE ANY AMBIGUITIES, DISCREPANCIES, OR IRREGULARITIES, VERIFY WITH ARCHITECTURAL TEAM PRIOR TO COMMENCING WORK.

5 ALL WORK IS TO BE COMPLETED IN CRAFTSMAN LIKE MANNER AND CONFORM TO ALL APPLICABLE BUILDING AND SAFETY CODES.

6 REFER TO ARCHITECTURAL PLANS FOR ADA CLEARANCE REQUIREMENTS FOR ALL SPACES, DOOR STRIKES, EXITS, AND AISLE WAYS AS THEY PERTAIN TO CODE ENFORCEMENT AND INTERPRETATION.

7 CONTRACTORS SHALL SUBMIT ALL SHOP DRAWINGS, FINISHES, STAINS, AND COLORS TO THE ARCHITECTURAL TEAM FOR APPROVAL PRIOR TO FABRICATION.

8 SEE ENGINEERING DOCUMENTS FOR TITLE 24 ENGINEERING CALCULATIONS FOR BUILDING PERMIT REQUIREMENTS.

9 CONTRACTOR TO VERIFY ALL EQUIPMENT CLEARANCES THRU BUILDING DOORS, HALLWAYS, OR ENTRY POINTS. NOT ALL EQUIPMENT WILL FIT THRU STANDARD DOOR OPENINGS.

10 ALL DRAWINGS BY WEBB FOODSERVICE DESIGN ARE FOOD SERVICE EQUIPMENT CONTRACT DOCUMENTS ONLY TO BE USED BY CONSULTANTS/ARCHITECTS AND FOR BIDDING, NOT FOR CONSTRUCTION.

11 VERIFY ALL DIMENSIONS AND CONDITIONS AT THE JOB SITE PRIOR TO PROCEEDING WITH WORK.

12 PARTITIONS ARE DIMENSIONED FROM FINISHED SURFACE, UNLESS OTHERWISE NOTED.

13 ALL HORIZONTAL DIMENSIONS ARE FROM FINISHED FACE OF WALL TO FINISHED FACE OF WALL OR CENTERLINE OF COLUMN.

14 ALL VERTICAL DIMENSIONS ARE FROM FINISHED FLOOR TO WALL OR WALL OPENING.

15 PROVIDE SMOOTH AND LEVEL FLOORS BELOW ALL KITCHEN EQUIPMENT UNLESS THESE DRAWINGS SHOW OTHERWISE.

16 GENERAL CONTRACTOR TO PROVIDE AND INSTALL BLOCKING IN WALLS FOR MOUNTING WALL SHELVES, POT RACKS, DISPLAY CASES, HOSE REELS, ETC., AS SHOWN ON PLANS.

17 WHERE REQUIRED, SPRINKLER HEADS IN WALK-IN FREEZER WILL BE PROVIDED BY AND PROTECTED AGAINST FREEZING BY GENERAL CONTRACTOR.

18 LEVEL PLATFORMS CONSTRUCTED PER CODE AND LOCATED ON ROOF ARE REQUIRED FOR COMPRESSOR. REFER TO ARCHITECTURAL AND MECHANICAL PLANS. (VERIFY LOCATION)

19 VERIFY AND COORDINATE EXACT LOCATION OF COMPRESSOR RACK(S) WITH ARCHITECT AND PROVIDE ACCESS FOR DELIVERY AND INSTALLATION OF EACH COMPRESSOR RACK.

20 SEE STRUCTURAL ENGINEER AND/OR ARCHITECTURAL PLANS FOR STRUCTURAL SUPPORT REQUIREMENTS OF ROOF SUPPORTING ALL FOOD SERVICE EQUIPMENT SUCH AS COMPRESSOR RACKS, EXHAUST AND MAKE-UP AIR SYSTEMS, AIR CONDITIONING, ETC., PRIOR TO BEGINNING CONSTRUCTION.

21 ROOF JACKS AND PENETRATIONS THROUGH ROOF ARE REQUIRED FOR REFRIGERATION LINES. SEE ARCHITECTURAL PLANS FOR DETAILS. (VERIFY LOCATION WITH REFRIGERATION CONTRACTOR)

22 ARCHITECT AND/OR MECHANICAL ENGINEER TO PROVIDE ADEQUATE VENTILATION AND COOLING FOR SPACES CONTAINING SELF-CONTAINED REFRIGERATION AND OTHER FOOD SERVICE EQUIPMENT EMITTING HEAT.

23 INTENDED ENVIRONMENT FOR REFRIGERATED GLASS FRONT & OPEN FRONT DISPLAY CASE, INCLUDING GLASS DOORS ON WALK-IN REFRIGERTORS AND FREEZERS IS 75ºF/55% RELATIVE HUMIDITY. VERIFY WITH MECHANICAL DRAWINGS.

24 FOOD SERVICE FACILITIES REQUIRE A DESIGNATED HOT WATER SUPPLY FOR FOODHANDLING AREAS, WAREWASHING AREAS, JANITOR SINKS AND EMPLOYEE RESTROOMS. REFER TO MECHANICAL AND/OR PLUMBING DRAWINGS.

25 HOT WATER SUPPLY TO POT AND PREPARATION SINKS SHALL BE 120 DEGREES MINIMUM. HOT WATER SUPPLY TO ALL DISH MACHINES SHALL BE 140 DEGREES MINIMUM.

26 ALL MATERIALS FOR FLOORS, WALLS, AND CEILINGS SHALL BE INSTALLED PER MANUFACTURER'S INSTRUCTIONS.

27 GENERAL CONTRACTOR SHALL ENSURE THAT ALL HARDWOOD PLYWOOD (HWPW), PARTICLE BOARD (PB), AND MEDIUM DENSITY FIBERBOARD (MDF) USED TO MAKE FINISHED GOODS, SUCH AS FURNITURE, CABINETS, COUNTERTOPS, SHELVING, FLOORING, MOLDING, ETC., SHALL COMPLY WITH THE CALIFORNIA AIR RESOURCES BOARD (CARB) AIRBORNE TOXIC CONTROL MEASURE (ATCM) TO REDUCE FORMALDEHYDE EMISSIONS IN COMPOSITE WOOD PRODUCTS. THE ATCM APPLIES TO PANEL MANUFACTURERS, THIRD PARTY CERTIFIERS, DISTRIBUTORS, IMPORTERS, FABRICATORS, AND RETAILERS OF HWPW, PB, MDF, AND FINISHED GOODS CONTAINING THESE PRODUCTS (INCLUDING LAMINATED PRODUCTS), SOLD OR DELIVERED TO CALIFORNIA, AND APPLIES TO DOMESTIC AND IMPORTED PRODUCTS.

28 COUNTERS ARE TO BE FABRICATED PROPERLY TO SUPPORT THE SPECIFIED COUNTER TOP MATERIAL IN ACCORDANCE WITH THE MATERIAL MANUFACTURER'S GUIDELINES.

29 ALL "DROP-IN" EQUIPMENT AND OTHER EQUIPMENT "ATTACHED TO", "SET ON", OR "BUILT-IN" TO THE COUNTERTOP MATERIAL IS TO BE INSTALLED IN ACCORDANCE WITH THE MATERIAL MANUFACTURER'S GUIDELINES AND TECHNICAL BULLETINS FOR THE INSTALLATION OF COMMERCIAL FOOD SERVICE EQUIPMENT.

ENVIRONMENTAL NOTES

1 ALL FOOD-RELATED AND UTENSIL RELATED EQUIPMENT SHALL BEAR THE ANSI/NSF EMBLEM AND/OR BE MANUFACTURED OR FABRICATED IN ACCORDANCE WITH APPROPRIATE ANSI/NSF STANDARD. SPECIFICALLY STANDARD 2 AND FOR ALL REFRIGERATED EQUIPMENT STANDARD 7.

2 FLOORS IN FOOD PREPARATION, FOOD STORAGE, WAREWASHING, JANITORIAL, HANDWASHING AND TOILET AREAS SHALL BE SMOOTH AND IMPERVIOUS TO WATER, GREASE, AND ACID AND OF EASILY CLEANABLE CONSTRUCTION WITH 6" CONTINUOUS SELF-COVED BASE WITH 3/8" RADIUS. WHERE EQUIPMENT IS INSTALLED ON A CURB, SELF-COVED BASE IS TO EXTEND 4".

3 AT EXTERIOR TRASH HOLDING AREAS, A CONCRETE SLAB MUST BE PROVIDED FOR TRASH , GARBAGE AND GREASE CONTAINERS. IF WALLS ENCLOSE THE AREA, THE INTERIOR WALL SURFACES ARE TO BE SMOOTH, SEALED AND WASHABLE (E.G. PLASATERED SMOOTH AND PAINTED, ETC.)

4 ALL FLOOR MOUNTED EQUIPMENT WILL BE INSTALLED ON MINIMUM 6" SANITARY LEGS, CASTERS OR COMPLETELY SEALED IN POSITION ON A 4" HIGH CURB WITH CONTINUOUSLY COVED BASE. COUNTER TOP EQUIPMENT SHALL BE MOUNTED ON 4" SANITARY LEGS OR SEALED TO THE COUNTER UNLESS READILY MOVEABLE.

5 ALL REFRIGERATION EQUIPMENT SHALL HAVE A THERMOMETER WHICH IS EASILY READABLE AND IN PROPER WORKING CONDITION.

6 WALLS IN FOOD PREPARATION AREAS AND DISHWASHING AREAS SHALL BE SMOOTH AND NON-ABSORBENT WITH A LIGHT COLORED, EASILY CLEANABLE FINISH. ALL PAINTED SURFACES SHALL BE SEALED WITH A GLOSS OR SEMI-GLOSS ENAMEL.

7 CEILINGS IN KITCHEN PREPARATION AREAS SHALL BE SMOOTH AND NON-ABSORBENT WITH A LIGHT COLORED, EASILY CLEANABLE FINISH. ALL PAINTED SURFACES SHALL BE SEALED WITH A GLOSS OR SEMI-GLOSS FINISH.

8 LAVATORY (HANDWASHING) SINKS SHALL BE PROVIDED IN THE FOOD PREPARATION, FOOD SERVING AND WAREWASHING AREAS. SOAP AND SANITARY TOWELS SHALL BE PROVIDED IN SINGLE SERVICE, PERMANENTLY INSTALLED DISPENSERS AT THE LAVATORY SINKS. ALL HANDWASHING SINKS SHALL HAVE A COMBINATION FAUCET OR PREMIXING FAUCET CAPABLE OF SUPPLYING WATER TEMPERED TO 100 F TO 108 F AND BE SELF CLOSING OR METERED TO PROVIDE TO PROVIDE AT LEAST 15 SECOND OF WATER WITHOUT REACTIVATION.

9 TOILET FACILITIES SHALL BE PROVIDED WITHIN EACH FOOD ESTABLISHMENT CONVENIENT FOR THE EMPLOYEES.

10 ALL TOILET ROOMS, JANITOR CLOSETS WITH JANITOR SINKS, INDOOR TRASH ROOMS AND DRESSING/CHANGE ROOMS SHALL BE PROVIDED WITH MECHANICAL VENTILATION, LIGHTS AND SWITCHES CONSISTENT WITH MECHANICAL CODE REQUIREMENTS.

11 ALL DELIVERY DOORS LEADING TO THE OUTSIDE SHALL OPEN OUTWARD, BE SELF-CLOSING, AND SHALL BE PROVIDED WITH AN OVERHEAD AIR CURTAIN. AIR CURTAIN SHALL PRODUCE A DOWNWARD AND OUTWARD AIRFLOW NOT LESS THAN 3" THICK AT THE NOZZLE WITH AN AIR VELOCITY NOT LESS THAN 1600 FPM AT 3 FEET A.F.F. ACROSS ENTIRE OPENING.

12 ALL EXTERIOR DOORS SHALL OPEN OUTWARD AND BE SELF-CLOSING AND TIGHT-FITTING. BI-FOLD, FRENCH, ACCORDIAON STYLE AND ROLL-UP DOORS CANNNOT OPEN INTO FOOD PREPARATION, UNPACKAGED FOOD SERVICE OR WAREWASHING AREA.

13 TOILET ROOM DOORS ARE TO BE SELF-CLOSING AND TIGHT-FITTING.

14 ALL PLUMBING, ELECTRICAL AND GAS LINES SHALL BE CONCEALED WITHIN THE BUILDING STRUCTURE TO AS GREAT AN EXTENT AS POSSIBLE. ALL EXPOSED CONDUIT, PLUBMING LINES, ETC. SHALL BE INSTALLED A MINIMUM OF 6" ABOVE THE FLOOR AND ¾" FROM THE WALLS USING STANDOFF EASILY CLEANABLE BRACKETS.

15 UTENSIL SINKS TO HAVE 3 COMPARTMENTS THAT ARE A MINIMUM SIZE OF 18" X 18" X 12" DEEP WITH A MINIMUM 18" DRAINBOARD AT EACH END. IF THE END IS AGAINST A WALL, THE END MUST HAVE AN 8" INTEGRAL BACKSPLASH. THE SINK TUB MUST BE CAPABLE OF ACCOMMODATING THE LARGEST UTENSIL TO BE WASHED.

16 PREP SINK COMPARTMENTS MUST BE AT LEAST 18" X 18" X 12" DEEP WITH A MINIMUM DRAINBOARD OF 18".

17 FAUCETS SHALL HAVE SPOUTS CAPABLE OF REACHING EACH SINK COMPARTMENT.

18 APPROVED BACKFLOW PREVENTION DEVICES SHALL BE PROPERLY INSTALLED UPSTREAM OF ANY POTENTIAL HAZARD BETWEEN THE POTABLE WATER SUPPLY AND A SOURCE OF CONTAMINATION. HOSES SHALL NOT BE ATTACHED TO A FAUCET OR HOSE BIBB UNLESS AN APPROVED BACKFLOW PREVENTER IS SUPPLIED.

19. IN EVERY ROOM AND AREA IN WHICH ANY FOOD IS PREPARED, MANUFACTUERED, PROCESSED, OR PREPACKAGED OR IN WHICH EQUIPMENT OR UTENSILS ARE CLEANED, SUFFICIENT NATURAL OR ARTIFICIAL LIGHTING SHALL BE PROVIDED TO PRODUCE LIGHT INTENSITY, WHILE THE AREA IS IN USE:

A) AT LEAST 10-FOOT CANDLES FOR THE FOLLOWING:
1) AT A DISTANCE OF 30 INCHES ABOVE THE FLOOR, IN WALK-IN REFRIGERATION UNITS AND DRY FOOD STORAGE UNITS.
2) AT A WORKING SURFACE ON WHICH ALCOHOLIC BEVERAGES ARE PREPARED OR WHERE UTENSILS USED IN THE PREPARATION OR SERVICE OF ALCOHOLIC BEVERAGES ARE CLEANED.
3) INSIDE EQUIPMENT SUCH AS REACH-IN OR UNDER THE COUNTER REFRIGERATORS.

B) AT LEAST 20-FOOT CANDLES FOR THE FOLLOWING:
1) AT A SURFACE WHERE FOOD IS PROVIDED FOR CONSUMER SELF-SERVICE OR WHERE FRESH PRODUCE OR PREPACKAGED FOODS ARE SOLD OR OFFERED FOR CONSUMPTION.
2) IN SERVER STATIONS WHERE FOOD IS PREPARED.
3) AT A DISTANCE OF 30 INCHES ABOVE THE FLOOR IN AREAS USED FOR HANDWASHING, WAREWASHING, EQUIPMENT AND UTENSIL STORAGE AND IN TOILET ROOMS.
4) IN ALL AREAS AND ROOMS DURING PERIODS OF CLEANING.

C) EXCEPT IN SERVER STATOINS WHERE FOOD IS PREPARED, AT LEAST 50-FOOT CANDLES AT A SURFACE WHERE A FOOD EMPLOYEE IS WORKING WITH FOOD OR WORKING WITH UTENSILS OR EQUIPMENT SUCH AS KNIVES, SLICERS, GRINDERS OR SAWS WHERE EMPLOYEE SAFETY IS A FACTOR.

D) LIGHT FIXTURES SHALL BE OF SHATTERPROOF CONSTRUCTION OR SHALL BE PROTECTED WITH SHATTERPROOF SHEILDS AND SHALL BE READILY CLEANABLE

ABBREVIATIONS

"T"	TEE
(N)	NEW
*	SEE REMARKS COLUMN
A	AMPS
A.F.F.	ABOVE FINISH FLOOR
A.G.A.	AMERICAN GAS ASSOCIATION
AL	ALUMINUM
ALT	ALTERNATE
APPROX	APPROXIMATE
ARCH	ARCHITECT
BLDG	BUILDING
BTU	BRITISH THERMAL UNIT
C	CONVENIENCE OUTLET
C.M.U.	CONCRETE MASONRY UNITS
CFCI	CONTRACTOR FURNISHED CONTRACTOR INSTALLED
CLG.	CEILING
CLR	CLEAR
CO	CONVENIENCE OUTLET
COL	COLUMN
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
CW	COLD WATER
D	DIRECT CONNECTION
DCO	DUPLEX CONVENIENCE OUTLET
DET	DETAIL
DFA	DOWN FROM ABOVE
DIA	DIAMETER
DIM	DIMENSION
DN	DOWN
DW	DIRECT WASTE
DWG	DRAWINGS
EA.	EACH
EH	EXHAUST
ELEC	ELECTRICAL
F	FREEZER
FD	FLOOR DRAIN
FIN	FINISH
FLR	FLOOR
FS	FLOOR SINK
FSEC	FOOD SERVICE EQUIPMENT CONTRACTOR
FT	FOOT
GA	GAUGE
GALV	GALVANIZED
GC	GENERAL CONTRACTOR
GL	GLASS
GPH	GALLONS PER HOURS
GYP. BD.	GYPSUM BOARD
HP	HORSEPOWER
HR	HOUR
HTR	HEATER
HW	HOT WATER
I.D.	INSIDE DIAMETER
IN	INCH
INS	INSIDE INSULATION
INT	INTERIOR
IW	INDIRECT WASTE
JAN	JANITOR
KIT	KITCHEN
KW	KILOWATT
L	LENGTH
LOT	LOT
MAX	MAXIMUM
MECH	MECHANICAL
MED	MEDIUM
MET	METAL
MFG	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
MOB	MOBILE
MTD	MOUNTED
N.I.C.	NOT IN CONTRACT
NIFSEC	NOT IN FOOD SERVICE EQUIPMENT CONTRACT
O.C.	ON CENTER
O.D.	OUTSIDE DIAMETER
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED OWNER INSTALLED
P.S.I.	POUNDS PER SQUARE INCH
PLY	PLYWOOD
POB	PART OF BUILDING
POF	PART OF FIXTURE
POL	POLISH, POLISHED
POT	PORTABLE
PR	PAIR
PT	PAINT
QTY	QUANTITY
R	REFRIGERATOR
REQ	REQUIRED
REQ'S	REQUIREMENTS
RM	ROOM
S/S	STAINLESS STEEL
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SIM	SIMILAR
SOV	SHUT-OFF VALVE
SQ	SQUARE
STD	STANDARD
STRUCT	STRUCTURAL
THK	THICK
TYP	TYPICAL
W	WIDE, WIDTH, WASTE
W/	WITH
WD	WOOD

GENERAL SYMBOLS

1 / FS-701 — ELEVATION REFERENCE

1 / 4 FS-701 2 / 3 — MULTIPLE ELEVATION REFERENCE

/ FS-801 — DETAIL REFERENCE

1 / FS-801 — SECTION REFERENCE

/ FS-801 — ENLARGED PLAN/ DETAIL REFERENCE

P-1 — SPECIFICATION REFERENCE
SEE TYPICAL SPECIFICATION SYMBOLS (ON INTERIOR DRAWINGS)

X — ITEM NUMBER

N — NORTH ARROW

1 — REVISION DELTA

+8'-0" — ELEVATION HEIGHT REFERENCE

SHEET INDEX

THIS PLAN IS A GENERAL ARRANGEMENT OF EQUIPMENT FOR THE CONVENIENCE OF CONTRACTORS AND IS MADE FROM AVAILABLE INFORMATION. WEBB FOODSERVICE DESIGN ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF SUCH MEASUREMENTS. FABRICATORS, CONTRACTORS, AND OTHERS UTILIZING THESE PLANS IN CONNECTION WITH THIS JOB ARE RESPONSIBLE FOR SECURING THEIR OWN MEASUREMENTS. PLUMBING AND ELECTRICAL INFORMATION INDICATED ON THESE PLANS ARE GENERALLY FOR FOOD SERVICE EQUIPMENT AND ARE INTENDED AS REFERENCE ONLY. WEBB DESIGN IS NOT RESPONSIBLE FOR THE ENGINEERING THEREOF OR FOR ANY PLUMBING OR ELECTRICAL FITTINGS, WORK, AND OR CONNECTIONS UNLESS SPECIFICALLY PROVIDED FOR IN THE SPECIFICATIONS. WEBB FOODSERVICE DESIGN ASSUMES NO RESPONSIBILITY FOR THE WORK DONE BY THE CONTRACTORS NOR FOR ANY CHANGES MADE NECESSARY BY THE LOCAL BUILDING CODES, ORDINANCES, STRUCTURAL CONDITIONS, OR BY THE SUBSTITUTION OR CHANGES MADE NECESSARY IN EQUIPMENT SHOWN ON THIS PLAN. CONTRACTORS ARE TO MAKE ALLOWANCES FOR ELBOWS, TRAPS, ETC. AND ARE TO MAKE FINAL CONNECTIONS ON THE JOB, SUPPLYING ALL NECESSARY VALVES, TRAPS, STEAM TRAPS, FAUCETS, STARTING SWITCHES FOR MOTORS, ETC. EXCEPT WHERE SPECIFICALLY NOTES OTHERWISE IN THE WRITTEN SPECIFICATIONS. THESE PLANS AND DESIGNS CONTAINED HERIN ARE THE PROPERTY OF WEBB FOODSERVICE DESIGN AND MAY NOT BE REPRODUCED OR USED BY ANYONE, EITHER ALL OR IN PART WITHOUT FIRST SECURING THE WRITTEN PERMISSION OF WEBB FOODSERVICE DESIGN.

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P 714.508.1880 www.webbfsd.com

NOT FOR CONSTRUCTION

rev	date	issue
	11/21/17	100% SD
	10/06/17	80% SD
	07/10/17	60% SD
	06/16/17	50% SD

COLLEGE OF MARIN IVC
JONAS CENTER & BLDG 18 ALTERATIONS

1800 IGNACIO BLVD. NOVATO, CA

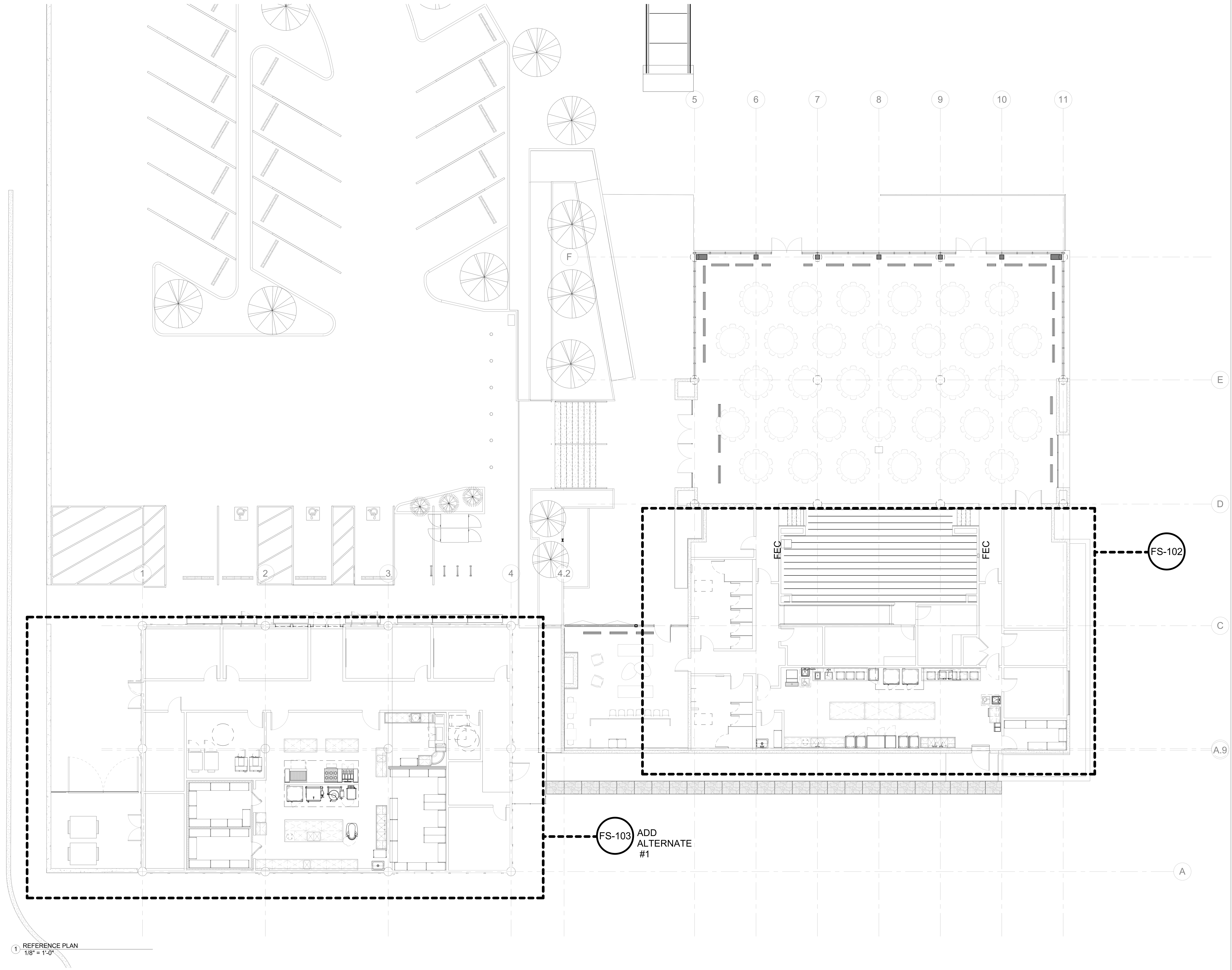
project number: 16-148.04
plot date: 11/20/2017 11:26:09 AM

scale: as noted
date: 11/21/2017

100% SD

SYMBOLS, NOTES, & INDEX

FS-100



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	06/16/17	50% SD

COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

1800 IGNACIO BLVD. NOVATO, CA

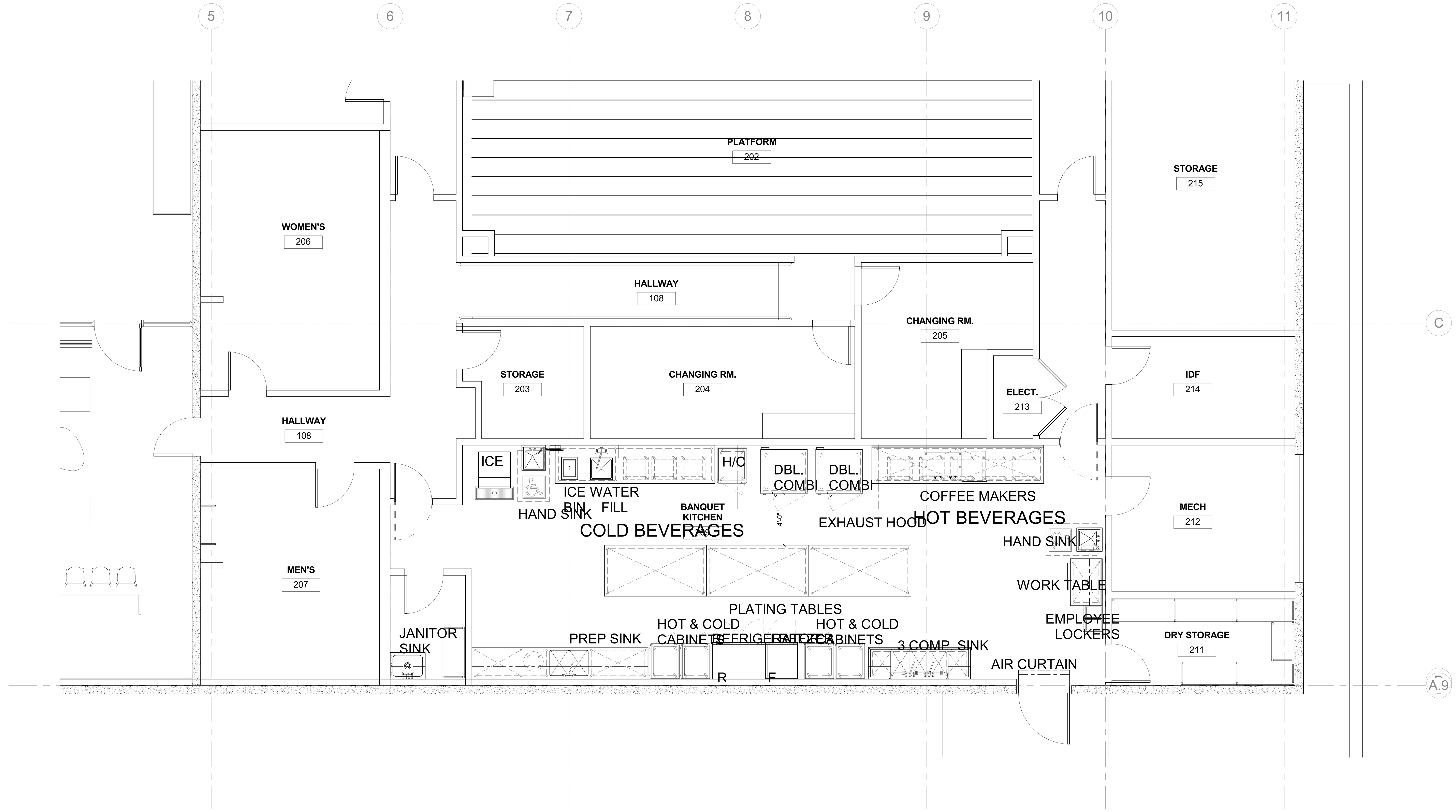
project number: 16-148.04
plot date: 11/21/2017 8:38:37 AM

scale: as noted
date: 11/21/2017

100% SD

OVERALL EQUIPMENT FLOOR PLAN

FS-101



1 EQUIPMENT FLOOR PLAN-BANQUET KITCHEN
1/4" = 1'-0"

webb

Sample Equipment Utility Loads- COM Jonas Center

Area	Plumbing Connections							Electrical	
	FS	FD	DW	HW	CW	Gas	MBTU	Voltage	Amps
Production Kitchen	13	9	7	12	16	12	2000	120/1	200
								208/1	250
Prod. Kitchen Hoods = 7000cfm									

FS: Floor Sinks
FD: Floor Drains
DW: Direct Waste

COM Jonas Center
Preliminary Food Service Equipment Opinion of Probable Cost
September 27, 2017

	Estimated ASF	Cost per ASF	Cost per Area
Production Kitchen	1,843	$220	$405,460
Total ASF	1,843		
Subtotal		$220	**$405,460**
Installation @ 14%			$56,764
8.25% Sales Tax			$33,450
GRAND TOTAL			**$495,675**

Included: Group 1 & 2 equipment, serving counters, exhaust hoods, fire suppression systems, refrigeration system, cooking equipment, preparation equipment, mobile carts, sales tax, kitchen contractor mark-up, installation.

Exclusions: Floor, wall and ceiling coverings, window coverings, building walls, plumbing, electrical, HVAC, dining room furniture, loading dock equipment and all general construction.

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rev	date	issue
	11/21/17	100% SD
	10/06/17	80% SD
	07/10/17	60% SD
	06/16/17	50% SD

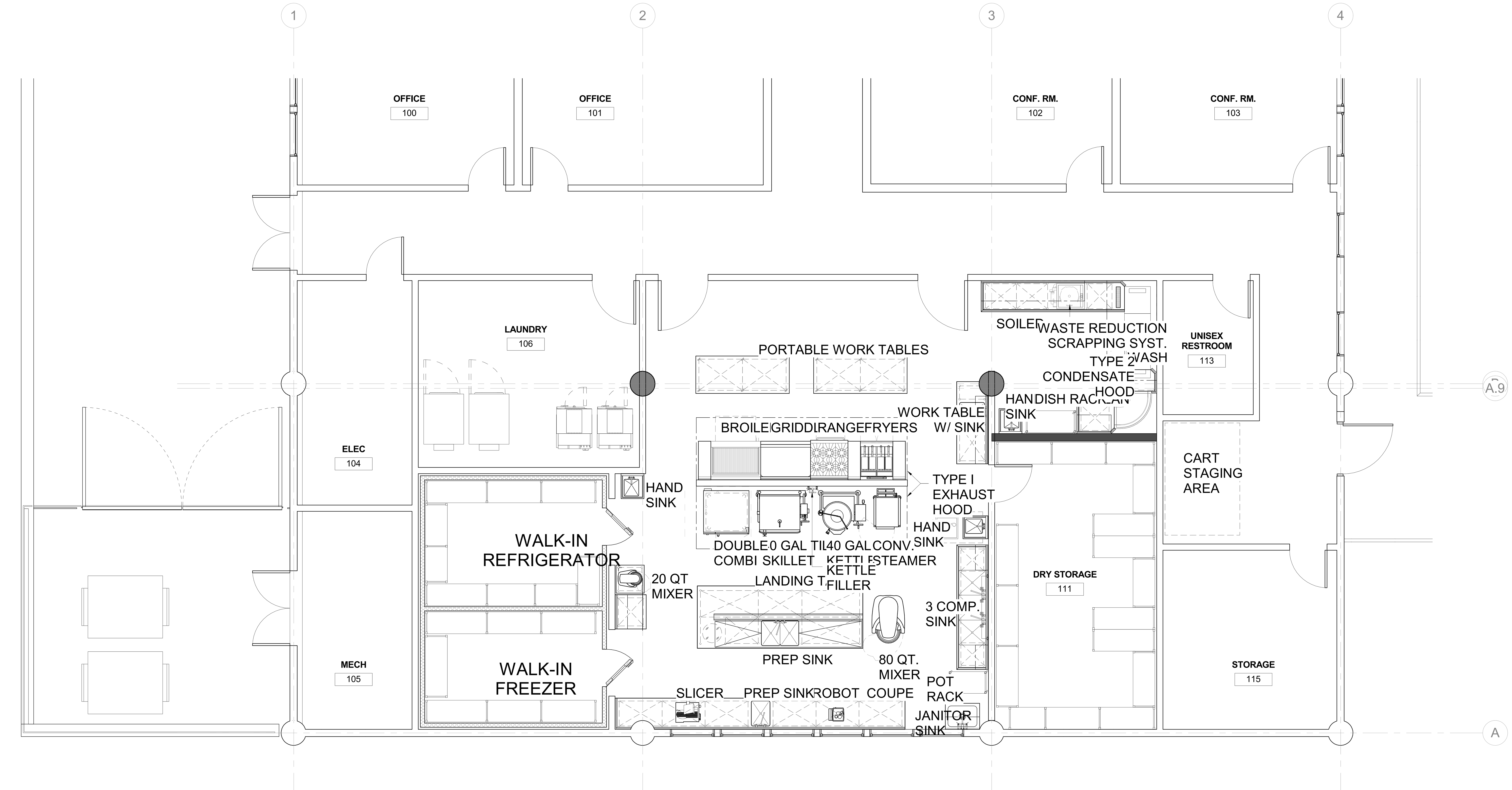
COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS
1800 IGNACIO BLVD. NOVATO, CA

project number: 16-148.00
plot date: 11/21/2017 8:38:39 AM
scale: as noted
date: 11/21/2017

100% SD

EQUIPMENT FLOOR PLAN - BANQUET KITCHEN

FS-102



1 EQUIPMENT FLOOR PLAN-PRODUCTION KITCHEN
1/4" = 1'-0"

COM Jonas Center

Preliminary Food Service Equipment Opinion of Probable Cost

September 26, 2017

	Estimated ASF	Cost per ASF	Cost per Area
Banquet Kitchen	1,077	$220	$236,940
Total ASF	1,077		
Subtotal		$220	**$236,940**
Installation @ 14%			$33,172
8.25% Sales Tax			$19,548
GRAND TOTAL			**$289,659**

Included: Group 1 & 2 equipment, serving counters, exhaust hoods, fire suppression systems, refrigeration system, cooking equipment, preparation equipment, mobile carts, sales tax, kitchen contractor mark-up, installation.

Exclusions: Floor, wall and ceiling coverings, window coverings, building walls, plumbing, electrical, HVAC, dining room furniture, loading dock equipment and all general construction.

Sample Equipment Utility Loads- COM Jonas Center

	Plumbing Connections							Electrical	
Area	FS	FD	DW	HW	CW	Gas	MBTU	Voltage	Amps
Banquet Kitchen	7	10	6	9	13	6	500	120/1	250
								208/1	200
Prod. Kitchen Hoods = 1750cfm									

FS: Floor Sinks
FD: Floor Drains
DW: Direct Waste

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rev	date	issue
	11/21/17	100% SD
	10/06/17	80% SD
	07/10/17	60% SD
	06/16/17	50% SD

COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

1800 IGNACIO BLVD. NOVATO, CA

project number: 16-148.04
plot date: 11/21/2017 8:38:42 AM

scale: as noted
date: 11/21/2017

100% SD

EQUIPMENT FLOOR PLAN - PRODUCTION KITCHEN

FS-103

BRIDGING DOCUMENTS

100% SCHEMATIC DESIGN
NOVEMBER 21, 2017

BILL AND ADELE JONAS CENTER AND BUILDING 18 ALTERATIONS

COLLEGE OF MARIN
INDIAN VALLEY CAMPUS
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NOVATO, CA 94949

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DOCUMENT 00 01 10

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DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

(Division 00 Documents not included in this submittal to be provided under separate cover by District)

INTRODUCTORY INFORMATION

PROCUREMENT AND CONTRACTING REQUIREMENTS

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(Division 01 Documents not included in this submittal to be provided under separate cover by District)

DIVISION 02 – EXISTING CONDITIONS

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DIVISION 04 – MASONRY

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DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

DIVISION 13 – SPECIAL CONSTRUCTION (NOT USED)

DIVISION 14 – CONVEYING EQUIPMENT (NOT USED)

DIVISION 21 – FIRE PROTECTION

DIVISION 22 – PLUMBING

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

DIVISION 25 – INTEGRATED AUTOMATION (NOT USED)

DIVISION 26 – ELECTRICAL

11/21/2017	--	**C**	**Audio Visual Report, Narrative and Budget**
			C-1: COM – Jonas Center AV Systems Engineering Report- 100% SD November 21, 2017, by The Shalleck Collaborative Inc.
			C-2: COM – Jonas Center AV Systems Narrative, dated November 21, 2017, by The Shalleck Collaborative Inc.
			C-3: COM – Jonas Center AV Systems Budgets – 100% SD, dated November 21, 2017, by The Shalleck Collaborative Inc.
11/21/2017	--	**D**	**Acoustic Report**
			Final Acoustical Recommendations- Bridging Documents – R1 College of Marin Indian Valley Campus Jonas Center (Bldg. 19) and renovation of existing Building 18, November 28, 2017, by Wilson Ihrig
12/01/2017	--	**E**	**Renderings**
			Jonas Center Renderings, Dated December 1, 2017, by Brick
			END OF DOCUMENT

DOCUMENT 00 01 20

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Contact: Mark Dupuis — E: mark.dupuis@sbdinc.com

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55 New Montgomery, Suite 805
San Francisco, CA 94105
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END OF DOCUMENT

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Demolition of items indicated on the Drawings and required for completion of the work.
   2. Disconnecting, capping or sealing, and removing of utilities.
   3. Design Builder's Demolition Plan.

B. Related Requirements:
   1. Structural, Mechanical, Electrical and Plumbing demolition Drawings for extent of demolition.
   2. Demolition Plan Drawings.

1.02 DEFINITIONS

A. Remove: detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.

B. Remove and Salvage: Detach items from existing construction and deliver them to District as directed.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-Demolition Meeting: Conduct a pre-demolition meeting at project site before commencing demolition.
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review demolition methods and procedures.
   3. Review protection measures for existing construction and building occupants.
   4. Report unresolved issues or conflicts to District Representative.
   5. Review and finalize Demolition Plan and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.

1.04 MATERIALS OWNERSHIP

A. Items of interest or of value to District will be removed prior to Design Builder commencing demolition.

1.05 ACTION SUBMITTALS

A. Demolition Plan as specified below.

B. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification data for demolition firm if a separate subcontractor will be used.

B. Inventory: After demolition is complete, submit a list of items that have been removed and salvaged, not previously removed by District, and that may be of value or of use to the District.

1.07 DEMOLITION PLAN

A. The Design Builder shall submit a complete Demolition Plan detailing procedures and sequence for removing existing interior improvements and structural elements in a safe and controlled manner to insure stability of the structure at any given time.

B. Thoroughly investigate the condition of portions of the existing Building to be removed before proceeding with the Demolition Plan.

C. The Demolition Plan shall consist of the following:
   1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
   2. Interruption of utility services.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Details and locations of shields or other protective measures to ensure that occupants will not be endangered and improvements to remain will not be damaged.

D. Review by the District's Design Consultant of the Demolition Plan, or field observations performed by the District's consultants, will in no way relieve the Design Builder of full responsibility for the Demolition Plan and procedures.

1.08 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.09 FIELD CONDITIONS

B. Special care shall be exercised to protect existing improvements and other items to remain.
   1. Damage or disturbance to existing facilities and items to remain shall be promptly restored, repaired, or replaced to match existing at no cost to the District.
   2. If the Design Builder has any question as to the extent of demolition or items to remain, Design Builder shall notify the District's Design Consultant and request a clarification before proceeding.

C. Utility Services:
   1. Except where utilities are affected by demolition, maintain existing utilities and protect against damage during demolition operations.
   2. Utilities interfacing with demolition shall be disconnected and sealed before starting demolition operations.
   3. Coordinate interruptions with the Building Management and provide temporary service as required where utilities are common to other occupants in the Building.

D. Hazardous Materials: If hazardous materials are encountered, do not disturb and immediately notify District's Design Consultant. Materials determined to be hazardous will be removed by District under separate contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of additional demolition required.

B. Inventory and record the condition of items to be removed and salvaged.

C. Photographic documentation of existing conditions prior to execution of work under this Contract is not required. This does not, however, relieve the Design Builder of the responsibility of restoring and replacing existing improvements to remain, determined by the District as damaged by work under this Contract, at no additional expense to District.

3.02 DEMOLITION

A. Existing work to be removed shall, in general, be as indicated on the Drawings and shall include other existing materials and work necessary to install new work indicated and specified.

B. Surfaces to remain, when cut, shall be carefully restored and refinished to provide a continuous, even finish to nearest intersections.

3.03 SALVAGED ITEMS

A. Where required by the Bridging Documents or directed to be salvaged and/or reused, existing materials shall be removed in the most careful manner possible to avoid damage; and, if damaged, such items shall be restored to conditions satisfactory to the District's Design Consultant.

3.04 SITE RESTORATION

A. Completely fill voids resulting from demolition operations that will not be required by new construction.

3.05 REPAIRS

A. Promptly repair damage to existing improvements to remain.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. Except for items or materials indicated to be recycled, salvaged, or otherwise indicated to remain District's property, remove demolished materials from Project site and legally dispose of them in accordance with in accordance with requirements specified in Section 01 7419, “Construction and Demolition Waste Management.”
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage outside of the Contract work area and into other Building areas.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to the following:

1. Furnish, install, and remove formwork, shoring and temporary structural supports for cast-in-place concrete.
2. Furnish and install inserts, anchors and other embedded items.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 03 20 00, Concrete Reinforcement.
4. Section 03 30 00, Cast-in-Place Concrete.
5. Section 03 35 00, Concrete Finishes.
6. Section 05 31 00, Steel Decking.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Concrete Institute (ACI):
   a. ACI 117, “Tolerances for Concrete Construction and Materials.”
   b. ACI 301, “Specification for Structural Concrete for Buildings.”
   c. ACI 318, “Building Code Requirements for Structural Concrete.”
3. American Society for Testing and Materials (ASTM):
   a. ASTM C578, “Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.”
   b. ASTM D6817, “Standard Specification for Rigid, Cellular Polystyrene Geofoam.”

1.3 SUBMITTALS

A. Review of submittals is of a general nature only, and responsibility for conformance with intent of Drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit Shop Drawings per Division 01.
2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:

a. Specific situations not addressed in the Construction Documents,
b. Proposed variations from the Construction Documents, or
c. Clarification requests (clearly note the nature of the question).

C. Action Submittals:

1. Formwork Shop Drawings to include:
   a. Location and layout of all construction, crack control, and expansion joints shown in approved Concrete Joint Plan submittal described in Section 03 30 00, Cast-in-Place Concrete.
   b. Location of formed edges, openings, depressions and penetrations shown in approved Penetration Plan submittal described in Section 03 30 00, Cast-in-Place Concrete.
   c. For exposed concrete surfaces, type and location of reveals, form joints, sleeves, finished surface textures, tie holes or plugs, embedded items and other features that will be exposed on the finish wall.
2. When a mock-up is required, submit shop drawings of the mock-up.
3. Submit manufacturer's data for formwork release agent. Indicate the form surfaces where the formwork release agent will be used.

D. LEED Submittals:

1. Submit product data indicating that all adhesives and sealants used inside building and applied on site comply with LEED VOC Requirements outlined in Environmental Quality Assurance article.

1.4 QUALITY ASSURANCE

A. Formwork and Shoring Design:

1. Formwork, shoring, and reshoring design is the sole responsibility of the Contractor; resultant concrete to conform to required shape, line and dimensions.

1.5 ENVIRONMENTAL QUALITY ASSURANCE

A. Adhesives, sealants, and sealant primers shall not exceed VOC limits established in Section 01 35 63, LEED Requirements.

B. Applicable LEED Credits:

1. Category – Indoor Environmental Quality:
   a. Credit 4.1, Low-Emitting Materials, Adhesives and Sealants.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forming Materials:

1. Formwork materials shall be appropriate for the specified finishes. Refer to Section 03

35 00, Concrete Finishes.

2. Chamfer Strips: Rigid PVC or wood, 3/4-inch by 3/4-inch size, maximum possible length. For each application use only one product.

3. Form Gaskets: Of sufficient thickness, widths and compressibility for specific use.

4. Polystyrene Foam where indicated on the Drawings:
   a. ASTM D6817, Type EPS29. Minimum compressive resistance:
      1) 25 psi at 10 percent deformation, and
      2) 10 psi at 1 percent deformation.
   b. Foam blocks to be stamped with ASTM foam grade.

2.2 FORM HARDWARE

A. Use commercially manufactured formwork accessories. Do not use wire ties or wood spreaders.

B. Form ties shall not leave open holes through concrete and shall permit neat and solid patching at every hole. At walls exposed to weather or water, form ties shall have integral water barrier plates in walls.

C. For walls exposed to weather, earth or water:

1. Extruded fiberglass form ties, RJD Industries Supertie or approved equal, or

2. Metal ties with minimum breakback of 1-1/2 inches below concrete surface when forms are removed.

D. For interior walls protected from the weather and water:

1. Extruded fiberglass form ties, or

2. Standard steel ties with minimum breakback of 3/4 inch below concrete surface when forms are removed.

E. Use plastic cones or washers to completely cover holes in forms.

F. Where wall is exposed to view in completed structure, use form ties with cones that leave a hole of not more than one inch in diameter on concrete surface.

2.3 FORMWORK RELEASE AGENTS AND SEALERS

A. Use commercially manufactured form release agents.

B. Formwork release agents and sealers shall not harmfully affect appearance, discolor or change texture of finished concrete surface or inhibit proper application of any surface finishes, coatings or bonding agents.

C. VOC content to comply with the more restrictive of Air Quality Management District requirements or LEED accreditation requirements.

2.4 MOCK-UP

A. Construct mock-up. See Drawings for extent of mock-up. Employ products, materials, and workmanship to be used in completed structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspection:

1. Inspect the installed Work of other trades and verify that such Work is completed to the point where this installation may properly commence.
2. Verify that forms are constructed in accordance with all applicable codes and regulations, referenced standards, and Construction Documents.

B. Discrepancies:

1. In the event of discrepancy or conflict, immediately notify Architect and Structural Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 CONSTRUCTION OF FORMS

A. When a mock-up of concrete is required, do not construct forms for visible concrete, other than for mock-up, until mock-up has been accepted.

B. Earth Forms: Unless otherwise required by Construction Documents, concrete that will remain in permanent contact with soil may be placed directly against vertical excavated surfaces provided the material will stand without caving or no sloughing of loose material. Make excavations as near as possible to neat lines required by the Drawings.

C. Layout:

1. Form concrete to shapes, sizes, lines, and dimensions indicated on the Drawings. Camber forms where camber is indicated.
2. Make provision for openings, offsets, sleeves, recesses, anchorage, blocking, reglets, chases and other features of the Work as shown or required.
3. Provide openings as necessary to place and consolidate concrete. Provide temporary holes in formwork to facilitate cleaning and inspection.
4. See Drawings for patterns, textures, and reveals on concrete surfaces.
5. Minimize, to a practical minimum, the number of seams on exposed or smooth surfaces.
6. Form Ties for Exposed Surfaces: Locate as shown on Drawings. Unless otherwise indicated, arrange in a symmetrical regular pattern in level horizontal rows and plumbed vertically. Obtain prior approval from Architect for variations or changes in pattern from those shown on the Drawings.
7. Camber forms as shown on the plans. If camber is not shown, for spans greater than 30 feet in length, forms shall have a minimum camber at the center of the span of 1/80 inch times span length in feet. Camber shall approximate a smooth S-curve in elevation between the middle and both ends of the span.
8. Conform to requirements of ACI 301 Section 2.3.1.

D. Construction Joints:

1. Construction joints in exposed surfaces shall be located only at revealed form joint locations as indicated on the Drawings.

E. Tolerances:

1. Tolerances for formwork and embedded items shall be the most restrictive of:
   a. Specified in ACI 117,
   b. Specified in Section 03 35 00, Concrete Finishes,
   c.
   d. As required for the installation of other items, and
   e. As specified below.
2. Regardless of formed surface irregularity class specified, minimum section thickness shall not be less than that defined in ACI 117 for cross-sectional dimension tolerance, and clear cover over reinforcement shall not be less than that defined in ACI 117 for reinforcement location tolerance.

F. Construction:

1. Tape form joints for concrete exposed to view in the finished structure, including joints between form panels and trim strips.
2. Provide 3/4-inch chamfers in corners of formwork on permanently exposed surfaces. Do not chamfer re-entrant corners or top edges of beams and slabs.
3. Trowel rounded edge at top edges of beams and slabs, unless otherwise noted on the Drawings.
4. Form panel joints to be tight butt joints with edges true and square.
5. Do not install inside forms until reinforcement has been inspected.
6. For slabs on grade, verify top of subgrade is compatible with slab thickness shown.
7. Remove loose concrete, dust, and other material from existing concrete surfaces prior to erection of forms.

G. Finishes:

1. Provide as-cast surfaces as defined in Section 03350, Concrete Finishes.

H. Form Release Agents:

1. Apply form release agent on formwork in accordance with manufacturer's recommendations.
2. Apply form release agents prior to placing reinforcement and embedded items.
3. Keep form release agents away from reinforcement, embedded items, and concrete against which fresh concrete will be placed.

3.3 EMBEDDED ITEMS

A. General:

1. Install anchorage devices, inserts, and other items embedded in cast-in-place concrete straight, level, plumb, and in accordance with manufacturer's recommendations:
2. Secure anchor bolts and other embedded items in place during concrete placement.
3. Fill voids in sleeves, inserts, and anchor slots with readily removable material to prevent entry of concrete into voids.

B. Notify Architect and Structural Engineer whenever any embedded item interferes with

placement of reinforcement or placement of concrete. Maintain concrete cover and spacing around embedments not less than that required for reinforcement.

C. Comply with ACI 301 Sections 2.3.1.12 and 2.3.1.13.

3.4 PREPARATION FOR PLACEMENT

A. Clean and prepare existing concrete surfaces prior to installing forms.

B. Clean and inspect forms, embedded materials, and existing concrete surfaces immediately before placing concrete. Remove any material that will impair bond to reinforcement or concrete.

C. If bottoms of trenches become softened due to water before concrete is cast, repair as recommended by Geotechnical Engineer.

D. Hold formwork tight to previously placed concrete when placing subsequent pours at construction joints, to prevent fluid loss, mortar loss, and to maintain alignment of concrete surfaces.

E. Cover form clean-out openings and install removable sections of forms only after inspection of forms.

3.5 SHORES AND REMOVAL OF FORMS

A. Comply with ACI 301 Sections 2.3.2 through 2.3.5.

B. Comply with ACI 318 Section 6.1.

C. Prior to installation of waterproofing or placement of backfill, remove formwork below ground surface on side to be waterproofed or backfilled.

3.6 FIELD QUALITY ASSURANCE

A. Geotechnical Engineer will inspect earthwork forms prior to placing of reinforcement.

B. Owner’s Testing Agency will, prior to pour, inspect:

1. Existing concrete surfaces.
2. Shape, location, and dimensions of forms.
3. Verify documentation and labeling of polystyrene foam delivered to site.

3.7 CLEANING

A. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 03 10 00

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to reinforcing for concrete.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 03 10 00, Concrete Formwork.
4. Section 03 25 00, Concrete and Masonry Anchors.
5. Section 03 30 00, Cast-in-Place Concrete.
6. Section 05 12 00, Structural Steel.

1.2 REFERENCES

A. Published specifications, standards, test methods, or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Concrete Institute (ACI):
   a. ACI 117, “Tolerances for Concrete Construction and Materials.”
   b. ACI 301, “Specification for Structural Concrete for Buildings.”
   c. ACI 318, “Building Code Requirements for Reinforced Concrete.”
3. American Society for Testing and Materials (ASTM):
   a. ASTM A82, “Standard Specification for Cold-Drawn Steel Wire for Concrete Reinforcement.”
   b. ASTM A185, “Standard Specification for Welded Steel Wire Reinforcement, Plain, for Concrete.”
   c. ASTM A497, “Standard Specification for Welded Steel Wire Reinforcement, Deformed, for Concrete.”
   d. ASTM A615, “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.”
   e. ASTM A706, “Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.”
   f. ASTM A970, “Standard Specification for Headed Steel Bars for Concrete Reinforcement.”
4. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
5. American Welding Society (AWS):
   a. AWS D1.1, “Structural Welding Code – Steel.”
   b. AWS D1.4, “Structural Welding Code – Reinforcing Steel.”
6. ICC Evaluation Service, Inc. (ICC-ES):
   a. AC347, “Acceptance Criteria for Headed Ends of Concrete Reinforcement.”

1.3 DEFINITIONS

A. Collector: a beam and/or strip of slab aligned with shear walls, and reinforcing in these beams and strips of slab running parallel to a shear wall. A collector may extend from the end of a shear wall, or may run alongside a shear wall and extend beyond the end of a shear wall.

B. Evaluation Service Report (ESR): Product testing report from ICC Evaluation Service or equivalent from another approved agency.

C. Seismic Load Resisting System (SLRS): shear walls, shear wall foundations and collectors.

D. T2-Head: End anchorage plate with net area at least 9 times reinforcing bar area. Alternative names that may appear on the structural drawings: “Large Head” or “T-Head.”

E. T1-Head: End anchorage plate with net area at least 4 times reinforcing bar area. Alternative names that may appear on the structural drawings: “Small Head” or “D-Head”>

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and responsibility for conformance with intent of Drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit Shop Drawings per Division 01.
2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittals:

1. Welding Procedure Specifications (WPS) and Welding Procedure Qualification Records (WPQR) in accordance with AWS D1.1 and D1.4.
2. Submit record of Welder Performance Qualifications in accordance with AWS D1.1 and D1.4.
3. Shop Drawings:
   a. Submit fully detailed shop drawings of concrete reinforcement for review prior to start of fabrication.
   b. Show sizes and grades of steel, bending and splicing details, splice locations, accessories and concrete protection over steel reinforcement.
   c. Shop drawings to include:
      1) Reinforcement placing drawings, bending schedules and bending diagrams showing size, dimensions, and location of reinforcing steel.
      2) Elevations of beams and walls.
      3) Details of areas of congestion. Identify where reinforcing steel will interfere with the placement of embedded items such as anchor rods, anchors, inserts, conduits, sleeves and any other items which are required to be cast in concrete.
      4) Supplemental reinforcement required at construction, crack control, and expansion joints shown in approved Concrete Joint Plan submittal described in Section 03 30 00, Cast-in-Place Concrete.

5) Supplemental reinforcement required at edges, openings, depressions and penetrations shown in approved Penetration Plan submittal described in Section 03 30 00, Cast-in-Place Concrete.

4. Direct copies of the contract documents are not acceptable as Contractor submittals.

D. Information-Only Submittals:

1. Mill Certificates: Submit steel producer's certificates of mill analysis, including steel source, description, heat number, yield point, ultimate tensile strength, elongation percent, bend test and the chemical composition of each heat as determined by ladle analysis, before delivery of steel to site.

2. Product Certifications:
   a. Furnish headed bar manufacturer's certification and test reports demonstrating compliance with ASTM A970, along with manufacturer's marking system used to identify headed bars.
   b. Furnish mechanical coupler, headed bar, and deformed bar anchor manufacturers' certifications that products comply with specified ESR.
   c. Furnish welding electrode manufacturer's certification that each electrode type meets the requirements of its AWS classification.

E. LEED Submittals:

1. Recycled Content: Submit product data indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.

1.5 QUALITY ASSURANCE

A. Owner's Testing Agency:

1. Shop and field testing and inspection of reinforcing will be performed by an independent laboratory ("Testing Agency") engaged by the Owner.

2. The inspector inspecting welding operations will be currently certified as an AWS Certified Welding Inspector.

B. Qualifications of Welders:

1. All welding shall be performed by operators who are qualified for the types of welds used. Each operator shall have been qualified within the preceding one year as prescribed by AWS D1.1 and D1.4. Welder qualification shall include passing the Charpy tests when specified for the electrode.

2. Require welders to retake the qualification test if, as determined by the Special Inspector, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, he shall not perform any welding on the project.

3. Pay all costs associated with welder qualification.

1.6 ENVIRONMENTAL QUALITY ASSURANCE

A. Provide materials with minimum percentage of recycled content as specified under Part 2 Materials article.

B. Applicable LEED Credits:

1. Category – Materials and Resources:

a. Credits 4.1 and 4.2, Recycled Content.
b. Credits 5.1 and 5.2, Regional Materials.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver reinforcement to jobsite bundled, tagged and marked. Use tags that indicate bar size, grade, lengths and marks corresponding to markings shown on shop drawings.

B. Reinforcement shall be stored clear of the ground in piles according to size, in a manner to prevent bending, rusting or accumulation of dirt or oil.

C. Use all necessary care to maintain identification of reinforcing after bundles are broken apart.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars:

1. ASTM A615, Grade 60, except as otherwise noted.
2. ASTM A706 for members of the Seismic Load Resisting System (SLRS).
3. Reinforcing bars to be welded: ASTM A706. Welding is only permitted where called for on the drawings.
4. Recycled Content: 90 percent minimum.

B. Plain Wire: ASTM A 1064

C. Deformed Wire: ASTM A 1064

D. Welded Wire Fabric (WWF) Reinforcement:

1. Plain and deformed wire reinforcement: ASTM A1064.
2. Where placed in concrete exposed to weather or potentially exposed to interior water (shower areas, etc), galvanize per ASTM A123.
3. Recycled Content: 90 percent minimum.

E. Spiral Reinforcement: ASTM A82 if specified as wire or ASTM A615, Grade 60, if specified by bar size.

F. Accessories:

1. Metal or plastic spacers, supports, ties, precast concrete blocks, etc., as required for spacing, assembling and supporting reinforcing in place. Supports of wood, clay or brick are not allowed.
2. Use stainless steel, plastic or CRSI Class 1 wire supports where contact surface is exposed to weather or dampness, or where epoxy-coated reinforcing is used.

G. Anchor Bolts and Anchor Rods:

1. See the Structural Notes on the Structural Drawings for anchor bolt materials.

2. Nuts:
   a. Heavy hex.
   b. As recommended by ASTM specification for corresponding anchor rod or bolt.
3. Washers:
   a. As recommended by ASTM specification for corresponding anchor rod or bolt.
   b. For oversize and slotted holes in steel material, see washer provisions of Research Council on Structural Connections (RCSC) “Specification for Structural Joints Using ASTM A325 or A490 Bolts.”
   c. For wood sill anchor bolts in shear walls, provide 1/4-inch thick by 3-inch square steel plate washers. If washer holes are slotted, comply with CBC Section 2305.3.11.
4. Couplers shall match or exceed strength of rods they connect.

H. Electrodes for Welding Reinforcing Steel: As required by AWS D1.4.

I. Mechanical Couplers:

1. Type 2 mechanical couplers in accordance with the provisions of ACI 318.
2. In addition, provide test reports to failure, demonstrating that no observed partial or total fracture of the coupler or the coupler-bar connection occur; the failure shall be observed to occur in the parent reinforcing bar material a minimum of one bar diameter from the coupler connection. Failure of the head or the head-to-bar connection within the attachment region is unacceptable and shall be cause for rejection.
3. Acceptable Products:
   a. HRC Couplers conforming to ICC-ES Report No. ER-5309,
   b. Dextra Bartec Mechanical Splice System conforming to ICC-ES Report No. ESR-1705,
   c. Bar-Lock L-series Couplers conforming to ICC-ES Report No. ESR-2495, but only where diameter and length of coupler can fit between transverse reinforcing without displacing the transverse or longitudinal reinforcing, or
   d. Equal or better approved substitution.
4. Form-saver couplers shall meet Mechanical Couplers requirements 1 and 2.

J. Headed Shear Connector Studs (Nelson S3L and similar)

1. AWS D1.1 Type B Studs
   a. 51 ksi minimum yield, Fy
   b. 65 ksi minimum tensile strength, Fu
2. Manufacturer, ICC ES evaluation report and ASTM specification:
   a. Nelson Stud Welding Divsion of TRW
      1) Conforms to ESR-2856
      2) ASTM A29-12, Grades 1010 through 1020, cold-drawn steel
   b. Stud Welding Associates, Strongsville, Ohio
      1) Conforms to ICC-ES Report No. 1094
      2) ASTM A108 Grades C-1010 through C-1020, cold drawn steel
   c. Equal or better approved substitution

K. Deformed Bar Anchors (Nelson D2L and similar):

1. ASTM A496
   a. 70 ksi minimum yield, Fy
   b. 80 ksi minimum tensile strength, Fu

2. Manufacturer and ICC-ES report:
   a. Nelson Stud Welding Divsion of TRW:
      1) Conforms to ESR-2856
   b. Stud Welding Associates, Strongsville, Ohio
      1) Conforms to ER-4601 (legacy report)
   c. Equal or better approved substitution.

L. ”T2-Head” Headed Bars:

1. Net head area at least 9 times the bar area.
2. Conforming to Caltrans “Prequalification Procedures and Acceptance Criteria for Headed ASTM A706 Reinforcing Steel Bars,” March 15, 2010. Testing to demonstrate “Rupture in the rebar, with visible necking or decrease in the sample’s cross-sectional area, at the point of rupture, at a minimum distance of one bar diameter away from the head to bar connection for friction welded and forged headed bar reinforcement, and/or the threads end for threaded headed bars.”
3. Acceptable Products:
   a. HRC 100 series or HRC 200 series headed bars manufactured by Headed Reinforcement Corp. (www.hrc-usa.com/product_tbar.php) and conforming to ICC-ES Report No. ER-5292,
   b. Bartec Large End Anchors by Dextra America (www.dextragroup.com), or
   c. Approved equal or better substitution.
4. Reinforcing bars shown graphically with plate heads are “T2-Heads” unless otherwise noted on the drawings.

M. “T1-Head” Headed Bars: Rebar terminations with a development length equal to or less than that of a standard hook.

1. Net head area at least 4 times the bar area.
2. Conforming to ACI 318, Section 12.6.
3. Conforming to ICC-ES AC347.
4. Acceptable Products:
   a. HRC 555 series forged head bars manufactured by Headed Reinforcement Corp. (www.hrc-usa.com) and conforming to ICC-ES Report No. ESR-2935, or
   b. Bartec Small End Anchors manufactured by Dextra America (www.dextragroup.com) and conforming to ICC-ES Report No. ESR-2166, or
   c. Lenton Terminator Type D16 manufactured by Erico, Inc., (www.erico.com) and conforming to ICC-ES Report No. ER-3967, or
   d. Dayton Superior End Anchor Type D-158-B manufactured by Dayton Richmond (www.daytonrichmond.com), or
   e. “T2-Head” headed bars, provided that required concrete coverage, edge distance and clearance to adjacent reinforcing and headed bars are satisfied, or
   f. Approved equal or better substitution.
5. Reinforcing bars shown graphically with plate heads are “T2-Heads” and not “T1-Heads” unless specifically called out as “T1-Heads” on the drawings.

2.2 FABRICATION

A. Conform to requirements of ACI 318 Chapter 7, except lap bar splices as indicated on the drawings. Refer to structural details for bar sizes, number of bars, and placing details.

B. Fabricate reinforcing bars in accordance with the tolerances of ACI 117 and ACI 318 Section

7.5.2 unless noted otherwise.

C. Bending:

1. Minimum bend diameters and hook extensions as shown on the drawings.
2. Reinforcing bars are to be bent cold unless heating is permitted.
3. Do not bend or kink reinforcing except as shown on the Drawings.

D. Shop fabricated fusion-welded assemblies (such as “Idea Machine” rebar cages) are acceptable provided:

1. Reinforcing bars: ASTM A706.
2. Holding wires: ASTM A82 or ASTM A496.
3. Welding process in accordance with ASTM A185 and A497.

E. Spirals: Provide a minimum of 1-1/2 finishing turns top and bottom.

F. Install mechanical couplers and headed bars in accordance with manufacturer’s recommendations and ESR.

G. Headed Shear Connector Studs (Nelson S3L and similar) and deformed bar anchors (Nelson D2L and similar):

1. Install headed studs and deformed bar anchors with stud welding gun to achieve full fusion arc weld in accordance with the manufacturer's recommendations and the requirements of AWS D1.1.
2. Deformed Bar Anchors: Detailing of bends, hooks, etc., to comply with requirements for reinforcing bars.

H. Requirements for shop welding to be the same as specified for field welding in Part 3.

2.3 SHOP QUALITY ASSURANCE

A. Testing and inspection of shop-fabricated components or assemblies will be the same as specified for field quality assurance in Part 3.

B. Identify reinforcing and verify reinforcement is of type and grade specified.

C. Test reinforcing in accordance with CBC section 1916A.2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Inspect all excavations in accordance with Earthwork specifications prior to placing reinforcement.
2. Wherever embedded items interfere with placement of reinforcement, notify Architect and Structural Engineer and obtain written approval before placing any concrete.

B. Placing:

1. Do not exceed the tolerances defined in ACI 117 or ACI 318 Section 7.5 or CBC Section 1907A.5.
2. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
3. Use templates for placement of column dowels.
4. Do not place reinforcement in floor slabs or beams until concrete has been placed in columns and walls where the reinforcing will restrict the placement of concrete.
5. Dowels shall be tied securely in place before concrete is deposited.
6. Do not install kinked, bent or misplaced reinforcing.
7. The uppermost and lower most horizontal reinforcement for concrete walls shall be placed within one half of the specified spacing at the top and bottom of the wall and at all construction joints.
8. Continue reinforcement across construction joints at least equal to lap development lengths on either side of the joint unless otherwise detailed.

C. Installation of Welded Wire Fabric (WWF) Reinforcement: Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces a minimum of 18 inches and at least one full mesh. Offset laps of adjoining widths to prevent continuous laps in either direction.

D. Field Bending:

1. Field bending or straightening in accordance with ACI 301 Section 3.3.2.8.
2. Do not re-bend reinforcement that has previously been bent within 6 inches of new bend except as shown on the Drawings or explicitly allowed by the Architect and Structural Engineer.

E. Spacing of Reinforcing: Where Drawings do not show the spacing of the reinforcing, provide minimum clear spacing conforming to ACI 318 Section 7.6 nor less than 4/3 times the maximum size aggregate.

F. As a minimum provide the concrete cover shown on the drawings.

G. Splicing:

1. Make splices only at those locations shown on the Drawings or as accepted by the Architect and Structural Engineer.
2. Stagger splices in adjacent bars wherever possible.
3. Lap splice lengths as per Typical Lap Splice detail unless otherwise shown.

H. Reinforcing Supports:

1. Suitable metal or plastic devices of some standard manufacture shall be used to hold reinforcement in its true horizontal and vertical positions. These devices shall be sufficiently rigid and numerous to prevent displacement of the reinforcement during placement of concrete. All such devices shall have prior approval from the Architect.
2. Support reinforcement supported on the ground on precast concrete units or other non-corrosive supports.
3. On surfaces of walls to be sandblasted or where exposed to view in the final structure use stainless steel supporting chairs, spacers, or bolsters. Plastic chairs,spacers and bolsters may be used where walls are exposed to view but not sandblasted, with the

prior approval of the Architect.

4. Where concrete is exposed to the elements or where the underside of slabs or beams is exposed to view in the completed structure, use plastic or stainless steel supports.
5. Do not use wood, brick, stone or other similar materials to support reinforcing.
6. Do not use reinforcing supports or reinforcing to support concrete conveying equipment and similar construction loads.

I. Tying:

1. Reinforcing shall be rigidly and securely tied. Tie wires, after cutting, shall be bent away from exposed concrete surfaces and so that concrete placement will not force the wire ends to surface of exposed concrete.
2. Reinforcing in concrete members that have one or more surfaces exposed to weather (with or without a painted finish) shall be tied with galvanized wire.

J. Anchor Bolts and Rods:

1. Supervise setting of anchor bolts required for wood framing and anchor rods required for erection of structural steel. Ensure correct installation and location of anchor bolts and rods.
2. Anchor bolts and rods must be securely held in place and aligned in a true straight line prior to and during concrete placement.
3. Anchor bolts and rods may not be “wet set,” i.e., pushed into wet concrete.

K. Embedded Items:

1. Secure embedded items to prevent displacement during placement of concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.
2. Aluminum embedments (including aluminum conduit) in direct contact with concrete are not allowed.
3. Utilities: The location and protection of existing utilities is the responsibility of the Contractor. Notify Structural Engineer if utility pipes run through, or within 24 inches below, any new concrete construction. If the condition is not covered by details in the drawings, the Structural Engineer will provide the Contractor with design details under such circumstances.
4. Soil-Concrete Interface: Buried pipes or conduits in soil entering subgrade concrete (foundations, basement walls, retaining walls, slabs-on-grade, mat slabs, etc.) shall, within the concrete, be wrapped with compressible material (e.g. polyurethane foam), at least 3/4 inch thick. Alternatively, install pipe within a plastic pipe sleeve with an annular gap between inside of sleeve and outside of pipe of no less than 3/4 inch and no more than 1-1/4 inch, unless otherwise noted in the drawings. Wrap or sleeve shall extend at least 18 pipe diameters into the concrete unless otherwise noted on the drawings. Outside face of wrap or sleeve shall be at least one inch clear of all reinforcing.
5. Pipes and conduits:
   a. Shall be at least 1 inch clear of adjacent reinforcing.
   b. Place pipes and conduits no closer than two slab depths from columns, walls, drop panels or stud rails, unless specifically shown on structural drawings.
   c. Provide pipe sleeves where pipes pass through concrete before pour.
   d. Comply with ACI 318 Section 26.8.

6. Pipes and plastic or steel electrical conduits running horizontally in slabs (both slabs-on-grade and elevated slabs) may be embedded in slabs provided that the following criteria are met:
   a. Diameter limits: The outside diameter does not exceed one quarter of the slab thickness, nor 1-1/2 inches.
   b. Location in slab depth: Pipes and conduits shall be located within the middle third of the slab thickness, and located at least 1.5 inches clear of all reinforcing running parallel to, or within 45 degrees of, the pipe or conduit.
   c. Distance from columns and walls: Pipes and conduits in elevated slabs shall be located at least five slab thicknesses away from columns; pipes and conduits running parallel or within 45 degrees to walls shall be located at least four slab thicknesses away from the wall. Pipes or conduits embedded in the mat slab shall be located at least two slab depths away from columns that support braced frames above, and at least one slab depth away from perimeter retaining walls.
   d. Clear spacing: The clear spacing between the pipes or conduits is not less than three (3) times the diameter of the largest pipe or conduit.
   e. Precedence: Location of reinforcing takes precedence over location of conduits. Conduits shall not interfere with, displace or offset reinforcing or post-tensioning tendons.
   f. Cross-overs: Where pipes and/or conduits cross over each other, they shall remain within the middle third of the slab. Pipes and conduits shall cross over each other at right angles +/- 30 degrees. Only one cross-over layer is allowed at any location in plan.
   g. Dense arrays of conduit: Conduit entering the slab from one location (e.g. at electrical rooms), spaced closer than three clear diameters apart, is not allowed. At such locations, conduit shall run below the slab until the conduit spreads far enough apart that it meets the three clear diameters spacing requirement before entering the slab.
   h. Anchor bolts: Conduits or pipes in slabs shall be located at least 12 inches or at least one embedment depth (whichever is more) from anchor bolts, anchor rods, stud rails, tendon anchorages or hold-downs, where embedment depth refers to the anchor bolts, rods, rails, anchorages or hold-downs.

7. Conduits or pipes in walls:
   a. 3/4 inch diameter or less and spaced at least 18 inches apart.
   b. Place conduits and pipes in middle third of wall.
   c. Not allowed within two feet of end of wall.

8. Conduits and pipes in columns:
   a. Not allowed.

L. Notify Architect and Structural Engineer whenever any embedded item interferes with placement of reinforcement or placement of concrete. Maintain the same concrete cover and spacing around embedments as that required for reinforcement.

M. Field Welding:

1. Deformed bar anchors (Nelson D2L bars and similar) may be field welded using manufacturer's full fusion arc welding equipment.

2. Other field welding is not permitted unless specifically shown on Structural Drawings.

3. Welding to comply with AWS D1.4 and shall be continually inspected during welding.

4. Chemical test for weldability is not required if:
   a. Bars meet ASTM A706, or
   b. Bars are assumed to to have a carbon equivalency of 0.75 or greater, and

corresponding pre-heat provisions of AWS D1.4 are followed.

5. Welding material, wire cuttings and tramp metal shall be thoroughly cleaned from forms for exposed concrete before any concrete is placed.

6. Tack welds not incorporated into other welds will not be allowed without prior written acceptance.

7. Do not weld within 2 bar diameters of where bars have been bent cold.

8. Do not weld without continuous visual inspection by Owner's Testing Agency.

N. Install deformed bar anchors in accordance with manufacturer's recommendations.

O. Install mechanical couplers and headed bars in accordance with manufacturer's recommendations. Install mechanical couplers only at locations shown on the drawings.

P. Install other manufactured products listed in Part 2 of this specification according to manufacturers' recommendations.

Q. Cleaning:

1. Clean reinforcement to remove earth, ice, oil, grease and other materials that will destroy or reduce bond between steel and concrete.

2. Rust and mill scale that is "tight" to the bar is allowed to remain. Rust that is flaky or easily removed, such as by dropping or striking with a hammer, indicates excessive rust. Such bars shall:
   a. Be cleaned of rust, and
   b. Not be used unless found to comply with ACI 318 Section 7.4.2.

3. Where there is a potential of rust staining adjacent finish surfaces, take necessary steps to prevent staining.

3.2 FIELD QUALITY ASSURANCE

A. Notify Owner's Testing Agency, Architect and Structural Engineer at least two business days before concrete is to be poured or reinforcing is covered up. Allow sufficient time to perform any corrective actions prior to concrete pour.

B. Owner's Testing Agency will:

1. At a minimum, perform all testing and inspection required by CBC Section 1916A.2.

2. Inspect reinforcing for conformance with ACI 318 Sections 7.1 through 7.7.

3. Verify that anchor bolts, anchor rods and other embedded items are held firmly in position prior to placing concrete.

4. Provide continuous inspection during any field bending of reinforcement.

5. Inspect re-bent bars for signs of cracking or fracture.

6. Provide continuous inspection during any welding of reinforcement:
   a. In accordance with AWS D1.4 and CBC Section 1704A.4.2; Table 1704A.3, Item 5b; and Table 1704A.4, Item 2..
   b. Verify that reinforcement is only welded where shown on the structural drawings.
   c. Verify fit-up prior to welding.
   d. Verify weld filler metal, welding equipment, weld quality, and welder certification.
   e. At the Architect's or Structural Engineer's option, provide recognized non-

destructive evaluation such as radiographic, magnetic particle, and liquid dye penetrant testing.

7. Inspect installation of headed shear connector studs (Nelson S3L studs and similar) and deformed bar anchors (Nelson D2L bars and similar) in accordance with Section 7.1 of AWS D1.1 and corresponding ESR.

8. Inspect mechanical coupler installation in accordance with corresponding ESR.

C. Correct all errors and discrepancies prior to concrete placement.

3.3 CLEANING

A. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 03 20 00

SECTION 03 25 00

CONCRETE AND MASONRY ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to concrete and masonry anchors shown on the structural or architectural drawings and installed after concrete is placed.

B. Where structural drawings show cast-in-place embedded anchors, post-installed concrete and masonry anchors shall not be substituted without prior approval of Structural Engineer. Heavily loaded embedded anchors, such as shear wall, braced frame and moment frame tie-down rod anchorages, usually do not have an acceptable post-installed equivalent anchor. If such cast-in-place anchors are omitted, remedial action is likely to be removal, repair and recasting of concrete.

C. See Mechanical, Fire Suppression, Plumbing and Electrical Divisions for concrete and masonry anchors for utilities and equipment. Concrete and masonry anchors for all Divisions shall meet seismic requirements for cracked concrete where such conditions apply, and shall have supporting Evaluation Service Reports.

D. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Division 03 Concrete Sections.
4. Division 04 Masonry Sections.
5. Division 05 Metals Sections.
6. Section 06 10 00, Rough Carpentry.
7. Division 21 Fire Suppression, Division 22 Plumbing, Division 23 HVAC and Division 26 Electrical Sections.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Concrete Institute (ACI):
   a. ACI 318, “Building Code Requirements for Structural Concrete.”
3. American National Standards Institute (ANSI):
   a. ANSI B212.15, “Carbide-Tipped Masonry Drills & Blanks for Carbide-Tipped Masonry Drills.”

1.3 DEFINITIONS

A. Evaluation Service Report (ESR): Product evaluation report issued by ICC Evaluation Service, IAPMO, or equivalent from another approved agency.

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and the responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that the fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit shop drawings and product data per Division 01.
2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittals:

1. Submit product data including ESR for each anchor product proposed for use.

D. Substitution Requests: If one product is specifically called out in the drawings, and a substitution request is proposed, submit substitution request in accordance with Division 01 requirements and containing the following:

1. Original product and proposed substitution.
2. Location and quantity of anchors and drawing detail where anchor is called out.
3. Comparison of ESRs for original product and proposed substitution, circling or highlighting the following:
   a. Tension and shear values at equivalent embedment depths and edge distances that occur on the project,
   b. Minimum edge distances, with actual minimum distances occurring in the project noted alongside.
4. Only anchor products listed in this specification may be proposed as a substitution for anchors called for on the drawings.
5. Expansion anchors may not be proposed as a substitution for undercut, screw-in or epoxy-grouted anchors.
6. Do not install proposed substitution unless and until after substitution request is approved.

PART 2 - PRODUCTS

2.1 EPOXY-GROUTED DOWELS

A. Not allowed for permanent gravity-loaded connections, loaded in either shear or tension.

B. For anchoring reinforcing steel or threaded dowels in concrete:

1. Simpson SET-XP, in accordance with ICC-ES Report No. ESR-2508(design basis).
2. Simpson SET-XP, in accordance with ICC-ES Report No. ESR-2508 (substitution request required).
3. Powers PE1000+, in accordance with ICC-ES Report No. ESR-2583 (substitution request required).

C. Dowels:

1. As called for in the drawings, or
2. For dowels not specified in the drawings, see Part 3 of this Section.

2.2 MECHANICAL ANCHORS

A. Expansion Anchors in Concrete:

1. Simpson Strong-Bolt 2, in accordance with ICC-ES Report No. ESR-3037 (design basis).
2. Simpson Strong-Bolt 2, in accordance with ICC-ES Report No. ESR-3037(substitution request required).
3. Powers Power-Stud+SD2, in accordance with ICC-ES Report No. ESR-2502 (substitution request required).

B. Undercut Anchors in Concrete:

1. Hilti HDA, in accordance with ICC-ES Report No. ESR-1546.

C. Screw-In Anchors in Concrete:

1. Simpson Titen HD Anchor, in accordance with ICC-ES Report No. ESR-2713 (design basis).
2. Simpson Titen HD Anchor, in accordance with ICC-ES Report No. ESR-2713 (substitution request required).
3. Powers Wedge-Bolt, in accordance with ICC-ES Report No. ESR-2526 (substitution request required).
4. Called out as “SCREW-IN ANCHOR” on the drawings,
5. Diameter and embedment length as called out on the drawings. If embedment length is not specified, provide longest minimum embedment length listed in ESR unless other physical limits are encountered, in which case use shortest minimum embedment length listed in the ESR.

D. Concrete/Masonry Screws:

1. Products:
   a. Simpson Titen Concrete and Masonry Screw (design basis).
   b. Simpson Titen Concrete and Masonry Screw (design basis).
2. Called out as “CONCRETE SCREW” on the drawings.
3. Unless otherwise noted on the drawings, 1/4-inch diameter screw with 1-3/4-inch minimum embedment into concrete.
4. Phillips flat tapered head if fastened to wood, pan hex head if fastened to steel.
5.

2.3 CORROSION PROVISIONS (APPLIES TO ALL FASTENERS AND ANCHORS):

A. Medium Corrosive Environment:

1. Exposed to weather, and
   a. Not within 200 yards of the ocean, and

b. Not in contact with pressure-treated wood other than SBX-DOT Zinc Borate:

2. Allowed fastener materials and/or coatings:
   a. Stainless Steel,
      1) Type 410 with protective top coat
      2) Type 304, 305, 316 or 316L.
   b. Hot-dip Galvanized (ASTM A153- Class D),
   c. Mechanically Galvanized (ASTM B695-Class 55),
   d. Proprietary organic coatings allowed for wet use, such as:
      1) Quik Guard (Simpson)
      2) ZMAX (G185) (Simpson)

B. High or Severe Corrosive Environment:

1. Dry Conditions:
   a. In contact with pressure-treated wood other than SBX-DOT Zinc Borate,

2. Wet Conditions (exposed to weather):
   a. In contact with pressure-treated wood other than SBX-DOT Zinc Borate,
   b. In contact with seawater, or
   c. Within 200 yards of the ocean.

3. Allowed fastener materials and/or coatings:
   a. Stainless Steel,
      1) 316L
      2) 304 or 305 is allowed only if not within 200 yards of the ocean and wood treatment is
         a) Fire ResistanceTreatment
         b) ACZA ,or
         c) AWPA chemical retention is equal to or less than AWPA UC4A
   b. Hot-dip Galvanized (ASTM A153- Class C)

PART 3 - EXECUTION

3.1 GENERAL

A. Before drilling, locate all embedded items, including reinforcing, post-tensioning tendons, conduits, and plumbing. Locate items by non-destructive methods such as survey before casting, pachometer survey, or ground-penetrating radar survey. Exploratory chipping is only allowed where concrete surface will be concealed. Patch chipped areas. Clearly mark all embedded items in a manner that will not stain or permanently mark visually exposed concrete.

B. Control drilling or coring operations to avoid cutting or damaging embedded items. Immediately report any violations to Project Inspector, Architect and Structural Engineer.

3.2 INSTALLATION

A. Epoxy-Grouted Dowels:

1. Overhead applications are not allowed.

2. Periodic Special Inspection shall be provided unless noted otherwise on the drawings.

3. Drill holes 1/8 inch larger than diameter of embedded rod or reinforcing, unless otherwise noted by manufacturer or applicable ESR. Use carbide-tipped drill bits. Rotary-hammer drills with light, high-frequency impact are recommended for drilling holes in reinforced concrete.

4. Remove dust from hole with oil-free compressed air for a minimum of 4 seconds.
5. Clean with a nylon brush for a minimum of 4 cycles.
6. Remove dust a second time with oil-free compressed air for a minimum of 4 seconds.
7. Hole shall be dry before inserting epoxy.
8. Concrete temperature shall be above minimum application temperature specified by manufacturer.
9. Use proprietary mixing nozzle applicable to particular epoxy product, and dispense initial shot of epoxy in waste container until properly mixed, as indicated by uniform color.
10. Fill hole one-half to two-thirds full, starting from bottom of hole, to prevent air pockets. Withdraw nozzle as hole fills up.
11. Insert clean, oil-free anchor, turning slowly until anchor contacts bottom of hole.
12. Remove excess epoxy from concrete surface around hole before it hardens.
13. Do not disturb, bolt up, or apply load to the anchor until the epoxy is fully cured (see manufacturer’s instructions for recommended minimum cure time).

3.3 MECHANICAL ANCHORS

A. Drill holes to manufacturer’s specified diameter with carbide-tipped bits meeting diameter requirements of ANSI B212.15. Rotary-hammer drills with light, high-frequency impact are recommended for drilling holes in reinforced concrete.

B. Follow manufacturer’s installation instructions. Torque bolts per manufacturer’s recommendations or requirements of applicable ESR.

C. Threaded end of bolt shall extend not less than flush with outside face of nut, and where exposed to view in the final structure, shall not extend more than 1/4 inch beyond outside face of nut, unless otherwise shown on the drawings.

D. Mechanical anchors shall be covered by spray-on fireproofing or otherwise protected from fire as required by the Architect.

3.4 FIELD QUALITY ASSURANCE

A. Owner's Testing Agency will:

1. Observe installation of reinforcing steel or threaded rods in grouted holes and then proof test per the Structural Notes in the drawings.
2. Perform inspections and tests in accordance with recommendations of ESR for anchor product. Special inspection shall be periodic unless noted otherwise on the drawings.
3. Test grouted reinforcing steel or threaded rods per CBC Section 1916A.8. Where drawings document the test loads, perform tests using those loads. If testing loads are not documented on the drawings, test each dowel to 80 percent of the specified minimum yield strength of the dowel.

B. Epoxy-Grouted Dowels in Concrete:

1. Owner’s Testing Agency will inspect and test as follows:
   a. At onset of installation, verify adhesive identification and expiration date, hole dimensions, hole cleaning procedures, hole spacing and edge distances,

concrete thickness, and dowel type, grade and size.

b. Continuous inspection is required.

2. Quality Control Pull Tests:
   a. Purpose of pull tests is to check epoxy bond to concrete, not concrete shear cone failure. Therefore the testing apparatus is allowed to react (push) against the concrete adjacent the dowel.
   b. After sufficient cure time, pull test epoxy-grouted threaded rod or reinforcing bars to the following loads:
      1) 3/8” rod or #3 bar: 3,000 lbs.
      2) 1/2” rod or #4 bar: 5,400 lbs.
      3) 5/8” rod or #5 bar: 8,400 lbs.
      4) 3/4” rod or #6 bar: 11,900 lbs.
      5) 7/8” rod or #7 bar: 16,200 lbs.
      6) 1” rod or #8 bar: 21,300 lbs.
      7) 1-1/8” rod or #9 bar: 27,000 lbs.
   c. Test frequency and pass criteria:
      1) Test 10% of all dowels:
         a) pass criteria: 100% pass.
      2) If not, test 25% of all dowels (i.e. test additional 15%):
         a) Pass criteria: 95% pass, replace and retest dowels that do not pass.
      3) If not, test 100% of dowels, replace and retest dowels that do not pass.

3.5 CLEANING

A. Upon completion and acceptance of testing, remove test dowels unless directed otherwise by Architect or Owner:

   1. Where test dowel locations will be concealed in completed structure, cut off test dowels flush with surrounding surface.

   2. Where test dowel locations will remain exposed to view in completed structure, cut off test dowels a sufficient depth below surrounding surface in order to accommodate patching as directed by Architect.

B. Upon completion of grouted anchor installation, remove and properly dispose of excess grout.

C. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 03 25 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cast-in-place concrete as shown and specified, and as required for a complete and proper installation, including but not limited to:

1. Foundations.
2. Retaining walls.
3. Concrete slabs on grade.
4. Superstructure, including columns, walls and elevated slabs.
5. Equipment pads and curbs.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 31 64 29, Drilled Concrete Piers.
4. Section 03 10 00, Concrete Formwork.
5. Section 03 20 00, Concrete Reinforcement.
6. Section 03 25 00, Concrete and Masonry Anchors.
7. Section 03 35 00, Concrete Finishes.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Concrete Institute (ACI):
   a. ACI 117, “Standard Tolerances for Concrete Construction and Materials.”
   b. ACI 211.4R, “Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials.”
   c. ACI 301, “Specification for Structural Concrete for Buildings.”
   d. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
   e. ACI 305.1, “Specification for Hot Weather Concreting.”
   f. ACI 306.1, “Standard Specification for Cold Weather Concreting.”
   g. ACI 308.1, “Standard Specification for Curing Concrete.”
   h. ACI 318, “Building Code Requirements for Structural Concrete.”
3. American Society for Testing and Materials (ASTM):
   a. ASTM C33, “Standard Specification for Concrete Aggregates.”
   b. ASTM C39, “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
   c. ASTM C94, “Standard Specification for Ready-Mixed Concrete.”

d. ASTM C150, “Standard Specification for Portland Cement.”
e. ASTM C171, “Standard Specification for Sheet Materials for Curing Concrete.”
f. ASTM C260, “Standard Specification for Air-Entraining Admixtures for Concrete.”
g. ASTM C289, “Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).”
h. ASTM C309, “Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”
i. ASTM C330, “Standard Specification for Lightweight Concrete Aggregate for Structural Concrete.”
j. ASTM C494, “Standard Specifications for Chemical Admixtures of Concrete.”
k. ASTM C595, “Standard Specification for Blended Hydraulic Cements.”
l. ASTM C618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.”
m. ASTM C881, “Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.”
n. ASTM C989, “Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
o. ASTM C1017, “Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.”
p. ASTM C1107, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).”
q. ASTM C1157, “Standard Performance Specification for Hydraulic Cement.”
r. ASTM C1293, “Concrete Prism Method for Alkali-Silica Reactivity.”
s. ASTM C1610, “Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique.”
t. ASTM C1611, “Standard Test Method for Slump Flow of Self-Consolidating Concrete.”
u. ASTM C1621, “Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring.”
v. ASTM E1155, “Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System.”
w. ASTM E1745, “Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.”

1.3 DEFINITIONS

A. Maximum Aggregate Size: Largest aggregate in a concrete mix. Note: Maximum Aggregate Size is defined on the Structural Notes on the Drawings. The Maximum Aggregate Size is often given as a range, such as 1/2” to 1”. In this example, a concrete design with a maximum aggregate size as small as 1/2” is acceptable. In this example, mixes with a maximum aggregate size of 3/4” or 1” are also acceptable.

B. Supplementary Cementitious Materials (SCM): Cementitious materials other than Portland cement, such as coal fly ash, blast-furnace slag and/or natural pozzolans.

C. Total Cementitious Materials: All cementitious materials, i.e., Portland cement plus SCM.

D. Well-graded: concrete mix that contains a range of intermediate aggregate sizes between sand and the maximum aggregate size.

E. Highly Flowing Concrete: concrete mix design with a target slump greater than 7 inches.

F. Self-Consolidating Concrete: concrete mix design with a target slump greater than 10 inches.

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and the responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that the fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit Shop Drawings per Division 01.
2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittals:

1. Concrete Mix Designs: Submit mix design documentation for each class of concrete prepared in accordance with ACI Section 5.2.3.
   a. The Owner’s Testing Agency will review and approve.
   b. As a minimum, mix designs to include the following:
      1) All materials and admixtures and their proportions.
      2) Water and cement content, water-cementitious material ratio, target slump, and combined aggregate gradation (percent retained on every sieve size).
      3) Target slump and tolerance if different from that specified in ASTM C94.
      4) Information on concrete materials per ACI 301 Section 4.1.2.3.
      5) Evidence that aggregate is not alkali reactive per ASTM C33 Appendix X1.
      6) Indication of whether mix is appropriate for pumping.
      7) Indication of where each mix will be used.
      8) Calculations and tests results required by ACI 318 Section 5.3.
      9) Cementitious material certification of compliance as required by DSA
      10) Test results of total chloride content.
      11) Test results of cement when tested in accordance with ASTM C289.
      12) Where lightweight aggregate is used, test results per ASTM C330.
      13) Where normal weight aggregate is used, test results per ASTM C33.
      14) Manufacturer’s certification of compliance for cement, aggregates, fly ash, and blast furnace slag.
      15) Manufacturer’s certification that each admixture conforms to requirements of this Section and that admixtures are compatible with one another.
      16) If highly flowing (slump > 7”) or self-consolidating (slump > 10”), test results showing resistance to aggregate separation as defined in Products section.
2. Concrete Joint Plan:
   a. Show all construction, control, and expansion joints in plan or elevation.
   b. Provide section cut details through each proposed type of joint (including shear keys, joint dowels, waterstops and other accessories as required).
   c. Show curbs, depressions, sleeves and openings.
   d. Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” proposed construction joint locations beyond those shown in the drawings. Locations of proposed additional joints to be based on provisions in ACI 301 Section 2.2.2.5a.
   e. Clearly identify, by circling with a cloud and adding the note “Architect Verify,”

proposed contraction joint locations beyond those shown in the drawings for concrete slabs on grade. Where contraction joints are not shown in the drawings, proposed locations to be based on provisions in ACI 302.1R.

f. This will be reviewed only for impact on performance of completed structure.

3. Penetration Plan:
   a. Using structural drawings as backgrounds, provide a single coordinated drawing for each level and/or wall and/or beam elevation, showing the size and location of all concrete slab openings, sleeves, cores and penetrations, including HVAC, electrical, telephone, fire sprinkler, plumbing and any other utilities.
   b. Show pipes or conduits routed through or embedded within all concrete structural elements such as beams, columns, footings, slabs and walls.
   c. Specifically identify openings and penetrations that will be cut or cored after concrete placement.
4. Submit proposed methods for cold and/or hot weather concreting when contemplated.
5. Provide samples of materials as required for testing and inspection.
6. Product Data: Submit product data for following products showing compliance with project specifications, compliance with referenced standards, manufacturer's recommendations, and known limitations.
   a. Curing materials.
   b. Non-shrink grout.
   c. Vapor retarder.

D. Information-Only Submittal:

1. Placement Plan: Submit schedule of concrete placement operations prior to commencement. Provide key plan identifying extent of each placement, or reference areas identified in approved Concrete Joint Plan submittal.

E. LEED Submittals:

1. Furnish product data indicating that all adhesives and sealants used inside building and applied on site comply with LEED VOC Requirements outlined in Environmental Quality Assurance article.
2. Recycled Content: Submit product data indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of embedded utilities and components that are concealed from view.

B. Placement Record: Keep a record of batch tickets and times and dates of placing concrete at the job office, open to inspection by the Architect, Special Inspector, and Building Official in compliance with DSA requirements.

1.6 ENVIRONMENTAL QUALITY ASSURANCE

A. Adhesives, sealants, and sealant primers shall not exceed VOC limits established in Section 01 35 63, LEED Requirements.

B. Provide concrete mixes with minimum percentage of recycled content from supplementary cementitious materials specified in the Concrete Mix Schedule on the structural drawings.

C. Applicable LEED Credits:

1. Category – Indoor Environmental Quality:
   a. Credit 4.1: Low-Emitting Materials, Adhesives and Sealants.
2. Category – Materials and Resources:
   a. Credits 4.1 and 4.2: Recycled Content.
   b. Credits 5.1 and 5.2: Regional Materials.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with ACI 301 Section 4.1.4.

B. Deliver materials in manufacturer's unopened packaging including application instructions.

C. Store materials in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement:

1. ASTM C150:
   a. Typically Type I or Type II cement, except:
   b. Type I cement is not allowed for concrete in contact with soil.
   c. Type IV, Low Heat of Hydration, for concrete mat slabs and foundation elements thicker than three feet.
2. ASTM C595:
   a. Types S and SA cement not allowed.
   b. Typically Type IS, Type IP, or Type P cement.
   c. Not allowed for mat slabs and foundation elements thicker than three feet.
3. ASTM C1157:
   a. Typically Type GU or Type MS cement, except:
   b. Type GU cement is not allowed for concrete in contact with soil.
   c. Type LH, Low Heat of Hydration, for concrete mat slabs and foundation elements thicker than three feet.

B. Supplementary Cementitious Materials (SCM):

1. Fly Ash: ASTM C618 Class F. Conform to additional requirements of CBC Section 1903A.5.
2. Ground Granulated Blast Furnace Slag (GGBFS): ASTM C989.
3. Natural Pozzolan: ASTM C10.
4. Contractor to comply with all applicable regulations concerning testing for, and limiting content of, hazardous materials in SCM.

C. Fine and Coarse Aggregates:

1. Normal Weight Aggregates: ASTM C33.
2. Maximum Aggregate Size: per the Structural Notes on the Structural Drawings. Note that if a range of sizes is given, the largest aggregate may be as small as the smallest size listed in that range.

3. Aggregates shall be well-graded, containing a range of intermediate sizes between sand and the maximum aggregate size.
4. Aggregates shall be free of alkali-silica reactivity. Evaluate aggregates for reactivity per ASTM C33 Appendix X1 and conform to additional requirements of CBC Section 1903A.3.
5. For concrete exposed to view in completed structure, provide aggregates from a single source.

D. Water: Clean, potable or recycled water meeting ASTM C1608, free from impurities detrimental to concrete, and conforming to requirements of ACI 318 Section 3.4.

2.2 ADMIXTURES

A. General:

1. Do not use admixtures other than those included in the approved mix design submittal. If the use of additional admixtures is contemplated, mix design must be revised and resubmitted.
2. Admixtures must be compatible with other admixtures and with other components of concrete mix.
3. Do not use admixtures that will negatively impact finish of concrete exposed to view. For concrete exposed to view, finish shall not vary as a result of changes in use of admixtures.
4. Admixtures containing calcium chloride, thiocyanates, or more than 0.05 percent chloride ions, are not allowed.

B. Air Entraining Admixture: ASTM C260.

C. Water Reducing Admixture: ASTM C494, Type A.

D. Water Reducing, Retarding Admixture (Hydration Stabilizer): ASTM C494, Type D.

E. High-Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G.

F. Accelerating Admixtures:

1. ASTM C494, Type C or E.
2. Accelerating admixtures are not allowed unless specifically called out in the Construction Documents or explicitly approved by Architect and Engineer.
3. Admixture must be non-corrosive, substantiated by long-term test data (of at least a year’s duration) from an independent testing laboratory using an acceptable accelerated corrosion test method.

G. Self-Consolidating Concrete Admixtures: ASTM C1017.

2.3 RELATED MATERIALS

A. Non-Shrink Grout and Drypack Grout:

1. ASTM C1107, non-metallic grout.
2. Minimum compressive strength of 2,400 psi in 48 hours and 5,000 psi in 28 days.
3. Add only enough water to meet both strength and consistency requirements. Do not

add excess water.

4. Non-Shrink Grout:
   a. Use where high fluidity and/or increased placing time are required; pour into void contained by temporary or permanent forms.
   b. Products:
      1) “Five Star Grout” by U.S. Grout Corporation,
      2) “Masterflow 713 Plus” by Chemrex/BASF,
      3) “Masterflow 928” by Chemrex/BASF, or
      4) Approved equal or better substitution.

5. Drypack Grout:
   a. Mix to a stiff plastic consistency and pack firmly into place.
   b. Products:
      1) “Embeco 636 Grout” by Master Builders,
      2) “Euco Dry Pack Grout” by Euclid Chemical Company,
      3) “Masterflow Dry Pack” by Master Builders, or
      4) Approved equal or better substitution.

B. Granular Material: Self-draining granular fill, trimmable and compactable for use under vapor retarder.

C. Curing Materials:

1. Curing Compound: ASTM C309, Type 1, clear or transparent and does not discolor finished concrete surface or inhibit proper application or performance of surface finishes. Comply with Federal, state, and local VOC limits. Comply with LEED requirements, including low VOC rating.

2. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

2.4 CONCRETE MIXES

A. General:

1. Assume full responsibility for meeting specified properties and for producing concrete that can be placed and finished in conformance with Contract Documents.

2. Proportion concrete mixes in accordance with contract documents and ACI 301 Section 4.2.3.

3. Submit alternate mix design with smaller aggregate per CBC Section 1905A.10, identifying locations where its use is anticipated.

4. Use admixtures and products in accordance with the manufacturers’ recommendations.

5. Cementitious materials and aggregates shall have a proven history of successful use with one another. Concrete mixes shall be free of alkali-silica reactivity.

6. Do not change brand, source, or proportion of any mix component without first submitting revised mix design and receiving review comments.

7. Verify that concrete mixes are not subject to aggregation segregation.

8. Default maximum ratio of water to cementitious material is 0.45.

9. Certain concrete mix properties are defined on the drawings.

10. Refer to Section 03 35 00 Concrete Finishes for additional concrete mix requirements.

B. Cementitious Materials:

1. Portland cement content not to exceed limit stated in General Notes on the structural drawings.
2. Provide supplementary cementitious material (SCM) content as required by Concrete Mix Schedule on the structural drawings, with the following additional requirements:
   a. Ground granulated blast furnace slag (GGBFS) to be the primary SCM, i.e., at least half of SCM content by weight.
   b. Fly ash content to be not less than 15 percent nor more than 30 percent of total cementitious material weight.
      1) Exception: at post-tensioned slabs, fly ash content is not required.
   c. If used, natural pozzolan not to exceed 10 percent of total cementitious material weight.
3. Use fly ash in conformance with CBC Section 1903A.5.

C. Highly Flowing Concrete (Target Slump Greater than 7 inches):

1. ASTM C1610: Maximum allowable static segregation limit is 15 percent.
2. ASTM C1611 with a slump flow not to exceed 27 inches, with a tolerance of plus or minus 3 inches with respect to the design slump flow. In addition, Visual Stability Index shall not exceed a value of 1.0. Report the T50 values.

D. Self-Consolidating Concrete (Target Slump Greater than 10 inches):

1. Not to be used for slabs or other flatwork.
2. Meet the testing requirements for Highly Flowing concrete defined above, and the additional requirements defined below.
3. ASTM C1621: Passing ability of mix measured by J-ring test method shall not exceed 2 inches.

E. Proportioning of Aggregates:

1. Standard Practice for Selecting Proportions:
   a. Normal weight concrete: ACI 211.1
2. Verify that aggregate size used is consistent with section being placed and amount of reinforcing steel.
3. Lightweight aggregates may not be used in normal-weight concrete.

F. Admixtures:

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as needed for placement and workability.
2. Ground granulated blast furnace slag is permitted.

G. Air Entrainment:

1. Concrete not exposed to freezing: Average air content not to exceed 3 percent.
2. Concrete exposed to freezing temperatures: Air content per ACI 201.2R, Table 1.1.

H. Do not exceed chloride limits in the ACI 318 Chapter 4 Commentary for member types:

1. ”Prestressed concrete” for members containing prestressing or post-tensioning

tendons.

2. ”Reinforced concrete exposed to chloride” for concrete that will be exposed to the weather in the completed structure or that will in contact with soil.

3. ”Other reinforced concrete construction” for remainder of the concrete.

I. Clarification of Mix Properties:

1. F’c is the minimum compressive strength at 28 days, unless noted otherwise, tested in accordance with ASTM C39.

2. Aggregate size is determined by largest coarse aggregate.

3. Air content is by volume. Tolerance is plus or minus 1.5 percent.

4. Water-cement ratio is the ratio of water to cementitious material by weight.

5. Concrete weight is maximum air-dry weight.
   a. Normal-weight concrete to be between 135 and 160 pcf, unless otherwise noted.

2.5 SOURCE QUALITY ASSURANCE

A. The Owner's Testing Agency will:

1. Review mix designs, certificates of compliance, and samples of materials Contractor proposes to use.

2. Take samples from Contractor's designated sources.

3. Prior to delivery of any concrete, inspect batch plant to verify:
   a. Plant is equipped with measuring devices to determine moisture content of fine aggregate.
   b. Adequacy of plant quality controls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, securely positioned, and will not impede placement of concrete.

D. Verify that slab depressions, slopes for drainage, and other features shown on the drawings are identified and accommodated.

3.2 INSTALLATION OF SLAB-ON-GRADE SUBGRADE

A. Vapor retarder:

1. Below enclosed spaces install vapor retarder above granular material in accordance with manufacturer’s recommendations.

2. Seal all edges.

3. Repair all punctures and tears.

3.3 PREPARATION

A. Prepare previously placed concrete by roughening surface to expose clean aggregate solidly embedded in mortar matrix and remove deleterious material: sand-blast, water-blast, or chip to provide 1/4-inch amplitude. Broom and vacuum clean.

B. Clear away debris, loose material, and excess water from areas where concrete will be placed. Remove any material from in-place concrete or steel which will impair bond. Clean forms and reinforcing of drippings.

C. Concrete in walls and columns from previous placement shall not project more than 3/8 inch vertically above the bottom of beams, drop caps and column capitals, and not more than 1/4 inch above the bottom of slabs thinner than 10 inches. Chip down such excess concrete after setting final form heights and before placing reinforcing or concrete above such horizontal joints.

D. Construction Joints:

1. When construction joints occur at unplanned locations, notify Architect and Structural Engineer and obtain instruction prior to proceeding.
2. Provide joints at locations noted on drawings, or as approved through action submittal.
3. Include shear keys and dowels as required.
4. Construction joints shall conform to ACI 318 Section 6.4.
5. Roughen concrete surface to an amplitude of approximately 1/4 inch.
6. Construction joints to be saturated surface dry immediately prior to placing fresh concrete.

E. Where concrete is placed on soil, thoroughly wet sub-grade prior to placement.

F. Before placing concrete, complete formwork and reinforcing inspections. Install all reinforcement and embeds prior to start of concrete placement. Wet-setting of reinforcement and/or embeds is not acceptable.

G. Do not place architectural concrete prior to acceptance of field samples and mock-ups.

3.4 PLACING CONCRETE

A. Mix and deliver concrete in accordance with ASTM C94.

B. Water:

1. Do not add water after batching except as allowed by ASTM C94. Added water to come only from truck tank and to be verified by inspector. Inspector to verify that total water content does not exceed the amount specified in the mix design.
2. Do not add water outside of truck at job site. Concrete cylinder samples shall only be taken after all water has been added.
3. Discharging chute wash water into pump hopper is strictly forbidden.

C. Conveying:

1. Do not subject concrete to any procedure that will cause aggregate segregation. Deposit concrete as closely as possible to its final position.

2. Do not use aluminum pipes or chutes.

3. Comply with ACI 301 Section 5.3.2.4.

D. Deposit concrete such that no new concrete will be placed on concrete that has hardened sufficiently to cause a cold joint.

1. Deposit concrete in accordance with ACI 318 Section 5.10. The unconfined vertical drop of concrete from the end of hoses or other conveying equipment to the placement surface shall not be greater than 4 feet for concrete with target slump less than or equal to 7 inches, and no greater than 2 feet for concrete with target slump greater than 7 inches (highly flowing or self-consolidating concrete).

2. Deposit concrete in its final position within ninety (90) minutes after batch mixing unless otherwise allowed. In hot weather, reduce this time limit so that stiffening of concrete does not occur until after it has been placed.

E. Place concrete in columns, walls, beams and joist stems prior to placing concrete slabs.

F. Consolidation:

1. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Vibrate concrete, but not against reinforcing.

2. Do not use vibrators to transport concrete.

3. Insert and withdraw vibrators vertically at uniformly spaced locations no farther apart than visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.
   a. Highly flowing concrete: moderate vibration still required, but carefully controlled to prevent aggregate segregation.
   b. Self-consolidating concrete: vibration not required.

4. Keep a standby vibrator in good working order, but not in use, at the site.

5. If a top layer of watery paste, deeper than typical “bleed water” and free of coarse aggregate, occurs:
   a. Immediately take measures to reduce aggregate segregation,
   b. Immediately verify that no water was added to the concrete in transit or on site,
   c. Immediately inform General Contractor and Special Inspector,
   d. Overpour and skim off layer lacking coarse aggregate,
   e. Take additional samples of in-place concrete for concrete compression tests,
   f. Inform Architect and Structural Engineer.

G. Flatwork:

1. Level and finish slab to specified degree of flatness and finish called for in Specification Section 03 35 00, Concrete Finishes.

2. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains 1/4 inch per foot or as indicated on Drawings.

H. Hot Weather Placement: When hot weather conditions exist, comply with ACI 305.1 and as specified below.

1. “Hot weather conditions” are defined as:
   a. Air temperature above 90 degrees Fahrenheit for casting or shooting of elements thicker than three feet.

b. Air temperature above 95 degrees Fahrenheit for casting or shooting of other elements.

2. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 degrees Fahrenheit. Mixing water may be chilled or chopped ice may be used to control temperature, provided that water equivalent of ice is added to total reported amount of mix water.

3. Cover reinforcing steel with water-soaked burlap if steel temperature will exceed ambient air temperature.

4. Fog-spray forms, reinforcing steel, and subgrade immediately prior to concrete placement. Keep subgrade moisture uniform without puddles or dry areas.

5. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

I. Cold Weather Placement:

1. Implement submitted cold weather procedures for placement of concrete when ambient temperature is less than 40 degrees Fahrenheit or when temperature is expected to drop below 40 degrees Fahrenheit during the following three days.

2. Comply with ACI 306.1.

3. Maintain a record of concrete surface temperature for first 7 days after each pour. This record shall be open to inspection by Architect and Structural Engineer.

J. Do not disturb reinforcement, inserts, embedded parts, formed joint fillers, joint devices during concrete placement.

3.5 CONCRETE FINISHING AND CURING

A. Refer to Section 03 35 00 for detailed provisions regarding finishes and tolerances of floors.

B. Flatness and Levelness: Unless otherwise noted, provide the following flatness and levelness per ASTM E-1155, for both slabs-on-grade and elevated slabs:

1. Carpeted interior spaces: FF25, FL20.

2. Slabs to receive thin-set flooring: FF30, FL20.

C. Minimum Curing Requirements:

1. See Section 03 35 00 for additional curing requirements.

2. Maintain concrete above 50 degrees Fahrenheit and in a moist condition for at least 7 days after placement.

3. Comply with ACI 301 Section 5.3.6.

4. Avoid alternate wetting and drying and fluctuations of concrete temperature.

5. Do not permit curing method to adversely affect finishes or treatments applied to finish concrete.

D. Whenever formwork is removed during the curing period, cure exposed concrete by one of the specified methods.

3.6 CLEANING AND PROTECTION

A. Clean surface of exposed concrete of foreign material. Protect concrete from damage and

discoloration.

3.7 DEFECTIVE CONCRETE

A. Notify Architect of honeycombing or other defects other than tie holes upon discovery. Requirements for repair or replacement of defective concrete will be determined by Architect.

B. Repairs involving structural strength are subject to approval by the Division of the State Architect.

C. Repair tie holes in accordance with ACI 301 Section 5.3.7.2.

3.8 GROUTING

A. Mix grout in accordance with the manufacturer's instructions to a consistency which will permit placement. Place grout in accordance with manufacturers' recommendations. Place grout so as to ensure complete bearing and elimination of air pockets.

3.9 FIELD QUALITY ASSURANCE

A. General:

1. Notify Owner's Testing Agency, Architect, and Structural Engineer at least two business days prior to concrete placement.
2. Provide copies of cementitious material supplier's certificates of compliance that represents materials used by date of shipment for concrete per CBC Section 1916A.1.

B. All tests and inspections specified in this section, including preparation of samples, will be performed by Owner's Testing Agency.

C. As a minimum, comply with special inspection provisions of CBC Section 1705A.3.

D. Continuously inspect concrete and grout placement operations.

E. Batch Plant Inspection:

1. Continuous batch plant inspection of quality and quantity of materials per CBC Section 1705A.3.2.
2. Continuous batch plant inspection may be waived if the requirements of CBC Section 1705A.3.3 are satisfied.

F. Batch Tickets:

1. Collect batch ticket for each batch of concrete delivered to job site.
2. Batch ticket to include:
   a. Number or other identification of mix design.
   b. Signature or initials of batch plant representative.
   c. Time of batching.
   d. Weight of cementitious materials, aggregates, water and admixtures in batch.
   e. Total volume of concrete in batch.
   f. Notation to indicate equipment was checked for contaminants prior to batching.
3. Retain batch tickets and submit as project record document.

G. Verify use of required design mix for specific location. Check number or other identification of mix design against concrete mix design submittal.

H. Take one grab sample for each day's pour and subsequently test such samples if required by Architect, who may be so advised by the Division of the State Architect.

I. Sampling Fresh Concrete: ASTM C94.

1. Sample concrete at point of discharge from truck.
2. Measure and document slump at point of discharge from truck when each set of concrete compression cylinders is taken.
3. If slump for batch exceeds target slump and tolerance in ASTM C94 for that class of concrete:
   a. Immediately inform Contractor so that corrective action can be taken if appropriate,
   b. Take additional slump tests and compression cylinders as appropriate.
4. Inspector to also visually monitor discharge of concrete at point of placement. If evidence of inappropriately added water or aggregate segregation or other change of consistency is observed:
   1) Immediately inform Contractor so that corrective action can be taken if appropriate,
   2) Take additional slump tests and compression cylinders as appropriate.
5. For concrete exposed to freezing, test air content when a set of compression cylinders are taken. When self-consolidating concrete is used, fill base in one layer with no rodding.
6. Concrete Temperature: One test for each set of compressive-strength specimens, one test hourly when air temperature is 40 degrees Fahrenheit and below or 80 degrees Fahrenheit and above.
7. Compression Test Samples:
   a. Sample frequency shall as a minimum be in accordance with ACI 318 Section 5.6.2 and CBC Section 1905A.
   b. Take a sample from each 50 cubic yards of each class of concrete or fraction thereof, or from each 2,000square feet of surface area for slabs or walls placed each day. A "class" of concrete is defined as each unique concrete mix design.
   c. Each compressive-strength sample consists of a set of at least five standard cylinders (one at 28 days for information, three to test at specified test age for acceptance, plus one hold).
      1) Take additional cylinders (such as at 7 days) when early tests are required for removal of formwork shoring.
      2) Either 4"x8" or 6"x12" cylinders may be used. If 6"x12" cylinders are used, the number of cylinders per sample may be reduced by one, with two tested at specified age instead of three.
      3) Test cylinders per ASTM C39, except cure per requirements below.
   d. When self consolidating concrete is used, fill cylinders in one layer with no rodding.
   e. When field cured cylinders are required, such as for formwork shoring comply with ACI 318 Section 5.6.4.
   f. Make additional cylinders at the expense of the Contractor when requested.
   g. Number and date each cylinder. Keep an accurate record of the location of the pour that each set represents.
   h. Curing:
      1) Except as noted below, samples may be field or laboratory cured.
      2) If cylinders are to be used to justify early removal of forms or shoring make additional cylinders for this purpose and field cure.
8. Acceptance: Strength level of concrete will be considered satisfactory if it meets the

criteria of ACI 318 Section 5.6.3.

9. Test results will be reported in writing to Architect, Structural Engineer, and Contractor within 24 hours after tests.

10. Reports of compressive strength tests will contain project name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength, and compressive breaking strength for all tests. Tests results for breaks at the specified test age shall also include acceptance status.

J. Field Testing of Self-Consolidating Concrete:

1. ASTM C1610.

2. Report slump flow, T50 values, and visual stability index using ASTM C1611.

3. ASTM C1621, using the J-ring test method.

K. Where Solar Reflectance Index is specified, test finished concrete to verify Solar Reflectance Index.

L. Test flatwork surfaces for flatness and levelness within 72 hours of casting of concrete. Test unformed surfaces sloped to drain for trueness of slope and smoothness.

M. Verify that specified curing temperatures and procedures have been complied with.

3.10 CLEANING

A. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 03 30 00

SECTION 03 33 00

ARCHITECTURAL CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Special requirements for exposed "Architectural" cast-in-place concrete.

B. Except as otherwise noted on the Drawings, it does not apply to interior concrete surfaces. It does not apply to concrete paving or walk surfaces.

1.02 DEFINITION

A. Cast-in-Place Architectural Concrete: Concrete that is exposed to view on surfaces of the completed work that requires special concrete materials, formwork, placement, and finishing to obtain specified architectural appearance.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination with below grade and concealed structural concrete that is contiguous with the exposed architectural concrete.

1.04 ACTION SUBMITTALS

A. Shop Drawings:
   1. Formwork: Show panels, joints, form tie locations, form material, and form layout.
   2. Indicate required Class.
   3. Reinforcing Steel: Show cover and special details.
   4. Structural design of formwork is a delegated design responsibility of the Design Builder.

B. Product Data: Manufacturers current catalog data and specifications for the following:
   1. Color admixture, if used.
   2. Waterproofing admixture, if used
   3. Form ties
   4. Other items as requested by District’s Design Consultant.

B. Design mix and certified compressive strength test reports prepared and certified by the ready-mix concrete supplier.

1.05 INFORMATIONAL SUBMITTALS

A. Statement of installer/finisher qualifications.

1.06 QUALITY ASSURANCE

A. Installer/Finisher Qualifications: Experienced in cast-in-place architectural concrete work and retaining a quality-control inspector who is ACI-certified Concrete Construction Inspector or is certified by ICC as a Reinforced Concrete Special Inspector.

B. Except as otherwise specified and indicated on the Drawings, comply with ACI 303.1, "Standard Specification for Cast-in-Place Architectural Concrete," ACI 303R, "Guide to Cast-in-Place Architectural Concrete."

C. Mockups:
   1. General: Notify District's Design Consultant 10 working days in advance of dates and times when mockups will be constructed.
   2. Free-Standing Site Mockup: Provide in location determined by the Design Builder but available to allow for District's Design Consultant's review of appearance color, texture, and primary and secondary reveals. Comply with the following specific requirements for architectural cast-in-place concrete:
      a. Mix design shall match that proposed for use in final construction including cement. Concrete finish for mockup appearance shall match finish of District's Design Consultant's control sample or photograph.
      b. Mockup will be evaluated for visual appearance of concrete, texture, workmanship, and patching methods. Include typical formwork intersection and corner treatment.
      c. One half of each mockup shall be treated with the proposed water and/or graffiti repellent.
      d. Prepare at sufficiently in advance before start of final concrete work to allow concrete to cure before application of repellent and District's Design Consultant's observation.

D. Finished concrete surface shall be free of bugholes to match the appearance of "CCS 1" as published by Cresset Chemical Company in connection with "Crete-Lease" form release agent.

E. Formwork for a given area shall be removed at the same time to enhance uniformity of final appearance.

PART 2 - PRODUCTS

2.01 FORMWORK

A. General:
   1. Formwork Surface Class: Class A. In addition to ACI 303.1 limits on form-facing panel deflection, limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, to 1/8 inch.
   2. Forms shall not be reused for Architectural Concrete if there is any evidence of surface wear or defect that would impair the quality of the surface.

B. Form Boards:
   1. Nominal Sizes: District's Design Consultant.
   2. Species and Grade: Douglas Fir, clear mixed grain, kiln dried to 15 percent.
   3. Texture on Exposed Face: Resawn.

C. Form Ties: Fiberglass rods which, after removal, shall be ground flush with wall and shall be virtually invisible in completed work. Plugging and patching of recesses for formwork ties is not acceptable.

D. Form-Release Agents: Meet applicable VOC requirements and shall not interfere with application water and graffiti repellent coating.

E. Reveal Strips: As required to produce uniform, straight, smooth lines and tight edge joints and match profiles shown on the Drawings.

2.02 REINFORCING

A. Materials as specified for structural concrete specified on the Structural Drawings and in Section 03 20 00, “Concrete Reinforcement.”

2.03 CONCRETE MATERIALS AND MIX

A. Provide as specified on the Drawings, Section 03 3000, “Cast-in-Place Concrete,” and as used for accepted sample and mockup. Ensure adequate supply and obtain cement from a single source.

B. Color Additive: To be finalized by District’s Design Consultant.

C. Concrete Design Mix: As approved for structural concrete specified [in Section 03 30 00, “Cast-in-Place Concrete.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF VERTICAL FORMS

A. General:
1. Formwork Surface Class: Class A. In addition to ACI 303.1 limits on form-facing deflection, limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, to 1/8 inch unless otherwise approved on accepted mockup.
2. Design formwork sequencing to provide monolithic pours.
3. Design and install form ties to prevent form deflection beyond tolerances and to prevent spalling upon tie removal.
4. Provide primary and secondary reveals in accordance with layout shown on the Drawings.
5. Forms shall not be reused for architectural cast-in-place concrete if there is any evidence of surface wear or defect that would impair the quality of the surface.

B. Form Boards:
1. Locate ties within reveal strips to provide a uniform pattern.
2. Layouts: Board alignment shall be in accordance with Types specified and located on the Drawings and in conformance with accepted mockup.
3. Snap-tie cones shall be centered on board and aligned vertically as shown.
4. Offset board end joints typical. Do not line up board end joints.
5. Formwork shall be formed for tight joints to prevent leakage of paste using demonstrated effective method that will not affect appearance of finished surface. Provide backup material at joints if required to prevent leakage and prevent fins.
6. Formwork shall be kept continuously wet from the time of construction until the time of placement to ensure dimensional stability.

3.02 CONCRETE PLACEMENT

A. Proper placement and thorough effective compaction of architectural cast-in-place concrete are most important. Place vibrators to minimize entrapped air between the concrete and the form and to blend the two layers.

3.03 FORMED WALL FINISHES

A. Architectural cast-in-place concrete shall be as-cast concrete with no dressing. Finish shall match approved free-standing site mockup.
   1. Exposed corners and edges shall be 90 degrees with no chamfer or radius unless otherwise shown.
   2. Provide architectural reveals and other features where shown.
   3. Edges and reveals shall be uniform, straight, plumb and true.

B. As-cast surface shall be free of fins or other projections. Remove projections without marring adjacent surface.

C. Abrupt offsets at formed edges shall not be filled or ground.

D. In general, surface blemishes will not require filling or treatment except where blemishes exceed acceptance criteria for visual quality based on approved mockup. Repairs shall be made to the satisfaction of the District's Design Consultant.

C. Leave exposed concrete exactly as it is formed, wash only. Do not patch, cut, wire brush, sandblast, bush hammer, or acid etch unless otherwise indicated on the Drawings or specified.

3.04 CURING

A. Cure architectural cast-in-place concrete as specified in Section 03 30 10, "Cast-in-Place Concrete," except that procedures and products shall not be detrimental to bonding of sealants or to applied coatings specified under other Sections.

END OF SECTION

SECTION 04 43 14

ADHERED STONE MASONRY VENEER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Mortar-placed, stone veneer installed over portland cement plaster base coats.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's literature for products to be used for setting stone veneer.

B. Samples: Sufficient quantity of stone, for review at Project site, to show range of sizes and appearance.

C. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification data for installer to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses and names of architects and owners.

B. Certification that bonding products meet building code requirements.

1.04 CLOSEOUT SUBMITTALS

A. Warranties as specified.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Documented experience in installation of stone veneer.

B. Mockups: First installed area of stone veneer shall serve as a mockup for visual appearance and quality standards for materials and execution.
1. Coordinate selection of area and size with District’s Design Consultant.
2. Make modifications to each mockup as requested by District’s Design Consultant.
3. Accepted mockups shall remain readily identifiable until completion and final acceptance of stone veneer work.

1.06 FIELD CONDITIONS

A. Cold Weather Requirements: Comply with IMIAC "Recommended Practices and Guide Specifications for Cold Weather Masonry Construction."

B. Hot Weather Requirements: Protect stone work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1.07 GUARANTY AND WARRANTY

A. Design Builder: Furnish a written extended 5 year guarantee against defects in workmanship and installation. Defects shall include, but are not limited to;
   1. Cracking due to insufficient expansion provisions.
   2. Bow or warp of masonry due to hysteresis or internal and exterior stresses.
   3. Staining from sealant.

B. Manufacturer of Setting Materials: Furnish District a 10 year warranty for setting material manufacturer against defects in materials and including without leakage and failure of mortar.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Stone and workmanship shall conform to applicable requirements of the following. In case of conflict or discrepancy with specified requirements, the most rigorous requirement shall govern.
   1. National Building Quarries Association Quarries Association, Inc.
   2. Building Stone Institute.
   3. Marble Institute of America, including most recent edition of “Dimension Stone Design Manual.”
   4. Masonry Institute of America (MIA) "Masonry Veneer" publication.

B. Apply protective coverings to prevent application or spilling of mortar materials onto adjacent surfaces.

C. Design, provide, monitor, and maintain protection of stone from actions or activities before, during, and after installation. Surface defects resulting from failure to provide adequate protection may result in removal and replacement of affected units as directed by District’s Design Consultant, at no cost to District.

2.02 STONE MATERIALS

A. Stone Type: District’s Design Consultant.

2.03 MORTAR AND GROUT

A. Latex Portland Cement Mortar: Conforming to ANSI A118.4 and equivalent to Laticrete “ “254 Platinum."

B. Polymer-Modified Cementitious Grout: Factory-prepared sanded grout exceeding requirements of ANSI A118.7 and equivalent to “PERMACOLOR Select” by Laticrete,.
   1. Grout Colors: As approved by District’s Design Consultant.

2.04 ADDITIONAL MATERIALS

A. Anchors, Dowels, Pins, and Threaded Fasteners for Caps and Sills: Fabricate Type 304 stainless steel, temper as required to support loads imposed without exceeding allowable design stresses.

B. Perimeter Sealant: One part silicone formulated to reduce or eliminate dirt pickup, surface streaking, and substrate staining; Type 1B as specified in Section 07 92 00, “Joint Sealants,” and as follows:
   1. Color: To be selected by District’s Design Consultant from manufacturer’s standard range or custom mixed.

C. Water: Clean and potable.

2.05 MIXING MORTAR

A. Mix and proportion setting bed materials in accordance with manufacturer's recommendations.

2.06 STONE FABRICATION

A. Cut stone to sizes shown, in conformance with accepted mockup, and as required for special conditions. Jointed surfaces shall be cut full and square from the face.

B. Fabricate units straight, smooth, and true to size and shape with exposed edges and corners square, unless otherwise indicated.

C. Do not use stone with cracks, seams, starts, and other defects which impair strength, durability, and appearance.

D. Fabrication Tolerances:
   1. Length and Width: Plus or minus 1/8 inch.
   2. Exposed surface of stone shall not vary at bed and joint arris lines more than one-sixth of indicated bed and joint opening.
   3. Faces shall be free from waves, projections, or depressions and shall not vary from true plane more than 1/32 inch.
   4. Thickness of stone shall not vary from indicated dimensions by more than 1/8 inch.

E. Saw or roughly dress backs of panels to approximately true planes.

PART 3 - EXECUTION

3.01 STONE INSTALLATION - GENERAL

A. Prepare surface, fit, set or bond, and clean in accordance with applicable requirements of the CBC, ANSI A108.5, and as specified.

B. Lay out work in accordance with patterns shown and to match accepted mockup.

C. Joint Width: 3/8 inch, unless otherwise shown or to conform to width on accepted mockup.

D. Water repellent and anti-graffiti coating shall be applied, as specified in other Sections, after final cleaning of stone.

3.02 STONE INSTALLATION METHODS

A. Installation over Portland Cement Plaster Base Coats:
   1. Thin-set stone over prepared brown coat of portland cement plaster using specified latex portland cement mortar.
   2. Allow tile to set at least 48 hours prior to grouting.

3. Install colored sanded grout in accordance with ANSI A108.10 and manufacturer's instructions.

B. Install sealant in perimeter and expansion joints.

C. Expansion Joints: Locate expansion joints and install in accordance with TCNA Method EJ171.

3.03 FIELD QUALITY CONTROL

A. Construction Tolerances: Unless more stringent tolerances are required to meet accepted mockup, exposed surface of stone shall not vary at bed and joint arris lines in excess of one-sixth of the bed and joint openings shown.

3.04 ADJUSTING

A. Replace unsatisfactory stone fabrications. In-place stone fabrications will be rejected for any one of the following reasons:
   1. Noncompliance with submittals and accepted mockup.
   2. Exceeding specified installation tolerances.
   3. Damage to units during construction or as a result of inadequate protection of stone.
   4. Exposed-to-view surfaces which develop or exhibit surface finish defects for whatever reason at time prior to Final Completion.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to the following:

1. Structural steel framing, including all structural and miscellaneous steel and fasteners shown on the structural drawings.
2. Standard shapes, plates and rods shown on the Architectural, Mechanical and Electrical drawings that connect to the building structure, and are not explicitly specified in other sections.
3. Leveling and grouting of base plates.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 03 20 00, Concrete Reinforcing.
4. Section 03 25 00, Concrete and Masonry Anchors.
5. Section 03 30 00, Cast-In-Place Concrete.
6. Section 05 31 00, Steel Decking.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Institute of Steel Construction (AISC):
   a. AISC 303, “Code of Standard Practice for Steel Buildings and Bridges.”
      1) No provision of AISC 303 shall be effective to change the duties and responsibilities of the Owner, Contractor, Architect and Structural Engineer from those set forth in these Contract Documents.
      2) Reference to AISC 303 is made only to technical issues and excludes all issues related to schedule, submittal review time, Owner’s responsibilities, approvals and commercial terms.
      3) Where discrepancies exist between the requirements of the Contract Documents and AISC 303, the requirements of the Contract Documents shall govern and the corresponding provision of AISC 303 shall be assumed as being deleted.
      4) Contrary to AISC 303 Section 4.1, issuance of structural design drawings for bid does not constitute a release for construction. Prior to proceeding with mill orders, shop drawings or fabrication, Contractor shall confirm with Owner, Architect and Structural Engineer which portions of the work

have been released for construction.

b. AISC 341, “Seismic Provisions for Structural Steel Buildings.”
c. AISC 358, “Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.”
d. AISC 360, “Specification for Structural Steel Buildings.”

3. American National Standards Institute (ANSI):
   a. ANSI B18.23.1, “Beveled Washers.”

4. American Society for Testing and Materials (ASTM):
   a. ASTM A6, “Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.”
   b. ASTM E23, “Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.”
   c. ASTM A29, “Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.”
   d. ASTM A36, “Standard Specification for Carbon Structural Steel.”
   e. ASTM A53, “Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.”
   f. ASTM A123, “Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.”
   g. ASTM A153, “Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.”
   h. ASTM A193, “Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.”
   i. ASTM A307, “Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.”
   j. ASTM A325, “Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.”
   k. ASTM A354, “Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.”
   l. ASTM A370, “Standard Test Methods and Definitions for Mechanical Testing of Steel Products.”
   m. ASTM A449, “Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.”
   n. ASTM A490, “Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.”
   o. ASTM A500, “Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.”
   p. ASTM A563, “Standard Specification for Carbon and Alloy Steel Nuts.”
   q. ASTM A572, “Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.”
   r. ASTM A588, “Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.”
   s. ASTM A606, “Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.”
   t. ASTM A668, “Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.”
   u. ASTM A673, “Standard Specification for Sampling Procedure for Impact Testing of Structural Steel.”
   v. ASTM A786, “Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.”
   w. ASTM A913, “Standard Specification for High-Strength Low-Alloy Steel Shapes

of Structural Quality, Produced by Quenching and Self-Tempering Process."

x. ASTM A992, "Standard Specification for Structural Steel Shapes."
y. ASTM A1008, "Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable."
z. ASTM A1011, "Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength."
aa. ASTM B695, "Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel."
bb. ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)."
cc. ASTM D520, "Standard Specification for Zinc Dust Pigment."
dd. ASTM E2248, "Standard Test Method for Impact Testing of Miniaturized Charpy V-Notch Specimens."
ee. ASTM F844, "Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use."
ff. ASTM F959, "Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners."
gg. ASTM F1554, "Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength."
hh. ASTM F1852, "Standard Specification for 'Twist Off' Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength."
ii. ASTM F2280, "Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength."

5. American Society of Mechanical Engineers (ASME) B18.2.6, "Fasteners for use in Structural Applications."

6. American Welding Society (AWS):
   a. AWS D1.1, "Structural Welding Code – Steel."
   b. AWS D1.8, "Structural Welding Code – Seismic Supplement."
   c. AWS C4.1, "Criteria for Describing Oxygen-Cut Surfaces, and Oxygen Cutting Surface Roughness Gauge."

7. Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

8. Society for Protective Coatings (SSPC):
   a. SSPC-SP 1, "Solvent Cleaning."
   b. SSPC-SP 2, "Hand Tool Cleaning."
   c. SSPC-SP 7, "Brush-Off Blast Cleaning."

1.3 DEFINITIONS

A. Approved Fabricator: A steel fabricator holding AISC Certified Building Fabricator (STD) certification throughout the project, subject to the additional requirements of CBC Section 1704A.2.5.

B. Bolt: Shorthand for bolt assembly consisting of bolt plus corresponding nut and washers.

C. Evaluation Service Report (ESR): Product testing report from ICC Evaluation Service or equivalent from another approved agency.

D. Extra Smooth: Surfaces noted as "Extra Smooth" require a finish with surface variation of 500 micro-inches or less (AWS C4.1, Sample No. 4).

E. Gouge: Depression deeper than the overall surface roughness.

F. High-Strength Bolt: Shorthand for high-strength bolt assembly consisting of high-strength bolt plus corresponding nut and washers. “High-strength bolt” is as defined in the RCSC Glossary, with the following additions:

1. Where “Group A” or ASTM A325 bolts are specified, alternative-design fasteners may include:
   a. ASTM F1852 twist-off type tension-control bolts, or
   b. Where the upper dimensional limits of ASTM A325 are exceeded, ASTM A354 Grade BC or ASTM A449 bolts conforming to dimensional requirements of ASME B18.2.6 heavy hex class 2A.
2. Where “Group B” or ASTM A490 bolts are specified, alternative-design fasteners may include:
   a. ASTM F2280 twist-off type tension-control bolts, or
   b. Where the upper dimensional limits of ASTM A490 are exceeded, ASTM A354 Grade BD bolts conforming to dimensional requirements of ASME B18.2.6 heavy hex class 2A.

G. Non-Destructive Testing (NDT): Non-destructive testing includes magnetic particle testing (MT), penetrant testing (PT), radiographic testing (RT), and ultrasonic testing (UT).The terms non-destructive examination (NDE) and non-destructive testing (NDT) are synonymous.

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and responsibility for conformance with intent of Drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit Shop Drawings per Division 01.
2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittals:

1. Coordination Drawings: Prior to submitting shop or erection drawings, submit plans of all levels showing dimensioned locations of slab edges and openings.
2. Shop and Erection Drawings: Prior to the start of fabrication, submit shop and erection drawings for all structural steel, showing:
   a. Erection plans or elevation drawings providing the following information:
      1) Member identification marks.
      2) Location and orientation of members.
      3) Details for field connections.
      4) Identification of joints or groups of joints where a specific assembly order, welding sequence, welding technique, or other special precautions are required.
   b. Details of all structural steel members and assemblies showing complete information necessary for the fabrication of members.
   c. Surface preparation and finishes, including both painting and grinding.
   d. Material grades of members, connection material, fasteners, and weld filler

metal.

e. Type, size and location of bolts and welds:
   1) Identification of high-strength bolted joints as snug-tight, pretensioned or slip-critical.

3. Material samples for testing as requested by Architect, Structural Engineer, or Owner's Testing Agency.

D. Information-Only Submittals:

1. Evidence of current AISC Certified Building Fabricator (STD) certification and fabricator approval as required by "Approved Fabricator" in the Definitions article.
   a. Exception: Where fabricator is not an Approved Fabricator, fabricator to reimburse Owner for the cost of required special shop inspections.
2. Evidence of current AISC Certified Building Erector (ACSE or CSE) certification.
3. Manufacturer's certification of conformance for electrodes, fluxes and shielding gases.
4. Manufacturer's product data sheets for welding material describing product, recommended welding parameters, and storage and exposure requirements.
5. Threaded Studs:
   a. Manufacturer's certification that studs meet the requirements of AWS D1.1.
   b. Certified copies of stud manufacturer's test reports covering most recently completed set of in-plant quality control mechanical tests for diameter supplied.
   c. Certified material test reports (MTR) from steel supplier.
6. Manufacturer's certifications for fastener components, including bolts, threaded studs, nuts, washers, and direct tension indicators (if used). Manufacturer's certifications to contain:
   a. Heat analysis, heat number, and a statement certifying that prohibited elements were not added to produce the fastener components.
   b. Results of hardness, tensile, and proof load tests, as required and performed.
   c. Lot number and purchase order number.
   d. If galvanized, measured zinc coating weight or thickness, and the results of rotational capacity tests, including test method used (solid plate or tension measuring device) and lubricant present.
   e. Results of visual inspection for bursts.
   f. Statement of compliance with dimensional and thread fit requirements.
   g. For "Group B" or ASTM A490 bolts, only the Production Lot Method of testing and certification is acceptable. Shipping Lot Method is not acceptable.

E. Quality Assurance Submittals: The following will be reviewed and returned by Owner's Testing Agency, but will be processed as information-only submittals by Architect and Structural Engineer:

1. Material Test Reports (MTR), also called mill test reports, complying with the requirements of ASTM A6, for all structural steel.
2. Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR):
   a. Conform to the requirements of AWS D1.1.
   b. List electrode type and manufacture of electrodes on the WPS where the WPS will be used for demand-critical welds.
   c. List power source (constant current or constant voltage).
3. Welding Performance Qualification Records (WPQR), in accordance with AWS D1.1, for all welders on the project. In addition submit documentation showing that:
   a. Welder has passed all designated supplemental welder qualification testing

required for types of welding to be performed.
b. Welder continued to use the applicable welding process on an ongoing basis since the WPQR test was conducted.

4. Weld Shrinkage and Distortion Control Plan:
a. Contractor is responsible for determining conditions requiring a Weld Shrinkage and Distortion Control Plan.
b. Where shrinkage is likely to cause distortion or other problems, submit a mitigation plan. Plan shall identify sequence of welding within connections with multiple welded joints.

F. LEED Submittals:

1. Submit product data indicating that all paints and coatings used inside building and applied on site comply with LEED VOC Requirements outlined in Environmental Quality Assurance article.

2. Recycled Content: Submit product data indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.

1.5 QUALITY ASSURANCE

A. Fabricator’s / Erector’s / Welders' Qualifications:

1. Steel Fabricator's Qualifications:
a. Not less than 5 years' experience in fabrication of structural steel.

2. Steel Erector's Qualifications:
a. Not less than 5 years' experience in erection of structural steel

3. Welders' Qualifications: Welding procedures, welders, welding operations, and tackers shall be qualified in accordance with AWS D1.1.
a. Welders shall have a valid Welding Performance Qualification Record (WPQR) for each welding procedure to be performed.
b. Welders who have not performed welding for period of six or more months shall be re-qualified.
c. Welders whose work consistently fails to pass inspection shall be re-qualified before performing further welding.
d. Contractor to pay costs of certifying qualifications.

B. Material Identification:

1. Comply with CBC Section 2203A.1.

2. Unidentified steel is not permitted.

1.6 ENVIRONMENTAL QUALITY ASSURANCE

A. Paints, coatings, and primers shall not exceed VOC limits established in Section 01 35 63, LEED Requirements.

B. Provide material with minimum percentage of recycled content specified in Part 2 Steel Materials article.

C. Applicable LEED Credits:

1. Category – Indoor Environmental Quality:
a. Credit 4.2, Low-Emitting Materials, Paints and Coatings.

2. Category – Materials and Resources:
   a. Credits 4.1 and 4.2, Recycled Content.
   b. Credits 5.1 and 5.2, Regional Materials.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle packaged materials in original unopened containers with seals unbroken and labels intact until time of use.

B. Products labels shall indicate brand name, model, and grade.

C. Handle materials with care.

D. Storage and protection:

1. Products shall be stored above ground on level platforms, allowing air circulation under stacked units. Cover products with waterproof covering providing air circulation and ventilation.
2. Store structural steel members, above ground on platforms or skids.
3. Do not store material on the structure in a manner that might cause distortion or damage to members of the supporting structure.
4. Store material to permit easy access for inspection and identification.
5. FCAW electrodes shall be received in undamaged moisture-resistant containers. Protect electrodes against contamination and injury.

1.8 JOB CONDITIONS

A. Provide Owner's Testing Agency with free access to places where materials are stored or fabricated, and to equipment.

1.9 SCHEDULING

A. Schedule inspections and notify Architect, Structural Engineer, Special Inspector, the Division of the State Architect, and any other regulatory agencies with sufficient notice to permit testing and inspection without delaying the Work. As a minimum, advance notice to be given three working days prior to inspection.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Structural Steel Rolled Shapes: As specified in the Structural Notes on the drawings, with the following additional requirements:

1. Wide-flange shapes in moment frames with flange thickness equal to or less than 2 inches to have minimum CVN toughness of 40 ft-lb at +70 degrees Fahrenheit, tested in accordance with ASTM A673 Frequency H.
2. Wide-flange shapes with flange thickness exceeding 2 inches shall have minimum CVN toughness of 20 ft-lb at +70 degrees Fahrenheit, tested in accordance with ASTM A6 Supplementary Requirement S30, "Charpy V-Notch Impact Test for Structural Shapes – Alternate Core Location."

B. Structural Steel Plates and Bars: As specified in the Structural Notes on the drawings, with

the following minimum CVN toughness at +70 degrees Fahrenheit, tested in accordance with ASTM ASTM A673 Frequency H:

1. Non-seismically loaded plates and bars with thickness exceeding 2 inches: 20 ft-lb.
2. Seismically loaded plates and bars: 30 ft-lb.

C. Recycled content: minimum 90 percent.

2.2 FASTENERS

A. Unfinished (Machine) Bolts: As specified in the Structural Notes on the drawings.

B. High-Strength Bolts:

1. As specified in the Structural Notes on the drawings.
2. Nuts per RCSC.
3. Washers per RCSC (brief recap below):
   a. Snug tight bolts, slotted hole in an outer ply: ASTM F436 washer or 5/16” thick common plate washer.
   b. Pretensioned bolts:
      1) A325 bolt up to 1.5” diameter or A490 bolt up to 1.0” diameter:
         a) Short slotted or oversized hole in outer ply: ASTM F436 washer or 5/16” thick common plate washer.
         b) Long slotted hole in outer ply: 5/16” thick plate washer or continuous bar
      2) A490 bolt greater than 1.0” diameter:
         a) Short slotted or oversized hole in outer ply: ASTM F436 washer with 5/16” thickness, or 3/8” plate washer plus ordinary thickness F426 washer
         b) Long slotted hole in outer ply: ASTM 436 washer with 3/8” thick ASTM A572 Gr. 50 plate washer or continuous bar.
      3) Twist-off-Type Tension Control Bolts:
         a) At nuts over all holes: ASTM A436 washer under nut as a minimum, with additional requirements as described for A325 and A490 bolts as described above.
         b) At heads over short-slotted or oversized holes in outer ply: Washers not required at heads that provide bearing circle diameter per ASTM F1852. For long-slotted holes, see additional requirements as described for A325 and A490 bolts above.

C. Blind Bolts:

1. Lindapter Hollo-Bolt Fastener.
2. Use only where called out as “blind bolt”, “Lindapter bolt,” or “Hollo-bolt” on the drawings.
3. For use where one side is inaccessible.
4. Allowed for use in Seismic Design Categories A through F.
5. Install per ICC ESR-3330. Note especially:
   a. hole diameter per Table 1.
   b. torque installation requirements per Figure 2.

D. Threaded Rods:

1. As noted on the Drawings. If not shown, use ASTM A572 Grade 50 for typical threaded rods, and F1554 Grade 55 for threaded rods used as anchor bolts.
2. Threads shall conform to ASME B18.2.6 Class 2A.
3. ASTM A193 Grade B7 may be substituted for A449 or F1554 Grade 105.
4. Nuts and washers as required by RCSC for ASTM A490 bolts, except:
   a. Nuts and washers as required for machine bolts may be substituted where threaded rod is ASTM A36 or A307.
   b. Nuts to be ASTM A563 heavy hex when embedded in concrete.
   c. Nuts to be ASTM A563 Grade C, C3, D, DH or DH3 or A194 Grade 2H where threaded rod is A193 Grade B7, A449 or F1554 Grade 105. ASTM A563 Grade A nuts are prohibited for this application.
   d. Washers as required by AISC Steel Construction Manual Table 14-2 for anchor rods in steel column base plates.

E. Threaded Studs:

1. Conforming to the requirements of AWS D1.1, with bases qualified for full-fusion welding.
2. Where stainless steel studs are used, studs to be post-annealed as required to prevent brittle failure.

F. Sleeve Nuts:

1. ASTM A29 Grade 1018.
2. Capacity greater or equal to that of threaded items connected.

G. Clevises and Turnbuckles:

1. ASTM A29 Grade 1035.
2. Forged according to ASTM A668 Class A.
3. Allowable capacities corresponding to those in the AISC Steel Construction Manual Part 15, with a minimum safety factor of 5.

H. Galvanized Fasteners: Fasteners designated as galvanized shall be hot-dip galvanized per ASTM A153, or mechanically galvanized per ASTM B695, Class 55 or greater.

I. All fastener components to have manufacturer’s symbol and grade marking.

J. Fastener product containers must be marked so that correspondence with mill reports can be established.

2.3 WELDING MATERIALS

A. Comply with AWS D1.1 with a nominal 70 ksi tensile strength.

B. Base selection of electrodes on actual properties of materials connected.

C. Where welds join dissimilar materials, for example stainless steel to mild steel, select electrode to prevent embrittlement.

2.4 OTHER PRODUCTS

A. Plastic Steel Putty: Type “A” by DEVCON (for non-structural repairs only).

B. Non-Shrinkage Grout and Drypack Grout:

1. Use non-shrink grout or drypack grout under steel base plates.
2. See Cast-in-Place Concrete specification section (under Related Materials) for grout requirements.

C.

2.5 FABRICATION

A. General:

1. Fabricate structural steel in accordance with AISC 360 (Chapter M and the first paragraph of J2), AISC 303 sections 3.2, 5, 6, 8, and AWS D1.1 as applicable to Statically Loaded Structures, except as otherwise noted.
   a. Assume all thermally cut edges are subject to tension stresses.
   b. Delete paragraph M4.6 from AISC 360.
2. Fabricate and assemble work in shop to greatest extent possible.
3. Provide holes and accessories required for securing other work to the work specified in this section.
4. Tolerances: Comply with AISC 360 Chapter M and AISC 303 sections 5 and 6. Adopt more restrictive tolerances when needed to properly install other systems and components.
5. Locate splices only where noted or approved by Architect and Structural Engineer.
6. Fabricate beams and girders with natural camber upward, unless shown otherwise.
7. Bending steel plate:
   a. Bend plates perpendicular to the rolling direction where feasible.
   b. Grind flame cut plate edges transverse to the bend line.
   c. Grind out nicks in plate edges transverse to the bend line.
   d. Round sharp corners on plate edges transverse to the bend line.

B. Bolted Joints:

1. Size and fabrication of holes to comply with RCSC. For purposes of hole fabrication, assume dynamically loaded connections.
2. Drill holes when material thickness is greater than connector diameter plus 1/8 inch.
3. Drill holes when bolt holes are subject to welding shrinkage stresses or when welding will occur within 1/2 inch of holes.
4. Holes in column base plates shall be per the Drawings.
5. Ream unfair holes:
   a. If ream exceeds 1/16 inch, then ream to next bolt size and install a bolt corresponding to the new hole size.
   b. Where reaming would result in less than minimum allowable hole edge distance, or where unfairness cannot be resolved by using next larger bolt size, repair hole in base material by welding solid before re-drilling hole of proper size.
6. Remove burrs that would prohibit solid seating of connected parts.
7. Provide hardened washers over slotted holes, oversized holes, or holes for anchor bolts.

8. Provide beveled washers under bolt heads or nuts resting on surfaces exceeding five percent slope with respect to head or nut
9. Mark completely tightened bolts with identifying symbol.

C. Unfinished Bolts (Machine Bolts) and Anchor Rods:

1. Install snug tight as defined by RCSC.
2. Install bolts with threads excluded from the shear plane.
3. Mutilate threads to prevent the nuts from backing off.

D. High-Strength Structural Bolted Joints:

1. Comply with requirements of RCSC.
2. Exclude threads from shear plane.
3. Unless otherwise noted, all connections to be fully pre-tensioned.
4. Provide Class A or Class B faying surfaces for connections in SLRS. ($m=0.35$ Class A, $m=0.50$ Class B). TNEMEC 90-97 TNEME-ZINC is acceptable and meets Class B requirements.
5. Twist-off-type tension-control bolt assemblies may be substituted for high-strength bolts as permitted by Part 1 Definitions article, provided that such assemblies are:
   a. Re-lubricated per manufacturer's written instructions.
   b. Retested after re-lubrication and prior to use to verify suitability for installation.
6. Provide direct tension indicator washers under the heads of slip-critical high-strength bolts (not required for twist-off type tension-control bolts).
7. Provide hardened washers under element turned when tightening high-strength bolts.
8. When connection has bolts and welds, tighten bolts prior to welding, except that in moment connections, the flange welds are completed prior to final tightening of high-strength bolts.
9. When previously tensioned bolts have had their tension relaxed, either re-torque the bolts using a calibrated wrench or replace the bolt and tension indicator and re-tighten.

E. Welded Construction (Shop and Field):

1. Weld in accordance with AISC 360 Chapter M and AWS D1.1.
2. Exterior welds must be watertight.
3. WPS shall be available to welders and inspectors prior to and during the welding process.
4. Groove welds to be complete-joint-penetration welds, unless noted otherwise.
5. Tack welds are permitted only if made with a compatible filler metal that does not reduce CVN toughness of required weld, and is subsequently incorporated into a required weld.
6. When removed from protective packaging, protect electrodes and coatings from moisture, deterioration or damage.
7. Assign each welder an identification symbol or mark. Welder shall mark or stamp this identification symbol at each weld completed. Stamps, if used, shall be the low-stress type.

8. Modification or lubrication of an electrode after manufacture is not permitted, except that drying shall be permitted when recommended by the manufacturer.

9. Welded Joint Details:
   a. Weld dams to conform to AWS D1.8.
   b. Weld Toes: Welded profile to satisfy the criteria of AWS D1.1 Section 5.24.
   c. Weld Access Holes:
      1) Weld access holes to comply with AISC 360 Section J1.6 and AWS D1.1.
   d. Web Welds: Provide a minimum clear distance of 1/2 inch between weld access hole and fillet welds connecting shear plate and beam web.
   e. Gravity Moment Connections: unless otherwise noted on the Drawings, gravity moment connection welds shall meet the requirements of SLRS connections and AWS 1.8 provisions for Demand-Critical Welds.
   f. Column Continuity Plate Details:
      1) Provide a reinforcing fillet weld between backing bar and column flange when backing bars remain in place. Do not place fillet weld between backing bar and continuity plate.
      2) After removal of weld tabs and finishing inspect the edge using MT.

F. Threaded Studs:

1. Install in accordance with AWS D1.1 stud welding provisions and manufacturer's recommendations.

2. Full-fusion weld bases unless qualified alternative welding procedure is submitted to and approved by Structural Engineer in advance.

3. Stud welding through metal deck and all other configurations shall be qualified through testing per AWS D1.1 sections 7.6 through 7.8.

G. Shop Painting:

1. Shop primer paint is not required on structural steel if not exposed to weather and not exposed to view in completed structure.

2. See Section 09 90 00, Painting, for coating requirements on interior and exterior steel that is exposed to view in completed structure.

H. Galvanizing:

1. Unless otherwise noted on the drawings, all structural steel members and bolts permanently exposed to the weather (not protected by a water-tight assembly) shall be galvanized.

2. To the extent possible, assemble structural steel in the shop prior to galvanization.

3. Galvanize shapes per ASTM A123 with a minimum coating grade of 75.

4. Galvanize fasteners per "Products-Fasteners-Galvanized Fasteners" article of this section.

5. Galvanized Repair Paint: High-Zinc-Dust-Content (Type III low-lead, 0.002 percent by weight, in accordance with ASTM D520) paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with SSPC-Paint 20 and compatible with finishes specified in Section 09 90 00, Painting.

6. Galvanizing shall also conform with ASTM A143 (Safeguarding Against Embrittlement), A384 (Safeguarding Against Warpage), A385 (Practice for High Quality Coatings) and A780 (Repair of Damaged Coatings).

7. Closed sections (such as tube or pipe sections with end caps) shall have vent holes installed to prevent bursting during galvanizing, and unless otherwise shown on the drawings, shall be located on the underside of such sections. The size and location of vent holes shall be shown on the shop drawings submitted to the Architect and Structural Engineer, with a cloud noted “Engineer Verify.”

8. Vent holes that are not located on the underside of the member shall be sealed after galvanizing with zinc plugs. Vent holes that are located on handrails or other members within reach of the public shall be plugged. Do not use aluminum, lead, or any material other than pure zinc. The plugs shall be filed smooth when located within bearing or faying surfaces or when located within reach of the public. Plugged vent holes shall be noted as such in the shop drawings with a cloud noted “Engineer Verify.”

2.6 SOURCE QUALITY ASSURANCE

A. Owner will provide Owner’s Testing Agency with a complete set of current Construction Documents.

B. Contractor to provide Owner’s Testing Agency with:

1. A complete set of accepted submittals,
2. Samples as requested by Owner's Testing Agency, and
3. Access and facilities, including scaffolding, temporary work platforms, etc., for testing and inspection at all places where materials or components are stored or fabricated, or in their erected position.

C. General:

1. Quality Assurance activities will be performed by Owner’s Testing Agency.
2. Owner’s Testing Agency will be listed and approved by the Division of the State Architect and selected by Architect, Structural Engineer, and Owner.
3. Owner’s Testing Agency will:
   a. Provide management, personnel, equipment, and services required to perform quality assurance functions listed.
   b. Perform tests and inspections, verifying that materials and workmanship conform to the Contract Documents.
   c. Comply with requirements of CBC Sections 1704A and 1705A.
   d. Forward copies of all product and procedure certificates, data sheets, and test and inspection reports to Owner, Architect, Structural Engineer, DSA, and Contractor.
   e. Verify that tests and inspections listed in Statement of Special Inspections are addressed in this section.
4. Tests and inspections listed are minimums. Additional tests and inspections may be performed as directed by Architect and Structural Engineer.

D. Materials:

1. Materials shall be identified in conformance with CBC Section 2203A.
2. Compare mill test reports and certificates of compliance against the material specified.
3. Verify that identification markings on material is consistent with specified material

E. Fabrication Inspections:

1. Inspect fabrication per CBC Section 1704A.3.2.1.

F. Bolting Tests and Inspections:

1. Test and inspect high-strength bolts in accordance with RCSC and CBC Sections 1704A.3.3 and 2212A.2.
2. Sample and test bolt assemblies in accordance with CBC Section 1704A.3.3.1 to verify that proper pre-tensioning is being achieved. Sample each size and lot.
3. Testing and inspection of bolting will as a minimum comply with AISC 360 Section M2.5.

G. Welding Inspection:

1. Inspect and test in accordance with CBC Section1704A.3.1, AISC 360 Section J2, AWS D1.1, and specified weld acceptance criteria.
2. Perform verification tests and inspections as required by AWS D1.1.
3. All welds will be visually inspected as a minimum. Visual inspection of multi-pass welds and complete and partial penetration groove welds to be continuous.
   a. Visually inspect welds to flanges and plates that exceed 2 inches in thickness at least 48 hours after completion of welding for the presence of cracks.
4. Regions of welds that cannot be inspected shall be identified and recorded, and the Architect and Structural Engineer shall be notified.
5. Review Welding Procedure Specifications (WPS) for conformance with AWS D1.1, the electrode manufacturer's recommendations and the Contract Documents.
6. Review the certifications of weld consumables for compliance with the Contract Documents.
7. Verify that Welding Procedure Specifications (WPS), with Procedure Qualification Records (PQR), are available, current and accurate.
8. Verify that welding is performed in accordance with the WPS and the Contract Documents.
9. Perform NDT after the visual inspection is complete and the assembly has cooled.
10. Mark the welds, parts, and joints that have been inspected, and accepted, with a distinguishing mark or die stamp, or maintain records indicating the specific welds inspected and accepted by each inspector.

H. Nondestructive Testing of Welded Joints:

1. Nondestructive Testing will be performed in accordance with AWS D1.1, .
2. Magnetic Particle Testing (MT) and Ultrasonic testing (UT) will be conducted at the frequencies designated in Table 2-1.

Table 2-1. Nondestructive Testing Requirements		
Weld Category	Nondestructive Testing Requirements (4)	
	Complete-Joint-Penetration Welds (1)	Partial-Joint-Penetration Welds and Fillet Welds (1)
Welds not described below	UT 25% of joints, full length (2)	MT 25% of joints 6-inch spot at random (2)
SLRS and Gravity Beam Moment Connections (3)	UT 100% of joints, full length	MT 100% of joints, full length
SLRS and Gravity Column Butt Joint Splices	UT 100% of joints, full length	MT 100% of joints, full length

3. K-Area Welding Inspection: After welds of continuity plates and doubler plates have cooled to ambient temperature, test column webs for cracking using liquid penetrant (PT) or magnetic particle testing (MT) over a zone 3 inches above and below each weld.

4. Perform MT after repairs associated with removal of backing bars.

I. Inspector's Inspection Records:

1. Maintain systematic record of all welds, including:
   a. Location and type of weld.
   b. Identification marks of welders.
   c. List of defective welds.
   d. Manner of correction of defects.

2. Maintain a daily record of the work that has been inspected and its disposition. Test reports will be made on the form suggested in the AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to the execution of the work under this specification section, inspect the job site and verify that this work may be erected in accordance with the Contract Documents.

B. Discrepancies:

1. Report unacceptable conditions to the Architect and Structural Engineer.

2. Do not proceed with construction in the region of the discrepancy until unacceptable conditions have been corrected.

3.2 ERECTION

A. Layout:

1. Supervise setting of embedded items required for erection of structural steel. Ensure

correct installation and location of anchor rods.

2. Verify location of anchor rods subsequent to placement of concrete.

3. Employ a licensed land surveyor for accurate erection of structural steel and embeds.

B. General Requirements:

1. Erect structural steel in accordance with AISC 303, AISC 360 Section M, and AWS D1.1 as applicable to Statically Loaded Structures.

2. The requirements for field work shall be the same as specified in Part 2 of this section.

3. Adopt more restrictive tolerances are necessary for proper installation of other building systems and components.

4. If welding to existing steel take samples to verify weldablity of existing material and to confirm applicability of welding procedures.

C. Field Cutting or Alteration: No field cutting, alteration or repair of structural steel members or of connections shall be performed without prior review and approval by Architect and Structural Engineer. Submit drawings showing reasons for, and details of, proposed corrective work.

D. Provide shoring and bracing as needed until permanent support is in place and complete. Contractor is responsible for identifying the need for temporary shoring and bracing.

E. Control erection procedures and sequences to avoid problems caused by temperature differentials and weld shrinkage, and other sources of expansion and contraction.

F. Clean bearing surfaces and surfaces to be in permanent contact before assembly.

G. Securely tighten erection bolts for welded construction and leave in place unless otherwise required.

H. Gas Cutting: Use of flame cutting torch will be permitted only after the Architect’s and Structural Engineer’s prior written approval and only where metal cut will not carry stress during cutting, and cut surfaces will not be visible. When thermal cutting is permitted, cutting shall be done with a mechanically guided torch or a torch controlled using a guide bar.

I. Field Touch-Up Painting: After erection, touch-up paint field connections and abrasions with same paint used for shop prime painting.

3.3 BASE PLATE GROUTING

A. Use non-shrink grout or drypack material.

B. Mix and install grout or drypack in accord with manufacturer's recommendations and directions.

C. Prepare surface of existing concrete as if for a construction joint.

D. Leave no voids between the base plates and the concrete.

E. Retighten anchor rods after grout has hardened.

3.4 SHOP COAT TOUCH-UP

A. Where high-zinc-dust-content paint is used to touch up missing or damaged hot-dip galvanizing, apply three coats each of 2.0 mil dry film thickness. Fewer coats will be

permitted only if Contractor can verify, through independent testing, that total dry film thickness is at least 1.5 times that associated with the specified ASTM A123 coating grade.

3.5 FIELD QUALITY ASSURANCE

A. General:

1. No work shall be performed without the required inspections.
2. The Provisions for Source Quality Assurance are also applicable to field work.

B. The Owner's Testing Agency will:

1. Inspect erected structural steel as required to establish conformity of Work with Contract Drawings.
2. Provide periodic inspection of bolting and field welding, except that compete penetration welds will be subject to continuous inspection.
3. Inspect welding equipment, electrodes, weld quality, welder certification, and conformity with contract documents.
4. Perform tests and inspections as defined in Part 2.
5. Expansion bolts to be proof tested after installation by loading 25 percent of them to 160 percent of the manufacturer's recommended tensile allowable design loads.
6. Inspect anchor rods prior to concreting.
7. Forward copies of all test and inspection reports to the Owner, Architect, Structural Engineer, DSA, and Contractor.

3.6 CLEANING

A. After erection, thoroughly clean surfaces of foreign or deleterious matter that would impair bond of fireproofing, concrete or other finishes.

B. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 05 12 00

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Railings and guardrails.
   2. Bollards.
   3. Cast abrasive strips for stairs.
   4. Miscellaneous framing and supports.

B. Related Requirements:
   1. Painting and Coating: Section 09 90 00.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittals.”

B. Where metal fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay work.

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Large-scale drawings for fabrication and erection of guardrails, railings, and other custom fabricated assemblies not completely shown by manufacturer's product data or included as part of shop drawings submitted under other Sections.
      a. Include, as appropriate, plans, elevations, complete details, thicknesses, sizes, types, grades, classes of metal, connecting and joining methods, anchorages.
      b. Show required field measurements and interface with work of other Sections.
      c. Welds, both shop and field, shall be indicated by AWS "Symbols for Welding, Brazing and Nondestructive Examination," A2.4.
      d. Indicate all required field measurements.
   2. Setting drawings, templates, instructions, and directions for installation of anchorage devices.
   3. Coordinate with shop drawing requirements of other Sections whose work adjoins decorative metalwork.

B. Product Data: Manufacturer's specifications for manufactured products to be used in the fabrication of work when requested by District’s Representative.

1.04 INFORMATIONAL SUBMITTALS

A. Certification for each welder.

B. Completed “Procedure Qualification Record” (PQR) and “Welding Procedures Specification” (WPS) forms for the welds to be performed under this Specification in accordance with AWS

D1.1. Weld procedure qualification shall be for the same paint to be welded through in project work.

C. Mill test reports certifying physical and chemical properties for each lot of A325 and A449 anchor bolts to be delivered to the site.

D. Certification: Submittal drawings, if not signed by design engineer, shall be certified that structural portion of drawings are in compliance with design calculations.

1.05 QUALITY ASSURANCE

A. Design Engineer: Professional structural or civil engineer registered in the State of California or shall otherwise be acceptable to governing authorities. Design engineer shall be experienced in providing engineering services of the kind indicated.

B. Welding:
1. Qualifications: Certified and qualified in accordance with AWS D1.1.
2. Procedures and operations shall comply with AWS "Standard for Welding Procedure and Performance Qualifications," B2.1.
3. Comply with AWS publication "Welding Zinc Coated Steel" for galvanized products.
4. Welding inspector's qualifications shall be in accordance with AWS D1.1.

C. Wedge-type and expansion-nut concrete anchors, resin/adhesive anchors, and headed concrete anchors shall be ICC-ES approved.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

E. At stairs, steps, platforms, and landings, comply with the requirements of the CBC and ADA for tread striping. Coordinate with other Sections. Abrasive strips shall meet requirements of California Title 24.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect steel from corrosion.

B. Store packaged materials in original unbroken package or container.

C. Comply with additional requirements specified in Section 01 66 00 “Product Delivery Storage and Handling."

1.07 FIELD CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on shop drawings. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabrication without field measurements.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE REQUIREMENTS

A. Industry Standards: Comply with "Metal Rail Manual" of National Ornamental and Miscellaneous Metals Association (NOMMA).

B. Regulatory Requirements:
   1. Comply with the Americans with Disabilities Act (ADA).
   2. Comply with the CBC.

C. Structural Performance of Railing Assemblies, Handrails, and Guardrails:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 pounds per lineal foot applied in any direction.
      b. Concentrated load of 200 pounds applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
      d. Top Rails shall support minimum 300 lbs. concentrated single point load applied at any point vertically or horizontally.
   2. Infill of Guards:
      a. Concentrated load of 50 pounds applied horizontally on an area of 1 square foot.
      b. Infill load and other loads need not be assumed to act concurrently.

D. If modifications to designs indicated on the Drawings are proposed in order to meet code requirements, indicate them as such on shop drawing submittals. Work with District's Representative to arrive at an acceptable design that is sufficiently similar to the design indicated.

2.02 METAL MATERIALS

A. Standard Structural Steel Shapes, Bars and Plates: ASTM A36.

B. Architectural and Miscellaneous Steel Items: ASTM A283, grade optional.

2.03 ADDITIONAL MATERIALS

A. Anchor Bolts: ASTM A307, nonheaded type, unless otherwise indicated.

B. Fasteners:
   1. Provide zinc-coated fasteners with galvanizing complying with ASTM A153 for exterior use or where built into exterior walls.
   2. Select fasteners for type, grade, and class required for installation.

C. Welding:
   1. Electrodes: In accordance with AWS Code.
   2. Welding Filler Metal for Carbon Steel: AWS A5.1 or A5.5 E70XX for SMAW welding process, AWS A5.18 ER70S-X for GMAW welding process, AWS A5.17 or A5.23 F7X-EXXX for SAW welding process, and AWS A5.20 E7XT-X for FCAW welding process.

D. Non-Metallic, Non-Shrink Grout: Premixed, conforming to ASTM C1107, with minimum compressive strength of 5000-psi at 28-days.

2.04 GALVANIZING

A. Galvanizing: Provide zinc coating for items exposed to exterior atmosphere, shown on the Drawings, or specified to be galvanized using the hot-dip process after fabrication in accordance with ASTM A385.
   1. Comply with ASTM A153 for galvanizing of iron and steel hardware.
   2. Comply with ASTM A123 for galvanizing of rolled, pressed, and forged-steel shapes, plates, bars, and strips 1/8 inch thick and heavier.
   3. Comply with ASTM A123 for galvanizing of assembled steel products.
   4. Safeguarding against warping and distortion during hot-dip galvanizing of metal fabrications shall be in conformance with ASTM A384.

B. Newly galvanized items shall not be water quenched or chromate quenched after galvanizing if they are scheduled to receive a paint coating.

C. Exterior standard bolts, cast-in-place anchor bolts, turnbuckles, clevises, and nuts shall be galvanized.

2.05 PROTECTIVE PAINT COATINGS

A. Products:
   1. Galvanizing-Repair Paint: Minimum 95 percent zinc-dust-content in dried film paint for regalvanizing welds in galvanized steel[, complying with FS DOD-P-21035a]; “Z.R.C. Cold Galvanizing Compound” by ZRC Worldwide, “Cold Galv Primer” by Valspar, or equal. Where repaired galvanizing is to be left exposed, use repair paint that will closely match appearance of hot-dip galvanizing; “Galvilite” by ZRC Worldwide, or equal.
   2. Shop Primer for Ferrous Metal - Not Galvanized:
      a. Interior: Modified alkyd; Tnemec Series "FD88 Azeron," or equal, applied to 1.5 to 2.5 mils DFT.
      b. Exterior – Not Galvanized: Inorganic, zinc-rich: "Tneme-Zinc 90-97," or equal, applied to 2.0 to 3.5 mils DFT.
      c. Exterior - Galvanized: Low VOC polyamidoamine epoxy’ Tnemec “L69,” or equal applied at 2.0 to 3 mils DFT.
   3. Field-Applied Finish Paints: As specified in Section 09 90 00 “Painting and Coating."

B. Preparation of Galvanized Surfaces for Priming: SSPC No. 1 and additional recommendations included in the AGA document “Suggested Specification for Preparing Hot Dip Galvanized Surfaces for Painting.”

C. Shop Priming: In accordance with the following surface preparation and SSPC PA1, “Shop, Field, and Maintenance Painting.”
   1. Galvanized Surfaces: As specified.
   2. Concealed Items: SSPC-SP No 3, “Power Tool Cleaning.”
   3. Exposed Items: SSPC-SP No. 6/NCACE No. 3 “Commercial Blast Cleaning.”

D. Finish Painting: As specified in Section 09 90 00 “Painting And Coating.”

2.06 FABRICATED ITEMS

A. Bollards: Galvanized 6 inch diameter schedule 40 steel pipe with 5/8 inch x 10 inch x 10 inch base plate, concrete filled, crowned cap, as detailed.

B. Exterior Railings and Guardrails: Fabricated from galvanized steel to design and materials at each location as shown on the Drawings and as follows:

1. Finish: High-performance coating.

C. Frames for Overhead Door Openings: Refer to Section 13 34 19 “Pre-Fabricated Metal Building” for information.

2.07 MANUFACTURED ITEMS

A. Bollards: [Brick to provide]

B. Wheel Guards for Overhead Door Openings: Cast iron, three-quarter round with rounded tops, 24 inches high x 6-inch diameter; [Brick to provide], or equal.

C. Cast Abrasive Nosing: 3 inches x 5/16 inch cast aluminum with ribbed abrasive aggregate strips; American Safety Tread Co., or equal.
   1. Color: Black, unless otherwise selected by District’s Representative.
   2. Provide with manufacturer's standard integral anchors for embedding units in concrete.
   3. Comply with State of California Title 24 Safety Strip requirements for the visually impaired.
   4. Length: One piece with termination distance from end of tread as noted on the Drawings or, if not noted, as selected by District’s Representative.
   5. At concrete construction, apply black asphaltic coating to concealed bottoms, sides, and edges.

2.08 FABRICATION - GENERAL REQUIREMENTS

A. Form decorative metal to required shapes and sizes, with true lines and angles in sizes and profiles indicated.

B. Use concealed fasteners, unless otherwise indicated on reviewed shop drawings.

C. Joints and Connections:
   1. Use connections that maintain structural value of joined pieces.
   2. Detail connections to facilitate fabrication and erection in accordance with the referenced AISC code.
   3. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather so as to exclude water penetration.

D. Welding and Brazing: Comply with AWS-recommended practices.
   1. Welds shall be continuous.
   2. Dress exposed and contact surfaces.

E. Finishing:
   1. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
   2. Welds, burrs, roller marks, seams, and rough surfaces shall be ground neat and smooth.
   3. Mill markings shall be completely removed.
   4. Gouges, dents, and other surface abuse shall be filled and ground smooth.

PART 3 - EXECUTION

3.01 FIELD PREPARATION

A. At the time of connecting, bearing surfaces shall be free from loose or non-adherent rust, loose mill scale, oil, grease, dirt, mud, and any foreign matter, coating, or defect that adversely affects the connection.

B. Surface preparation for welding shall be in accordance AWS D1.1, except loose or non-adherent rust, loose mill scale, and paint shall be removed by wire brushing.

3.02 INSTALLATION

A. Install metal fabrications as shown on the Drawings in accordance with reviewed submittals and referenced standards including allowable tolerances as defined in the AISC “Code of Standard Practice for Steel Buildings and Bridges.”

B. Cut, drill, and fit as required for installation.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.

D. Set work accurately in location, alignment, and elevation; plumb, level, true, and free of rack; measured from established lines and levels.

E. Adjust items prior to securing in place so as to ensure proper matching of components and correct alignment.

F. Holes that require enlarging to admit bolts shall be reamed. Holes shall not be enlarged by flame cutting.

G. Field Welding: Comply with requirements specified for shop welding and Local Jurisdictions requirements for welding in the Building.

3.03 ADJUSTMENT AND TOUCH-UP

A. Inspect installed work. Correct deficiencies.

B. Field Galvanizing Repair: Wire brush welds and damaged coating to clean bright metal and apply one coat of galvanizing repair paint.

C. Restore finishes damaged during installation and construction period so that no evidence of correction work remains.

D. Return items that cannot be refinished or corrected in the field to the shop. Make required alterations and refinish entire unit, or provide new units.

3.04 PROTECTION

A. Protect finishes of metal fabrications from damage during construction period as required.

END OF SECTION

SECTION 05 70 00

DECORATIVE METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: The following decorative metal items:
   1. Railings and guardrails at stairs including wall-mounted handrails.
   2. Custom fabricated gates at Trash enclosure.
   3. Additional custom ornamental iron and metal work, both interior and exterior, as shown on the Drawings.
   4. Shop-applied finishes.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Prior to installation of selected decorative metal items, Design Builder, District's Design Consultant, representative of metal fabricator, installer, and others whose work interfaces with decorative metal work or may affect its quality shall meet at the Project site to coordinate related requirements.

1.03 ACTION SUBMITTALS

A. Shop Drawings: Large-scale drawings for fabrication and erection of the following custom fabricated assemblies:
   1. Gates
   2. Railings and guardrails.

B. Product Data: Manufacturer's specifications and installation instructions for manufactured products including shop-applied coatings, glass, and exposed hardware.

C. Samples:
   1. Exposed metals in selected finish, 12 inches x 6 inches, or 12 inches long as applicable.
   2. Additional samples as requested by the District's Design Consultant.

D. Delegated-Design: Prepare and submit engineering calculations for railings and guardrails to verify compliance with performance and design criteria, and acceptance by the authorities having jurisdiction. Calculations shall be signed and sealed by the engineer in responsible charge retained by the Design Builder. Engineer shall be a California licensed civil or structural engineer.

E. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Certification for each welder/

B. Completed "Procedure Qualification Record" (PQR) and "Welding Procedures Specification" (WPS) forms for the welds to be performed under this Section.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Fabricator/Installer: Documented experience in fabrication and installation of decorative metal similar to that indicated for this Project, and with a record of successful in-service performance.
   2. Welders: Certified and qualified in accordance with procedures specified in American Welding Society Standard in accordance with AWS D1.1.

PART 2 - PRODUCTS

2.01 PERFORMANCE AND DESIGN CRITERIA

A. Decorative steel shall be considered Architecturally Exposed Steel and shall conform to Section 10 of the AISC Code of Standard Practice and the additional recommended practices of the Architectural Products Division (AMP) of the National Association of Architectural Metal Manufacturers (NAAMM).

B. Sheet metal work shall comply with applicable provisions of the "Architectural Sheet Metal Manual (SMACNA Manual)," as issued by the Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA).

C. Design exterior items to be watertight and to drain properly.

D. Structural Performance of Railing Assemblies, Handrails, and Guardrails:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 pounds per lineal foot applied in any direction.
      b. Concentrated load of 200 pounds applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
      d. Top Rails shall support minimum 300 lbs. concentrated single point load applied at any point vertically or horizontally.
   2. Infill of Guards:
      a. Concentrated load of 50 pounds applied horizontally on an area of 1 square foot.
      b. Infill load and other loads need not be assumed to act concurrently.

E. Industry Standards:
   1. Comply with "Metal Rail Manual" of National Ornamental and Miscellaneous Metals Association (NOMMA).
   2. Comply with "Pipe Railing Manual" of National Association of Architectural Metal Manufacturers (NAAMM).

F. Welding shall comply with AWS B2.1, "Standard for Welding Procedure and Performance Qualifications," and "Welding Zinc Coated Steel" for galvanized products.

G. Modifications to designs shown on the Drawings and proposed in order to meet code or performance requirements shall be noted on submittals. Design Builder shall work with District’s Design Consultant to arrive at an acceptable design that is sufficiently similar to the designs shown.

2.02 METAL MATERIALS

A. General: Metal surfaces exposed to view shall not exhibit pitting, seam marks, roller marks, splice marks, mill identification markings, stains, discolorations, or other blemishes and imperfections.

B. Steel: Provide steel and iron, in form indicated, to comply with the following requirements:
   1. Bars and Plates: ASTM A36.
   2. Pipe: ASTM A53, Grade B, Schedule 40.
   3. Cold-Drawn Tubing: ASTM A500, Grade B.

C. Stainless Steel: Type 304 at interior, Type 316 at exterior
   1. Bars: ASTM A276.
   2. Tubing for Railings and Guardrails: ASTM A554.
   3. Finish: American Iron and Steel Institute (AISI) No. satin directional brushed.

2.03 ADDITIONAL MATERIALS

A. Fasteners: Provide anchorage devices and fasteners where necessary for securing decorative metal to in-place construction.
   1. Do not use metals that are corrosive or incompatible with materials joined.
   2. Exterior Steel Items: Stainless steel.

B. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for strength and compatibility in fabricated items.

C. Nonshrink Grout: ASTM C1107; nonmetallic, nonstaining, nongaseous, premixed grout with at least 8,000-psi compressive strength at 28 days

2.04 FABRICATION METHODS - GENERAL

A. Form decorative metal to required shapes and sizes, with true lines and angles.

B. Joints and Connections:
   1. Use connections that maintain structural value of joined pieces.
   2. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather so as to exclude water penetration.

C. Welding and Brazing:
   1. Comply with AWS-recommended practices.
   2. Exposed welds shall be continuous.

D. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
   1. Welds, burrs, roller marks, seams, and rough surfaces shall be ground neat and smooth.
   2. Mill markings shall be completely removed.
   3. Gouges, dents, and other surface abuse shall be filled and ground smooth.
   4. Use electrochemical or mechanical methods or abrasive cleaners on stainless steel to remove weld discoloration on exposed surfaces. Welded area shall match appearance of adjacent surface after cleaning.

2.05 GALVANIZING

A. Removal soluble salts as specified in Section 09 90 00, “Painting and Coating,” prior any surface preparation.

B. Surface Preparation Prior to Galvanizing: In accordance with SSPC Specification SP-10, "Near White Blast Cleaning."

C. Provide galvanizing for steel items exposed to exterior atmosphere using the hot-dip process after fabrication.
   1. Comply with ASTM A153 for galvanizing of iron and steel hardware.
   2. Comply with ASTM A123 for galvanizing of assembled steel products and rolled, pressed, and forged-steel shapes, plates, bars, and strips 1/8 inch thick and heavier.

D. Newly galvanized items to be painted shall not be water quenched or chromate quenched after galvanizing.

2.06 PROTECTIVE PAINT COATINGS

A. General:
   1. Comply with manufacturer’s preparation and application instructions for each coating and NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Manufacturer’s instructions shall govern in event of conflict.
   2. Coatings shall be shop-applied to the greatest extent possible, including galvanized items, except surfaces and edges to be field welded.
   3. Prevent galvanic action and other forms of corrosion by insulating metals from direct contact with incompatible materials.
   4. Finish Painting: Where not shop finished, field finish painting shall conform to requirements specified in Section 09 90 00, "Painting and Coating."
   5. Finish exposed fasteners to match adjacent metal.

B. Products:
   1. Galvanizing-Repair Paint: Minimum 82 percent zinc-dust-content paint for regalvanizing welds in galvanized steel.
   2. Shop Primers and Finish Paints: As specified under each coating system in Section 09 90 00, “Painting and Coating.”

C. Surface Preparation:
   1. All Metals: Removal soluble salts as specified in Section 09 90 00, “Painting and Coating,” prior any other surface preparation.
   2. Non-Galvanized Steel: SSPC-SP No. 6/NCACE No. 3 “Commercial Blast Cleaning.”
   3. Galvanized Steel:
      a. Repair galvanized coating damaged after fabrication during handling, installation, or welding using specified repair paint in accordance with ASTM A780, AGA publication, "Recommended Practice for Touch-up of Damaged Galvanized Coatings," and manufacturer’s recommendations for application of repair paint.
      b. Surfaces shall be cleaned and profiled prior to receiving applied coatings in accordance with ASTM D6386 or ASTM D7396 for sheet products.
      c. Comply with the additional recommendations included in the AGA document “Duplex Systems: Painting Over Hot Dip Galvanized Steel,” and ASTM D6386.
   4. Comply with any additional procedures required by the coating manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Install decorative metalwork in accordance with reviewed submittals and referenced standards.
   2. Set work accurately in location, alignment, and elevation; plumb, level, and true; and free of rack; measured from established lines and levels.
   3. Field welding shall comply with applicable AWS specification and requirements specified for shop welding.
   4. Protect against galvanic action wherever dissimilar metals are in contact, using zinc-chromate primer on contact surfaces.

B. Railings:
   1. Cope neatly to fit.
   2. Longitudinal members shall be parallel to each other, to floor surface, or to slope of stairs.
   3. Secure wall railing brackets to stud wall construction with bolts into framing or solid backing. Secure to concrete with expansion bolts.
   4. Space brackets maximum 60 inches on center and 9 inches from end of rails.
   5. Return rails to walls at ends.
   6. Remove any burrs or protrusions that might snag fingers or clothing, and grind and polish smooth.

C. Restore finishes damaged during installation and construction period so that no evidence of correction work remains.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not limited to:

1. All rough carpentry as shown and as specified and as needed for a complete and proper installation.
2. Framing with dimension lumber.
3. Framing with timbers.
4. Wood structural panel sheathing and sub-flooring.
5. Wood nailers and blocking.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 03 20 00, Concrete Reinforcement
4. Section 03 25 00, Concrete and Masonry Anchors.
5. Section 05 12 00, Structural Steel.
6. Section 06 17 50, Engineered Wood I-Joists.
7. Section 06 18 50, Structural Glued Laminated Timber.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American National Standards Institute (ANSI):
   a. ANSI B18.2.1, “Square and Hex Bolts and Screws (Inch Series).”
   b. ANSI B18.6.1, “Wood Screws (Inch Series).”
3. American Society for Testing and Materials (ASTM):
   a. ASTM A36, “Standard Specification for Carbon Structural Steel.”
   b. ASTM A153, “Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.”
   c. ASTM A307, “Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.”
   d. ASTM A563, “Standard Specification for Carbon and Alloy Steel Nuts.”
   e. ASTM A653, “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.”
   f. ASTM D3498, “Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.”
   g. ASTM F1667, “Standard Specification for Driven Fasteners: Nails, Spikes, and

Staples."

4. American Wood Preservers Association (AWPA):
   a. AWPA M4, "Standard for the Care of Preservative-Treated Wood Products."
   b. AWPA U1, "Use Category System: User Specifications for Treated Wood."
5. Forest Stewardship Council (FSC) 1.2, "Principles and Criteria for Forest Stewardship."
6. U.S. Department of Commerce (DOC):
   a. Voluntary Product Standard PS-1, "Construction and Industry Plywood."
   b. Voluntary Product Standard PS-2, "Performance Standard for Wood-based Structural Use Panels."
   c. Voluntary Product Standard PS-20, "American Softwood Lumber Standard."
7. Redwood Inspection Service (RIS), "Standard Specifications for Grades of Redwood Lumber."
8. West Coast Lumber Inspection Bureau (WCLIB), "Standard Grading and Dressing Rules Number 17."
9. Western Wood Products Association (WWPA), "Western Lumber Grading Rules 05."

1.3 DEFINITIONS

A. Evaluation Service Report (ESR): Product testing report from ICC Evaluation Service or equivalent from another approved agency.

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and responsibility for conformance with Contract Documents remains with the Contractor. Review does not imply or state that Contract Documents have been interpreted correctly.

B. Submittal Protocol:

1. Submit items per Division 01.
2. Coordination Notes: Clearly identify, by circling with a cloud and adding the note "Engineer Verify," the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittals:

1. Nails and Staples:
   a. Submit a sample of each type of nail and/or staple to be used.
   b. Submit a copy of applicable ESR for each type of nail and/or staple to be used in nailing guns.
2. Preservative Treatment:
   a. Submit preservative treatment product data.
   b. Submit product data for field treatment for cut surfaces.
3. Wood Connectors:
   a. Submit evidence of equivalency when proposing substitution of wood connectors other than Simpson Strong-Tie, as described under Part 2 Products section.
   b. Do not submit hard copies of Simpson Strong-Tie catalog.

D. Information-Only Submittal:

1. Wood preservative treatments: For informational purposes, submit copies of the treatment manufacturer's instructions for the use of the treatment material.

E. LEED Submittals:

1. Submit product data indicating that all adhesives and sealants used inside building and applied on site comply with LEED VOC Requirements outlined in Environmental Quality Assurance article.

2. For wood products specified as FSC-certified in Part 2:
   a. Submit Chain-of-Custody (COC) certificates signed by manufacturers certifying that products were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2. Include evidence that mill is certified for COC by an FSC-accredited certification body.
   b. Submit vendor invoices with vendor's COC number and identify each FSC-certified product with associated cost on a line-item basis.
   c. Submission of a COC certificate without a corresponding invoice or submission of an invoice without a corresponding COC certificate shall not constitute acceptable documentation.

1.5 QUALITY ASSURANCE

A. Grade Marks: Identify lumber and wood structural panels by official grade mark or provide a certificate of inspection from a grading or inspection agency approved by American Lumber Standards Committee (ALSC).

B. Locate lumber and wood structural panel grade marks so they can be inspected during construction, but will not be visible in areas exposed to public view in completed structure.

C. When a certificate of grading is used in lieu of stamps, segregate lumber by grade.

D. Single-source responsibility for structural composite lumber products: Obtain each type of structural composite lumber products from a single manufacturer.

1.6 ENVIRONMENTAL QUALITY ASSURANCE

A. Adhesives, sealants, and sealant primers shall not exceed VOC limits established in Section 01 35 63, LEED Requirements.

B. For wood products specified as FSC-certified in Part 2:

1. Wood products shall originate in forests that are certified by an FSC-accredited certification body to comply with FSC 1.2.

2. Follow proper procedures to ensure that FSC-certified wood products are kept separate from non-certified materials and that auditing procedures as mandated by the certifier are complied with.

C. Applicable LEED Credits:

1. Category – Indoor Environmental Quality:
   a. Credit 4.1, Low-Emitting Materials, Adhesives and Sealants.

2. Category – Materials and Resources:
   a. Credits 5.1 and 5.2, Regional Materials.
   b. Credit 7, Certified Wood.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in unopened containers or in manufacturer's standard packaging.

B. Protect materials from moisture, weather, ground contact and excessive sun.

C. Replace damaged or deteriorated materials.

D. Stack lumber and wood structural panels, providing for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 SAWN LUMBER

A. Species: Douglas Fir-Larch.

B. Grading and Maximum Moisture Content at Initial Use: As indicated in Structural General Notes.

C. Grading Rules: WWPA or WCLIB Grading Rules.

D. Out-of-grade material is not acceptable even if it bears grading stamp.

E. All lumber to be free of heart center.

F. Surface: S4S, surfaced dry.

G. Do not use end-jointed lumber unless accepted by Architect.

H. Preservative-treat sills and equipment curbs in contact with concrete curbs or slabs-on-grade.

I. Use only FSC-certified sawn lumber.

2.2 PLYWOOD AND ORIENTED STRAND BOARD (OSB) STRUCTURAL PANELS

A. General:

1. Identify each wood structural panel with appropriate grade and APA trademark in accordance with DOC PS-1 or PS-2, most recent edition.
2. Plywood meeting requirements of DOC PS-1 shall be used on all flat or low-slope roof surfaces (shallower than 4:12).
3. OSB meeting DOC PS-2 may be substituted for plywood in other areas (walls, floors and steep roofs) unless otherwise noted in Structural Drawings.

B. Floor Sheathing: APA-rated Sturd-I-Floor.

1. Exposure Durability Classification: Exposure 1.
2. Panel Thickness: As shown in Structural Drawings.
3. Panel Span Rating:
   a. 20 OC for 5/8-inch nominal (19/32-inch actual) panel thickness,
   b. 24 OC for 3/4-inch nominal (23/32-inch actual) panel thickness,
   c. 32 OC for 7/8-inch nominal (27/32-inch actual) panel thickness, and

d. 48 OC for 1-1/8-inch nominal (35/32-inch actual) panel thickness.

4. Tongue and groove edges.

C. Wall Sheathing: APA-rated Structural I, unless otherwise shown in Structural Drawings.

1. Exposure Durability Classification: Exposure 1.

2. Panel Thickness: As shown in Structural Drawings.

3. Panel Span Rating:
   a. 32/16 for 1/2-inch nominal (15/32-inch actual) panel thickness,
   b. 40/20 for 5/8-inch nominal (19/32-inch actual) panel thickness,
   c. 48/24 for 3/4-inch nominal (23/32-inch actual) panel thickness, and
   d. 60/32 for 7/8-inch nominal (27/32-inch actual) panel thickness.

D. Roof Sheathing: APA-rated Structural I, unless otherwise shown in Structural Drawings.

1. Exposure Durability Classification: Exposure 1.

2. Panel Thickness: As shown in Structural Drawings.

3. Panel Span Rating: Same as wall sheathing.

2.3 STRUCTURAL COMPOSITE LUMBER

A. Laminated Strand Lumber (LSL):

1. Minimum grade and allowable stresses as shown in Structural General Notes.

2. Products:
   a. TimberStrand LSL manufactured by iLevel per ICC-ES Report No. ESR-1387,
   b. SolidStart LSL manufactured by Louisiana-Pacific Corporation per ICC-ES Report No. ESR-2403 or
   c. Approved equal or better substitution.

B. Laminated Veneer Lumber (LVL):

1. Minimum grade and allowable stresses as shown in Structural General Notes.

2. Products:
   a. Microllam LVL manufactured by iLevel per ICC-ES Report No. ESR-1387,
   b. RedLam LVL manufactured by RedBuilt per ICC-ES Report No. ESR-2993,
   c. SolidStart LVL manufactured by Louisiana-Pacific Corporation per ICC-ES Report No. ESR-2403 or
   d. Approved equal or better substitution.

C. Parallel Strand Lumber (PSL):

1. Minimum grade and allowable stresses as shown in Structural General Notes.

2. Species: Douglas Fir.

3. Product:
   a. Parallam PSL manufactured by iLevel per ICC-ES Report No. ESR-1387,
   b. Versa-Lam manufactured by Boise Cascade per ICC-ESR Report 1040,
   c. or approved equal or better substitution.

D. Rim Boards:

1. Provide solid-sawn rim boards adjacent to solid-sawn joists, unless otherwise shown

in the Structural Drawings.

2. For rim boards adjacent to I-joist framing, see Section 06 17 50, Engineered Wood I-Joists.

2.4 LUMBER FASTENINGS

A. Nails and Spikes: ASTM F1667, common wire unless otherwise noted.

B. Machine-Driven Nails and Staples: ICC-ES Report No. ESR-1539.

C. Screws: Bright steel wood screws, ANSI B18.6.1.

D. Steel Bolts: ASTM A307 Grade A, with ASTM A563 hex nuts. Upset or rolled threads are not permitted.

E. Standard Steel Cut Washers: ASTM F844.

F. Plate Washers: ASTM A36.

G. Malleable Iron Washers: ASTM A47.

H. Lag Screws: ANSI B18.2.1. Use hexagonal heads where exposed to view by the public in the completed structure.

I. Timber Rivets: ASTM F1667.

J. Powder-Driven Fasteners:

1. Fasteners shall have manufacturer’s standard corrosive-resistant coating.

2. Provide guide washers.

3. Provide the following default fasteners except where a different fastener is specifically called out in the Structural Drawings:
   a. Driven into steel:
      1) Hilti X-EDNI per ICC-ES Report No. ESR-1663 or
      2) Approved equal or better substitution.
   b. Driven into concrete:
      1) Hilti X-DNI per ICC-ES Report No. ESR-1663,
      2) Powers 0.300” Head PTZ Pin per ICC-ES Report No. ESR-2024,
      3) Simpson PDPWL per ICC-ES Report No. ESR-2138 or
      4) Approved equal or better substitution.

K. Where fasteners are exposed to weather, in ground contact, in areas of high relative humidity, or contact with preservative-treated wood or fire-retardant-treated wood, provide fasteners with a hot-dip zinc coating per ASTM A153, G185 HDG per ASTM A653. Provide fasteners of AISI Type 304 or Type 316 stainless steel where required for compatibility with wood treatment.

2.5 ROUGH HARDWARE

A. Wood Connectors:

1. Simpson Strong-Tie Connectors: Fastener call-outs on the drawings refer to Simpson Strong-Tie Connectors based on latest edition of catalog.

2. USP Lumber Connectors or other manufacturers' products may only be used if proposed connector:

a. Has a Simpson-equivalent reference number or label,
b. Has equal or greater allowable load values, substantiated by a current ESR,
c. Fits within the geometric constraints of the installed condition,
d. Has equal or greater corrosion resistance and
e. Is submitted and approved as an equal or better substitution.
f. Note: Some Simpson Strong-Tie products have no known substitutions, such as connectors with self-drilling screws.

3. Default surface treatment of connectors: Simpson Strong-Tie standard paint or G90 galvanized connectors.

4. When lumber is preservative-treated to AWPA UC3 or less, use ZMAX/HDG galvanized connectors with fasteners galvanized per ASTM A153.

5. When lumber is preservative-treated to a level in excess of AWPA UC3, use AISI Type 304 or Type 316 stainless steel connectors and fasteners.

B. Sheet metal straps: ASTM A653 galvanized sheet steel with G185 coating thickness, of gauges and designs indicated.

C. Sheet metal straps and connectors in contact with preservative-treated wood: ASTM A653 galvanized sheet steel with G185 coating thickness, or stainless steel where required for compatibility with wood treatment.

D. Fabricated Metal Hardware: Refer to Section 05 12 00, Structural Steel.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Field-Gluing Panels to Framing: ASTM D3498. Comply with LEED VOC Requirements outlined in Part 1 Environmental Quality Assurance article.

B. Use only solvent-based glues where OSB panels with sealed surfaces are used.

2.7 PRESERVATIVE-TREATED WOOD

A. As a minimum, preservative-treat the following items:

1. Wood members in contact with masonry or concrete: AWPA UC2.
   a. Exception: furring on interior face of concrete or masonry walls need not be preservative-treated.

2. Interior sills on concrete: AWPA UC2.

3. Lumber not in contact with soil but within 6 inches of the ground or adjacent exterior slab: AWPA UC3B or UC4A.

4. Above grade weather-exposed wood such as exterior deck framing and decking: AWPA UC3B.

5. Wood in direct contact with ground: AWPA UC4B.

6. Fiber cants, nailers, curbs, equipment support bases, blocking, stripping and similar members in connection with roofing, flashing, vapor barriers, waterproofing and cement plaster: AWPA UC3B.

7. Members called out as “pressure-treated” or “preservative treated” on the drawings. Preserve to AWPA UC standard for similar members and exposures described above.

B. Preservatives that require incising or contain colorants require special approval by the architect for wood members exposed to view. Preservative to be compatible with subsequent treatments and or painting.

C. Preservative-treated wood must be marked with the quality stamp or end tag of an agency accredited by accreditation body which complies with the requirements of the American Lumber Standards Committee (ALSC) Treated Wood Program.

D. Do not use wood preservatives containing creosote, pentachlorophenol, arsenic or arsenate (such as ACA, ACZA or CCA).

E. Species and grade for preservative-treated products to match that specified for untreated similar lumber or wood products (i.e., preservative-treated Hem-Fir may not be substituted for preservative-treated Douglas Fir), unless otherwise noted in drawings.

F. Where possible, preservative-treat lumber after all cutting, boring and fitting. Where not possible, field-treat all cut surfaces (including routed and drilled surfaces) by:

1. Soaking in approved field preservative treatment for at least one hour, or
2. Painting with two coats of approved field preservative treatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install framing members of size and spacing indicated.
2. Do not splice structural members except as shown.
3. Selection of lumber pieces: Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections.
4. Provide strong, tight and rigid joints, with full bearing for all members.
5. Split, warped, curled or otherwise defective material or careless improper workmanship will not be accepted.
6. Surfaces to be level, plumb and true.
7. Do not notch or bore holes in members except as shown in Structural Drawings.
8. Repair all floor and stair squeaks.

B. Blocking:

1. Install miscellaneous blocking and framing as required for support of facing materials, fixtures, specialty items and trim.
2. Furnish and install blocking and draft stops in accordance with CBC Sections 708 and 717.
3. Provide wood blocking, backing, shims or grounds detailed or required to provide anchorage for finishes, accessories, equipment, at joints between different materials, behind intersections of surfaces and behind all joints on vertical surfaces except horizontal joints in gypsum board.

C. Install headers of thickness equal to width of studs.

D. Sills:

1. Fasten sills to concrete with a minimum of two fasteners per piece and a fastener no more than 12 inches and no less than 7 bolt diameters from each end of piece.
2. Sills of bearing walls and shear walls bearing on concrete slabs to be shimmed and grouted with cementitious grout as needed to accommodate variations in concrete slab flatness and levelness.
3. Fasten all sill plates at non-structural partition walls to concrete slabs with 0.177-inch diameter stainless steel or mechanically galvanized powder driven fasteners at 16 inches on center, with 1-1/4-inch minimum concrete embedment, unless otherwise noted on the drawings. Fasten all sill plates at non-structural walls to pre-stressed concrete slabs with 0.145-inch diameter stainless steel or mechanically galvanized powder driven fasteners at 16 inches on center, with 3/4-inch minimum and 1-inch maximum concrete embedment, unless otherwise noted on the drawings.

E. Install structural composite lumber in accordance with the manufacturer's recommendations.

3.2 FLOOR, CEILING AND ROOF FRAMING

A. Install joists, rafters and beams with crown edge up. Maximum of 1/4 inch crown permitted.

B. Support ends of each joist with not less than 1-1/2 inches of bearing on wood or metal.

C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4 feet.

D. Block all joists at supports and under all partitions with minimum 2x solid blocking.

E. Regularly spaced bridging or blocking for floor and roof joists:

1. Provide bridging or full depth blocking for the following cases:
   a. No gypsum board or plaster fastened directly to the bottom flange of joist, or
   b. Joist depth-to-width greater than 5.
2. Provide bridging or full depth blocking at the following spacing:
   a. 8 feet for floor joists, or
   b. 10 feet for roof joists.

F. Install 2x solid blocking (2 inches thick by depth of joist) at ends of joists unless nailed to header or bearing member.

G. Under jamb studs at openings, install solid blocking between joists.

H. When pairs of bridging members are installed, provide a gap between them.

I. Drive up and nail lower end of bridging after floor or roof has been installed.

J. Under non-load-bearing partitions, install double joists.

K. Rafters: Notch to fit exterior wall plates and toe nail or use special metal framing anchors. Do not notch rafters cantilevering to form eaves, unless specifically shown in Structural Drawings. Double up rafters to form headers and trimmers at openings in roof framing (if any), and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

L. For timber framing provide not less than 4 inches of bearing on supports. Install continuous members unless shown otherwise.

M. Where built-up beams or girders of 2x lumber are shown, fasten together with 2 rows of 16d

nails spaced not less than 12 inches on center. Locate one row near top edge and other near bottom edge. Locate end joints in members over supports.

N. Glue and nail stair treads to stair stringers.

O. Do not over cut notches in stair stringers.

3.3 INTERIOR WALLS

A. Nail sill plates to joists, beams or blocking. Do not nail to sheathing without backing.

3.4 INSTALLATION OF WOOD STRUCTURAL PANEL SHEATHING

A. Lay floor and roof sheathing panels with face grain perpendicular to joists and rafters. Install with smooth side up. Minimum panel size not less than 24 by 48 inches with each panel continuous over two or more spans.

B. Orient wall sheathing panels with long dimension vertical. Minimum dimension for cut panels in shear walls is 16 inches in both directions.

C. Provide an1/8-inch space between all adjacent panels. Maintain at least minimum panel support at edges.

D. Panel Edge Support:

1. Block and fasten all panel edges not resting on framing members unless otherwise noted.
2. Provide plywood clips between rafters where roof panel edges are not blocked.

E. Nailing of Sheathing:

1. Head or crown of nail to be flush with surface of sheathing panel.
2. Do not overdrive nails such that nail heads penetrate surface by more than nail head thickness or break surface-ply wood fibers.
3. Roof and floor sheathing nails: deformed shank nails (helical or annularly threaded, also known as ring shank or thread shank).

F. Gluing of Sheathing:

1. Apply a continuous bead of glue (1/4-inch thick) to all floor joists and blocked panel edges before setting and nailing floor sheathing.
2. Install all nails immediately after application of glue.
3. Ensure full contact between floor sheathing and floor framing.
4. Glue tongue-and-groove edges (1/8-inch thick).
5. Use glue in accordance with manufacturer’s recommendations. Nail sheathing before glue sets.
6. Where OSB panels are used, comply with panel manufacture’s recommendations regarding use of glue.
7. Do not apply glue to wall studs.

G. Protect wood structural panels from exposure to excessive moisture prior to installation of final building finishes. Ensure that sheathing is dry before covering with finish surfaces or moisture barriers.

3.5 ROUGH HARDWARE, CONNECTORS, FASTENERS AND MISCELLANEOUS METAL

A. Install in conformance with manufacturer's recommendations and in accordance with applicable ESR.

B. Properly seat joists and beams in hangers.

C. Use stainless steel fasteners with stainless steel connectors. Use galvanized fasteners with galvanized connectors.

D. Anchor bolts must be securely wired in place and aligned in a true straight line prior to the concrete placement. Anchor bolts may not be “wet set.”

E. Re-tighten all bolts before closing in framing.

F. Unless otherwise shown on the Drawings:

1. Fill all fastener holes with the maximum number, diameter and length of fasteners (nails, bolts, etc.).
2. For straps where manufacturer offers nailed or bolted alternatives, install nails.

3.6 FASTENERS

A. Nails and Staples:

1. Use only sizes of nails defined in Contract Documents.
2. Use common wire nails, unless otherwise indicated.
3. Minimum nailing: CBC Table 2304.9.1 or as indicated in Structural Drawings.
4. Do not split wood, pre-boring as required to a diameter not to exceed 75 percent of the nail or spike diameter. Replace all split members.
5. Nailing guns:
   a. Use of machine nailing is subject to a satisfactory job site demonstration observed by the Owner's Testing Agency.
      1) The demonstration will consist of nailing one 4-foot by 8-foot wood structural panel with plywood edge nailing.
      2) If nail heads are over-driven, or if minimum allowable edge distances are not maintained, the performance will be deemed unsatisfactory.
   b. The continued use of machine nailing is subject to continued satisfactory performance.
   c. Any fastener overdrive will be considered of no value and shall be replaced with an additional fastener. If the additional nails result in spacing closer than 1 inch on center, if more than 10 fasteners in a row are overdriven, or more than 20 fasteners per wood structural panel are overdriven, the entire wood structural panel shall be removed and replaced.
   d. If the back side of sheathing cannot be viewed after nail installation, machine nailing is not allowed, unless inspection of first sheet is conducted before installation of second sheet.
   e. Use nailing gun that has a depth control adjustment feature that assures that head or crown of fastener is flush with the panel surface.
   f. Ensure that sheathing is installed tight against supporting members, with no gap.
   g. Requirements for nails also apply to staples.
6. For wood-to-wood joints, the center-to-center spacing of nails to be not less than 11

fastener diameters. End distances to be not less than 7 fastener diameters. Edge distances to be not less than 4 fastener diameters. Spacing, edge and end distances shall be such as to avoid splitting of the wood.

7. Space nails installed in PSL, LVL and LSL material that are parallel to the glue line, no closer than recommended by manufacturer or allowed by applicable ESR. Nailing into flanges of manufactured wood I-joists shall also be no closer than recommended by joist manufacturer.

B. Install fasteners without splitting of wood; pre-drill as needed to avoid splitting.

C. Select fasteners of length that will not penetrate members where opposite side will be exposed to view in completed structure, or will receive finish materials.

D. Bolts:

1. Drill bolt holes 1/16-inch larger in diameter than the bolts.
2. Provide washers under bolt heads and nuts bearing on wood, except carriage bolts require washers under the nut only.
3. Washers shall be malleable iron washers, except washers at countersunk heads or nuts shall be standard steel cut washers, unless otherwise noted on the drawings.
4. Drill bolt holes perpendicular to the surface in which they are placed. Align holes accurately with corresponding holes in adjacent steel or wood connecting materials.
5. Retighten bolts before closing in work or at completion of the project.
6. Anchor Bolts: see Specification Section 03 20 00, Concrete Reinforcement.

E. Expansion Anchors:

1. See Specification Section 03 25 00, Masonry and Concrete Anchors.
2. Install expansion bolts in accordance with manufacturer’s recommendations and in accordance with applicable ESR.
3. Retighten bolts before closing in work or at completion of the project.

F. Screws:

1. Lag screw lead holes:
   a. Clearance hole for shank: Same diameter and length as shank.
   b. Lead hole for threaded portion: Diameter equal to 60 to 70 percent of shank diameter.
2. Wood screw lead holes are not required and shall not exceed 75 percent of screw diameter at root of thread.
3. Screw, do not drive, lag and wood screws.
4. Lubricate threads with soap or other wood-compatible lubricant.
5. Lag screws may not be substituted for through-bolts.
6. Use washers under heads of lag screws where they bear on wood.

G. Timber Rivets:

1. Install rivets with wide face of rivet parallel to grain.
2. Diameter of rivet holes in plate 17/64 inch minimum to 18/64 inch maximum.

3. Tolerance in location of holes 1/8 inch maximum in any direction.
4. Drive rivet until head projects 1/8 inch above side plate.
5. Install rivets in a spiral pattern from outside of group toward center.

H. Powder-Actuated or Pneumatically Driven Fasteners:

1. Install in accordance with manufacturer's recommendations and in accordance with applicable ESR.

3.7 PRESERVATIVE-TREATED WOOD

A. Install preservative-treated wood where specified. Verify that moisture content does not exceed 19 percent when covered over or placed in an enclosed location.

B. When handling damage occurs, or cuts, daps or other machining is done in the field, field-treat cut or damaged surfaces as specified in AWPA M4, and as required by Preservative-Treated Wood article in Part 2 of this section.

C. Aluminum fasteners, connectors or flashing shall not be placed in contact with copper-based preservative-treated wood (e.g., CA or ACQ).

D. Protect fasteners, connectors and hardware in contact with preservative-treated wood as required in the Lumber Fastenings and Rough Hardware articles in Part 2 of this section.

3.8 FIELD QUALITY ASSURANCE

A. General:

1. Notify Architect and Owner's Testing Agency at least 48 hours prior to start of Work requiring inspection.
2. As a minimum, all testing and inspection shall be per this specification and CBC Chapter 17A.

B. The Owner's Testing Agency will:

1. Inspect lumber framing for conformance with Contract Documents.
2. Inspect floor and roof nailing for size, spacing and overdriving. Identify nails that miss framing.
3. Inspect lumber grades, size and connections of glue-laminated timber, chords and collectors.

C. Owner's Testing Agency will provide periodic special inspection of:

1. Anchor bolts, prior to concreting.
2. Tie-downs and hold-downs.
3. Bolts, screws and lag screws.
4. Thickness and grade of floor, roof and shear wall sheathing.
5. Size of members at edges of individual pieces of floor, wall, or shear wall sheathing.
6. Fastening of floor, roof and shear wall sheathing, including but not limited to verification of nail or staple size (diameter and length), spacing, edge distance,and whether fasteners are flush with surface of sheathing.

7. Where nailing spacing of 4 inches on center or less is called for, the member and the nailing are subject to the same special inspection requirements as for shear walls.

D. Installation of timber connectors will be continuously inspected by an inspector approved by the enforcement agency.

E. Moisture Content:

1. At the time lumber is incorporated into construction, and before floor or wall sheathing is applied, verify with a moisture meter that lumber has a moisture content that complies with contract documents.

2. At the time that structure is enclosed, verify that moisture content of lumber is in compliance with contract Documents.

3.9 CLEANING

A. Upon completion of the work, remove all debris, rubbish and surplus materials from the site. Do not leave any wood, shavings, sawdust, etc., on the ground or buried in fill.

B. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 06 10 00

SECTION 06 17 50

ENGINEERED WOOD I-JOISTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to the following:

1. Prefabricated wood I-joists.
2. Rim boards for I-joist framing.
3. Blocking, bridging, squash blocks, web stiffeners and other accessories as required for a complete installation.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 06 10 00, Rough Carpentry.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Society for Testing and Materials (ASTM):
   a. D5055, “Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.”
3. Forest Stewardship Council (FSC) 1.2, “Principles and Criteria for Forest Stewardship.”

1.3 DEFINITIONS

A. Evaluation Service Report (ESR): Product testing report from ICC Evaluation Service or equivalent from another approved agency.

B. I-joist: Prefabricated wood joist with I-shaped cross-section comprised of sawn or structural composite lumber flanges and wood structural panel webs, bonded together with exterior-grade adhesives and meeting the requirements of this Section.

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and responsibility for conformance with intent of Drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit Shop Drawings per Division 01.

2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittal:

1. Prior to fabrication, submit Shop Drawings for review.
   a. Show size, length, geometry, and connections for each I-joist.
   b. Include design calculations for all I-joists, stamped and signed by a California-licensed Civil or Structural Engineer. The purpose of the calculations is to verify the I-joists and connections shown on the drawings. I-joists and connections weaker or less stiff than those shown on the drawings are not allowed, even if justified by calculation.
   c. Indicate any change or deviation from the structural drawings by enclosing the change in a revision cloud with the note “Engineer Verify.”
   d. Do not fabricate I-joists until Shop Drawings have been reviewed, approved, and returned.

D. Information-Only Submittals:

1. Prior to delivery of I-joists to job site, submit certification to Architect stating that all delivered I-joists were fabricated in accordance with these specifications.

2. Submit report prepared by the manufacturer’s representative stating that I-joists have been installed in accordance with the manufacturer’s recommendations.

E. LEED Submittals:

1. Submit product data indicating that all adhesives and sealants used inside building and applied on site comply with LEED VOC Requirements outlined in Environmental Quality Assurance article.

2. For wood products specified as FSC-certified in Part 2:
   a. Submit Chain-of-Custody (COC) certificates signed by manufacturers certifying that products were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2. Include evidence that mill is certified for COC by an FSC-accredited certification body.
   b. Submit vendor invoices with vendor’s COC number and identify each FSC-certified product with associated cost on a line-item basis.
   c. Submission of a COC certificate without a corresponding invoice or submission of an invoice without a corresponding COC certificate shall not constitute acceptable documentation.

1.5 QUALITY ASSURANCE

A. Provide at least one person present at all times during execution of this portion of the work and who is thoroughly trained and experienced in the work of this Section and who shall direct all Work performed under this Section.

B. Manufacturer’s representative to inspect installation of I-joists.

1.6 ENVIRONMENTAL QUALITY ASSURANCE

A. Adhesives, sealants, and sealant primers shall not exceed VOC limits established in Section 01 35 63, LEED Requirements.

B. For wood products specified as FSC-certified in Part 2:

1. Wood products shall originate in forests that are certified by an FSC-accredited certification body to comply with FSC 1.2.

2. Follow proper procedures to ensure that certified wood products are kept separate from noncertified materials and that auditing procedures as mandated by the certifier are complied with.

C. Applicable LEED Credits:

1. Category – Indoor Environmental Quality:
   a. Credit 4.1, Low-Emitting Materials, Adhesives and Sealants.

2. Category – Materials and Resources:
   a. Credits 5.1 and 5.2, Regional Materials.
   b. Credit 7, Certified Wood.

1.7 DELIVERY, STORAGE AND HANDLING

A. Handle I-joists with care such that they are not damaged or over-stressed. Comply with manufacturer's recommendations.

B. Protect I-joists from exposure to harmful environmental conditions, at temperature and humidity conditions recommended by manufacturer.

C. Store I-joists in a vertical position, off the ground, protected from weather, and with dimension lumber separators to provide for adequate air circulation between I-joists and under protective coverings. Keep separators in line vertically.

D. Do not allow I-joists to have prolonged exposure to weather.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. LP Building Products, Nashville, TN.

B. RedBuilt, Stayton, OR (www.redbuilt.com).

2.2 I-JOISTS

A. Floor and Roof I-Joists:

1. "Red-I" manufactured by RedBuilt per ICC-ES Report No. ESR-2994, or

2. "SolidStart" manufactured by LP Building Products per ICC-ES Report No. ESR-1130 (LP 36/56 series) or ESR-1305 (LP 20Plus/32Plus series), or

3. Approved equal or better substitution.

B. Top and Bottom Flanges:

1. Laminated Veneer Lumber (LVL) with a minimum specific gravity of 0.49.

2. Flange material to be FSC-certified.

2.3 RIM BOARDS

A. Unless otherwise noted in the Structural Drawings,

1. Minimum rim board thickness to be 1-3/4 inches.
2. Rim board depth to match depth of adjacent I-joist framing.
3. Minimum rim board grade to be 1.5E.
4. Products:
   a. “TimberStrand LSL,” manufactured by iLevel per ICC-ES Report No. ESR-1387,
   b. SolidStart LSL manufactured by Louisiana-Pacific Corporation per ICC-ES Report No. ESR-2403 or
   c. Approved equal or better substitution.

2.4 ACCESSORIES

A. Blocking Panels: APA-rated sheathing of 1/2 inch minimum nominal thickness or approved rim board material.

B. Web Stiffeners: Lumber of same grade as wall studs, approved rim board material or APA-rated sheathing.

C. Wood Connectors and Fasteners: Refer to Section 06 10 00, Rough Carpentry.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to all work in this Section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

B. Verify that I-joists may be erected in accordance with the contract documents.

C. In the event of discrepancy, immediately notify the Architect and Structural Engineer.

D. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Install I-joists in accordance with contract documents, approved shop drawing submittals, and manufacturer's recommendations.

B. Supply all blocking panels, bridging, rim boards, squash blocks, web stiffeners and similar items as required by contract documents, as shown in approved shop drawing submittals, and as required for proper installation.

C. Block all I-joists at supports and under all partitions with minimum 2x solid blocking.

D. Regularly spaced bridging or blocking for floor and roof I-joists:

1. Provide bridging or full-depth blocking for the following cases:
   a. No gypsum board or plaster fastened directly to the bottom flange of I-joist, or
   b. I-joist depth-to-flange width greater than 5.

2. Provide bridging or full-depth blocking at the following spacing:
   a. 8 feet for floor I-joists, or
   b. 10 feet for roof I-joists.

E. Provide blocking connected to backer blocks in locations supporting concentrated loads in excess of 200 pounds.

F. Where possible, clinch nails that pass through I-joist webs.

G. Refer to Section 06 10 00, Rough Carpentry, for additional provisions related to fasteners, wood connectors such as I-joist hangers, and other hardware.

H. Provide erection and permanent bracing as required to maintain stability of structure at all times, in addition to bracing specified in contract documents, shown in approved shop drawing submittals, or as recommended by manufacturer.

I. Do not apply construction loads in excess of I-joist design capacity.

J. Do not cut, notch, hammer on, or otherwise damage I-joist flanges.

K. Do not cut or drill holes in I-joist webs except where explicitly permitted on the Structural Drawings and approved by Architect and Structural Engineer.

L. Do not make holes in I-joist webs with a hammer except where I-joist manufacturer has provided a knockout for this purpose.

M. Do not install visibly damaged I-joists.

N. Tolerances:

1. Alignment of I-joists: Top and bottom flanges within 1/2 inch of true vertical alignment.
2. Thickness of filler blocks: minus 0 inches to plus 1/8 inch.
3. Thickness of backer blocks: plus or minus 1/16 inch.

3.3 PROTECTION

A. Protect installed I-joists from damage due to prolonged exposure to weather.

3.4 CLEANING

A. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION

SECTION 06 18 50

STRUCTURAL GLUED LAMINATED TIMBER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to the following:

1. Structural glued laminated timber beams.

B. Related Sections:

1. Section 01 35 63, LEED Requirements.
2. Section 01 74 19, Construction Waste Management.
3. Section 05 12 00, Structural Steel.
4. Section 06 10 00, Rough Carpentry.

1.2 REFERENCES

A. Published specifications, standards, test methods or other documents listed below are invoked where cited by abbreviations noted below. Latest editions of references apply unless a specific date or edition is listed.

1. California Building Code (CBC), California Code of Regulations, Title 24, Part 2.
2. American Institute of Timber Construction (AITC):
   a. AITC 109, “Standard for Preservative Treatment of Structural Glued laminated Timber.”
   b. AITC 110, “Standard Appearance Grades for Structural Glued Laminated Timber.”
   c. AITC 111, “Recommended Practice for Protection of Structural Glued laminated Timber During Transit, Storage and Erection.”
   d. AITC 117, “Standard Specifications for Structural Glued Laminated Timber of Softwood Species.”
   e. AITC A190.1, “American National Standard, Structural Glued Laminated Timber.”
3. American Society for Testing and Materials (ASTM) D3737, “Standard Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam).”
4. Forest Stewardship Council (FSC) 1.2, “Principles and Criteria for Forest Stewardship.”

1.3 DEFINITIONS

A. Evaluation Service Report (ESR): Product testing report from ICC Evaluation Service or equivalent from another approved agency.

B. “Glulam” is an abbreviation for structural glued laminated timber.

C. “GLB” is an abbreviation for glued laminated timber beam.

1.4 SUBMITTALS

A. Review of submittals is of a general nature only, and responsibility for conformance with intent of Drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the construction documents.

B. Submittal Protocol:

1. Submit Shop Drawings per Division 01.

2. Shop Drawing Coordination Notes: Clearly identify, by circling with a cloud and adding the note “Engineer Verify,” the following:
   a. Specific situations not addressed in the Construction Documents,
   b. Proposed variations from the Construction Documents, or
   c. Clarification requests (clearly note the nature of the question).

C. Action Submittal:

1. Shop drawings showing location, dimensions, shape and camber of each glulam member. Indicate species and laminating combination, extent of tension laminations and adhesive type. Show details of fabrication of each member. Show large-scale details of connections.

D. Information-Only Submittal:

1. Submit certificate of conformance from manufacturer stating that glulam complies with requirements of AITC A190.1.

E. LEED Submittals:

1. Submit product data indicating that all adhesives and sealants used inside building and applied on site comply with LEED VOC Requirements outlined in Environmental Quality Assurance article.

2. For products specified as FSC-certified in Part 2:
   a. Submit Chain-of-Custody (COC) certificates signed by manufacturers certifying that products were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2. Include evidence that mill is certified for COC by an FSC-accredited certification body.
   b. Submit vendor invoices with vendor’s COC number and identify each FSC-certified product with associated cost on a line-item basis.
   c. Submission of a COC certificate without a corresponding invoice or submission of an invoice without a corresponding COC certificate shall not constitute acceptable documentation.

1.5 QUALITY ASSURANCE

A. Installer: Firm that has demonstrated competence specializing in installing glulam for at least 5 years.

1.6 ENVIRONMENTAL QUALITY ASSURANCE

A. Adhesives, sealants, and sealant primers shall not exceed VOC limits established in Section 01 35 63, LEED Requirements.

B. For wood products specified as FSC-certified in Part 2:

1. Wood products shall originate in forests that are certified by an FSC-accredited certification body to comply with FSC 1.2.

2. Follow proper procedures to ensure that FSC-certified wood products are kept separate from non-certified materials and that auditing procedures as mandated by the certifier are complied with.

C. Applicable LEED Credits:

1. Category – Indoor Environmental Quality:
   a. Credit 4.1, Low-Emitting Materials, Adhesives and Sealants.
2. Category – Materials and Resources:
   a. Credits 5.1 and 5.2, Regional Materials.
   b. Credit 7, Certified Wood.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in manufacturer's packaging.

B. Protect materials from moisture, weather, ground contact and excessive sun.

C. Stack glulam, providing for air circulation within and around stacks and under protective coverings.

D. Comply with the "recommended specifications" of AITC 111.

E. Prevent damage to finished surfaces.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED LAMINATED TIMBER (GLULAM)

A. Comply with AITC A190.1 and ASTM D3737.

B. Stamp members with either APA EWS Trademark or AITC Quality Mark. For members exposed to view in the completed structure locate stamp so that it will not be visible to the public. Alternatively provide a certificate of conformance for individual members.

C. Appearance Grade:

1. Appearance grades as defined by AITC 110.
2. Visually exposed glulam: Premium appearance grade, with all laminations of same species.
3. Concealed glulam: Industrial appearance grade.
4. Lamination thickness to be the same for all members.

D. Species and Combination Symbol: As required by Structural Notes on the structural drawings, with all lumber FSC-certified.

E. Laminating Adhesive: dry-use service conditions.

F. Space end joints as per bending member unless drawings indicate otherwise.

G. Edge joints need not be pre-glued.

H. Manufacture according to End-Use Classification: Glued laminated timbers of the following End-Uses are found on this project:

1. Simple span bending members
2. Continuous span bending members

I. Moisture content of glulam to be neither less than 7 percent nor greater than 12 percent.

2.2 SEALERS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer, effective in retarding transmission of moisture at cross-grain cuts.

B. Translucent Penetrating Sealer: Manufacturer's standard, translucent, penetrating wood sealer, that will not interfere with application of wood stain and transparent finish or paint finish.

2.3 FABRICATION

A. Comply with AITC 117 in providing units indicated.

B. Shop-fabricate for connections and connecting hardware to greatest extent feasible, including drilling of bolt holes.

C. Camber: Required camber for each member is shown on drawings, and may be either circular or parabolic, at manufacturer's option. Camber only single-span members without cantilever.

D. Clearly indicate top surface of each glulam.

E. End Sealer:

1. Apply immediately after end-cutting each member to final length, and after wood treatment.
2. Apply a saturation coat of end sealer to cuts, keeping surfaces flood-coated for not less than 10 minutes.

F. Surface Sealer: After fabricating and sanding each unit, and application of end-coat sealer, apply a heavy saturation coat of translucent penetrating sealer to surfaces of each unit, except where wood treatment includes water repellent.

G. Wrapping (applies to Premium or Architectural appearance grades):

1. Bundle-wrapped or individually wrapped, with water-resistant paper or opaque polyethylene covering with water-resistant seams.
2. Secure wrapping to member in factory by staples, tape or other suitable fastening that do not damage exposed surfaces.

2.4 FABRICATION QUALITY ASSURANCE

A. Glulam fabrication will be inspected full time by an inspector approved by the Division of the State Architect in accordance with CBC Section 1704A.6.2.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to installation of work of this Section, inspect installed work and verify that all such work

is complete to the point where this installation may properly commence.

B. In the event of discrepancy immediately notify Architect.

C. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Plan and execute erection procedures so that close fit and neat appearance of joints and structures as a whole will not be impaired.

B. Provide temporary bracing as required to maintain stability, and maintain bracing until stability is imparted by completed structure.

C. Install all required connectors, anchors and accessories.

D. Avoid cutting glulam during erection except for fastener drilling and other minor cutting. Coat cuts with end sealer.

E. When handling damage occurs, or cuts, daps or other machining is done in the field, field treat the cut or damaged surfaces as specified in AWPA M4.

F. Handle and temporarily support members to prevent damage to finished surfaces.

G. Do not remove wrapping on individually wrapped members until it is no longer required for protection from weather, soiling or damage from work of other trades.

H. Coordinate wrapping removal with finishing work. Retain wrapping wherever it can serve as a painting shield. If part of wrapping is removed during construction, replace it or remove all wrapping and take other steps to prevent sun bleaching or water staining.

I. Repair damaged surfaces and finishes after completing erection and removing wrappings, or replace damaged members as directed where damage is beyond acceptable repair.

3.3 PROTECTION

A. Control heating, ventilation and air conditioning in building to avoid a rapid lowering of relative humidity in the building that could lead to excessive checking of glulam.

3.4 CLEANING

A. Comply with the requirements of Section 01 74 19, Construction Waste Management, for removal and disposal of construction debris and waste.

END OF SECTION 06 18 50

SECTION 06 20 13

EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wood siding at exterior walls.
   2. Bio-based simulated wood panels.
   3. Soffit boards.
   4. Cladding drainage plane behind wood siding.
   5. Finish hardware items integral with exterior finish carpentry.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's descriptive literature and standard drawings for stock products and materials to be used.

B. Samples:
   1. Graded wood samples for review and approval for each wood texture, profile, and intended finish applied in step fashion. showing unfinished wood and each applied coating.
   2. Simulated wood panels, not less than 12 inches long in proposed texture and color.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 QUALITY ASSURANCE

A. Mockups:
   1. Prepare for the board siding to demonstrate seaming, joints, corner conditions, workmanship, visual effect, and qualities of materials and execution.
   2. In addition to siding, first installed example of each indicated type or profile of other exterior carpentry and each installation condition shall serve as a mockup for review and approval by District's Design Consultant of installation, visual effect, and interface with adjacent construction.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Exterior finish carpentry shall comply with the applicable requirements of the "North American Architectural Woodwork Standards (NAAWS)" published jointly by WI and AWMAC (hereinafter also referred to as the "woodworking standard") including Section 6, "Millwork," and applicable requirements of Appendix. Where the Bridging Documents indicate requirements that conflict with or augment the woodworking standard, comply with the conflicting or augmenting requirements.

B. Hammer, tool marks, and marred surfaces and edges are not acceptable on exposed surfaces.

C. Wood boards furnished by District shall be re-milled to profiles and designs shown on the Bridging Drawings and in accordance with Section 6 of the NAAWS.

2.02 WOOD MATERIALS

A. Soffit Boards:
   1. Soffit boards shall be full length with no joints except where soffit length exceeds available board length. Joints, if required, shall be shall be reviewed and approved by the District's Design Consultant.
   2. Provide kerfs on backside of boards as required to prevent cupping.
   3. Species to be determined by District's Design Consultant.

2.03 ADDITIONAL MATERIALS

A. Bio-Based Simulated Wood Panels at Trash Gate and Trellis on Building 18: Hollow profile extruded fiber reinforced composite material, 100 percent recyclable, composed of a proprietary blend of rice husks, salt and oil; "Resysta" by Resysta North America, Inc., Chino, CA, 909-393-2800, or equal.

B. Fasteners:
   1. Except as otherwise specified or noted on the Drawings, nails, screws, and other hardware shall be Type 316 stainless steel.
   2. Furnish items as indicated and required to complete the work.
   3. Provide concealed fasteners unless otherwise shown, specified, or noted. Fasten from behind or, where face fastening is unavoidable, countersink and plug.

C. Hat channel.

2.04 FINISHING

A. Prepare for finishing and shop or field finish in accordance with NAAWS factory finishing requirements as specified in Section 5 of the NAAWS.

B. Finished wood shall be sealed on all cut edges, backs and other areas concealed in final work prior to installation. Field-finished wood shall comply with this requirement prior to installation.

C. Thoroughly hand sand wood surfaces scheduled for a smooth finish with medium grit paper.
   1. Perform sanding in direction of grain; ease knife-edge corners by sanding.
   2. Provide wood surfaces free from dust, glue, stains, and other foreign matter and in proper condition to receive finish.
   3. Finish lumber shall have eased edges.

D. Coordinate application of coatings, both shop and field, with Section 09 90 00, "Painting and Coating."

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Install exterior finish carpentry work plumb, true, in accordance with the Drawings, NAAWS Custom Grade requirements.

B. Until installed, protect wood materials from direct sunlight, water saturation, dirt, and other elements. Store flat, elevated on stickers, spaced to avoid warping, and over a vapor barrier so that moisture is not absorbed through the bottom boards of the stack.

C. Use specified stainless steel fasteners for installation of exterior work.

D. Apply siding drainage plane in accordance with manufacturer's instructions. Provide continuous bug screen to prevent insect infiltration along open bottom and top edge of siding.

E. Secure siding and trim with blind fasteners into framing at a maximum 24 inches on center.
   1. Predrill at corners, edges, and ends to avoid splitting.
   2. Where concealed fastening is not possible, coordinate exposed fastening method with District's Design Consultant for approval prior to proceeding. Exposed fasteners, where approved, shall be carefully aligned in both directions and uniformly spaced.

F. Field Finishing: Apply in accordance with Section 09 90 00, "Painting and Coating."

END OF SECTION

SECTION 06 40 23

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Horizontal wood plank paneling.
   2. Interior wood millwork not provided under Section 06 10 00, “Architectural Wood Casework.”
   3. Wood Slat Ceiling

1.02 REFERENCES

A. Woodwork Institute (WI): “North American Architectural Woodwork Standards” (NAAWS) published jointly by WI and the Architectural Woodwork Manufacturers of Canada (AWMAC).

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit for all custom fabricated items and millwork profiles.
   2. Prepare in accordance with the NAAWS Section 1 Article entitled “Submittals.”

B. Wood Samples:
   1. 12-inch lengths for each trim profile in proposed wood species and Grade, finish painted as specified.
   2. Finish shall be applied in step fashion showing unfinished wood and each applied coating.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Verifiable successful experience in successful completion of work similar to work of this Project.

B. Mockups: First installed example of each item, profile, or installation condition shall serve as a mockup for review and approval by District’s Design Consultant of workmanship, visual effect, and interface with adjacent construction.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE REQUIREMENTS

A. Standard for Materials and Workmanship: Comply with applicable requirements of the NAAWS (referred to as the "woodworking standard"). Where Contract Documents Show

requirements that conflict with or augment the woodworking standard, comply with the most stringent requirements.

B. Opaque-finish millwork shall conform to NAAWS Custom Grade or WMMPA WM 4, P-grade requirements.

C. Adhesives and Glues: VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Do not use materials that are unsound, warped, improperly treated or finished, or inadequately seasoned.

E. Do not use manufactured products with defective surfaces, sizes, or patterns.

F. Miter corners of casing and trim.

G. Hammer, tool marks, and marred surfaces and edges are not acceptable on exposed surfaces.

2.02 WOOD MATERIALS

A. General:
1. Moisture Content at Time of Fabrication: As specified in woodworking standard.
2. Provide wood dressed on all exposed faces.
3. Do not use twisted, warped, bowed, or otherwise defective wood.
4. Do not mark or color material, except where such marking will be concealed in finish work.
5. Lumber shall be free of sapwood, knots, pitch, or resin and conform to NAAWS Custom Grade requirements.

B. Solid Stock Species for Clear Finish: To be determined by District's Design Consultant.

C. Board Paneling: To be determined by District's Design Consultant. Species and finish to match wood slat ceiling.

2.03 PANEL MATERIALS

A. Medium-Density Fiberboard (MDF): ANSI A208.2; with no added formaldehyde, 11/16 inch thick or equivalent as standard with manufacturer, paint grade; "Medite II" by SierraPine; or equal.

2.04 FINISHING

A. Cut edges, and surfaces which are not exposed to view at any time and abut walls or floor, shall be primed with one heavy coat of VOC compliant coating.

B. Prepare for field finish in accordance with the woodworking standard.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all millwork plumb, true, aligned with adjacent materials, and in accordance with the Drawings and NAAWS and WMMP Standards.

B. Field Finishing: Apply in accordance with Section 09 90 00, “Painting and Coating."

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Custom casework with wood veneer facing.

1.02 REFERENCES

A. Woodwork Institute (WI): "North American Architectural Woodwork Standards" (NAAWS) published jointly by WI and the Architectural Woodwork Manufacturers of Canada (AWMAC).

1.03 DEFINITIONS

A. Unless otherwise specified, exposed, semi-exposed, and concealed surfaces shall conform to the cabinet surface terminology in Section 10 - Casework of the referenced NAAWS publication.

1.04 ACTION SUBMITTALS

A. Shop Drawings:
   1. Drawn to scale dimensioned plans, elevations, component profiles, and large scale details for each casework item.
   2. Prepare in accordance with NAAWS, Section 1, "Submittals."

B. Product Data:
   1. Cabinet hardware items.
   2. Shop-applied coatings.

C. Samples:
   1. Panel with wood Veneer selected from and representative of veneer flitches to be used; complete with specified finish.
   2. Hardware: Items as requested by District's Design Consultant.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.05 INFORMATIONAL SUBMITTALS

A. Certification: Before delivery of casework to jobsite, submit WI Certified Compliance Program certificates.

B. Fabricator qualifications.

1.06 QUALITY ASSURANCE

A. Qualifications: Firm specializing in quality architectural cabinetwork and active member of WI or AWI. Fabricators not active members of WI or AWI will be considered upon submission of

verifiable evidence of experience in successful completion of work similar to work of this Project. This provision does not waive compliance with specified WI Certification.

B. WI Certified Compliance Program:
   1. Casework and the installation thereof for this Project shall be certified by Design Builder for compliance to the Contract Documents:
   2. Fees charged by WI to either WI licensee or non-licensee are the responsibility of the Design Builder.
   3. Casework and/or installation determined to be non-compliant by WI and not corrected will be rejected.
   4. Issuance of the WI Certified Compliance Certificate is a prerequisite for District acceptance.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Standard for Materials and Workmanship: Comply with applicable requirements of the NAAWS (referred to as the "woodworking standard"). Where Contract Documents Show requirements that conflict with or augment the woodworking standard, comply with the most stringent requirements.

B. Adhesives and Glues: VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Anchorage shall meet Project seismic requirements.

D. Moving or operating parts to function smoothly and correctly.

2.02 WOOD MATERIALS

A. Wood Veneer:
   1. General: Conform to NAAWS Premium Grade requirements or HPVA Grade "AA," whichever is more restrictive or required for appearance match District's Design Consultant's control sample.
   2. Species and Cut: To be determined by District's Design Consultant.
   3. Edge: "Self-edge" sliced from the same veneer flitch as exposed faces.

B. Solid Stock:
   1. Concealed: Species and grade as specified in woodworking standard for casework construction, unless otherwise indicated.
   2. Exposed: Premium Grade to match adjacent wood veneer.
   3. Moisture content at time of fabrication: As specified in woodworking standard.
   4. Provide wood dressed on all exposed faces.
   5. Do not use twisted, warped, bowed, or otherwise defective wood.

2.03 PANEL MATERIALS

A. Hardwood Veneer Plywood: Non-toxic, urea formaldehyde free, hardwood plywood using soy-based adhesive; "PureBond" by Columbia Forest Products, Inc., "Freshply" by True North, or equal.
   1. Face Veneer: Species as specified and in thickness not less than 0.02 inches.
   2. Edge: "Self-edge" sliced from the same veneer flitch as exposed faces.

B. Softwood Plywood: DOC PS 1 of Types, grades, and cores in accordance with the woodworking standard
   1. Provide AB Marine Grade plywood at locations subject to moisture.

C. Medium-Density Fiberboard (MDF): ANSI A208.2, formaldehyde free. FSC Certified; "Arreis" by SierraPine, Ltd, Roseville, CA, or equal.
   1. Density: 47 pounds / cubic foot.
   2. Type: Grade 130.
   3. Thickness: 3/4 inch, unless otherwise required to meet NAAWS performance requirements.

D. Hardboard: Tempered Grade, conforming to standards of American Hardboard Association or PS-50; use smooth side exposed.

E. Particle Board: Not permitted.

2.04 HARDWARE

A. Comply with requirements of BHMA A156.9, Type 2 (Institutional).

B. Finishes:
   1. Exposed Items: Satin stainless steel, 630, complying with ANSI/BHMA A156.18.
   2. Concealed Items: Manufacturer's standard finish, complying with applicable product class of ANSI/BHMA A156.9.

C. Hinges: Provide two per door up to 36 inches high, three per door over 36 inches high.
   1. Totally Concealed, Free Swinging: Häfele #329.06.602 or 611 or equal.
   2. Totally Concealed, Self-Closing: Häfele #329.07.609 or 618, or equal.

D. Drawer Slides: Accuride, Knape & Vogt, or accepted equal. Provide two per drawer.
   1. Type:
      a. Full depth of drawers; quiet type with nylon ball-bearing rollers; positive pull-out stop.
      b. Side mounted, lift out, full extension.
   2. Capacity, per Pair: Not less than 100 pounds.
   3. In addition to capacity, slides shall be sized in accordance with manufacturer’s recommendations for drawer width.

E. Pulls:
   1. Type: To be determined by District’s Design Consultant.
   2. Quantity: One for each door or drawer, two for each drawer 30 inches or wider.

F. End Supported Shelf Supports: Right angle clips with quake hole for insertion into 1/4-inch holes, nickel finish; RPC, or equal.

G. Locks: CompX National #C8703/8704, or equal.
   1. Locations: To be provided by District’s Design Consultant.
   2. Cylinders to be keyed into door keying system specified in Section 08 71 00, “Door Hardware.”

H. Bumper Pads (Silencers): Hemispherical, quiet clear type, 55 Shore A hardness; 3M Bumpon Protective Products, or equal.

2.05 FABRICATION

A. Construction and assembly shall be in accordance with NAAWS requirements for wood casework including casework requirements of Appendix.

B. Grade: NAAWS Premium Grade.

C. Carcass Construction: Type A frameless. Provide as single unit at open shelving.

D. Door and Drawer Front Style: Flush overlay, NAAWS Style A. Drawer and door panel edges shall be square.

E. Edge Profiles:
   1. Shelves: Square, with thick applied matching hardwood band.
   2. Door and Drawer Edge Profile: Square edge with thin applied band of matching veneer.

F. Shelf Supports: To be determined by District's Design Consultant.

2.06 SHOP FINISHING

A. General:
   1. Coatings shall be shop applied and comply with NAAWS Premium Grade requirements.
   2. Surfaces of which are not exposed to view at any time and abut walls or floor shall be thoroughly back painted with one heavy coat of finishing material in shop.

B. Wood Veneer:
   1. Veneer Layup on Exposed Surfaces: To be determined by District's Design Consultant.
   2. Veneer faces shall be glue spliced. Stitched faces will not be accepted.
   3. Veneer matching shall be continuous across doors, drawer fronts, and panels.

C. Transparent Finish: CAB-acrylic lacquer; Sherwin Williams CCF23 or equal.
   1. Stain: To be finalized by District's Design Consultant and to match District's control sample.
   2. Vinyl Sealer: As recommended by finish coating manufacturer.
   3. Sheen: To match control sample.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cabinetwork plumb and level and in conformance with requirements of NAAWS Standard and as shown.

B. Install sealant as specified in Section 07 92 00 "Joint Sealants," as required to close any small unavoidable gaps between casework and abutting surfaces.

C. Damaged, stained, scratched, or otherwise disfigured portions of the work shall be touched up, refinished, or replaced to satisfaction of the District's Design Consultant.

END OF SECTION

SECTION 07 13 55

BELOW-GRADE SHEET MEMBRANE WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Self-adhered and composite sheet below grade waterproofing membrane systems.
   2. Drainage composite panel/protection course.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work of trades performing work in and around the waterproofing that precedes, follows, or penetrates the waterproofing including responsibility for installation of penetration seals.
   2. Coordinate installation requirements of concrete reinforcing steel at horizontal surfaces with waterproofing work including restriction on use of chair supports.
   3. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than recommended by the manufacturer.

B. Pre-Installation Meeting: Approximately 10 working days prior to scheduled commencement of waterproofing installation, conduct a site meeting to review materials, procedures, schedules, and other requirements and conditions related to installing waterproofing. Attendees in addition to Design Builders shall include the following as applicable to the respective waterproofing system:
   1. Waterproofing installer
   2. Reinforcing steel installer
   3. Concrete installer
   4. Installers of items penetrating waterproofing
   5. District’s third part inspector
   6. Preparer of substrate to receive waterproofing.
   7. Installers of other work in and around waterproofing that must precede, follow, or penetrate waterproofing (including mechanical and electrical installers as applicable.
   8. District’s Design Consultant
   9. Waterproofing manufacturer's representative

1.03 ACTION SUBMITTALS

A. Shop Drawings: Manufacturer’s details of penetrations, terminations, and key plan showing typical location of each detail for conditions not shown on the Drawings. Manufacturer’s standard details shall be modified, as required, to represent actual project conditions.

B. Product Data:
   1. Manufacturer's descriptive data for each proposed product.
   2. Sample warranty.

1.04 INFORMATIONAL SUBMITTALS

A. Installer Qualifications: Letter from waterproofing system manufacturer certifying that installer is approved, authorized, or licensed by manufacturer to install specified waterproofing system.

1.05 CLOSEOUT SUBMITTALS

A. Statement of Application: Upon completion, submit written statement signed by Design Builder, manufacturer's technical representative and applicator, stating that waterproofing system complied with the Drawings and Specifications, and that installation methods complied with manufacturer's printed instructions and were proper and adequate for conditions of installation and performance.

B. Extended warranty.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Trained and approved by manufacturer of waterproofing materials, and eligible to receive manufacturer's warranty.

B. Manufacturer Responsibilities: A representative of manufacturer of primary waterproofing materials shall provide field instructions and supervision for installation of system, prior to start of installation.

C. Independent Testing Agency: Provide a qualified third part inspection agency approved by manufacturer and experienced in observation and inspection of waterproofing systems.

D. Single Source Responsibility:
   1. To assure a complete and coordinated monolithic envelope, resistant to hydrostatic pressure between subgrade construction and earthwork, all below grade systems shall be installed under the direction supervision of the same waterproofing subcontractor.
   2. Materials used in conjunction with the membrane waterproofing system shall be manufactured by or acceptable to the membrane waterproofing material manufacturer for use on this Project.

1.07 FIELD CONDITIONS

A. Comply with the ambient installation conditions required by manufacturer for each waterproofing system.

1.08 PROTECTION

A. Take and maintain necessary preventative measures to protect work of this Section from damage until Project is accepted.

1.09 WARRANTY

A. Design Builder: Furnish District with a written 20-year warranty for waterproofing system, agreeing to repair or replace waterproofing that leaks water, deteriorates, or otherwise fails to perform as required within warranty period as a result of failure of materials or workmanship, at no expense to the District.

B. Manufacturer: Furnish District with an executed copy of waterproofing system manufacturer's standard 20-year "Membrane System Warranty," with a no-dollar-limit penal sum.
   1. Warranty shall be signed by an authorized representative of the waterproofing system manufacturer.
   2. Warranty shall cover both labor and material necessary to provide watertightness, including that required to repair roof leaks caused by structural movement or standing water on roof membrane.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Products specified, unless otherwise noted are manufactured by GCP Applied Technologies. Equal products of other manufacturer's meeting the design and performance criteria of the Basis of Design products shall be submitted for approval by the District's Design Consultant. All references to products by Grace Construction Products shall be construed to include the words "or equal."

2.02 PRIMARY MEMBRANE MATERIALS

A. Modified Bituminous Sheet Waterproofing: A cold-applied, self-adhering, preformed membrane, 0.060 inch thick with a 0.004 inch thick polyethylene film coated on one side with a layer of adhesive-consistency rubberized asphalt; "Bituthene 4000."

B. Bonded Sheet Membrane at Horizontal Locations and Vertical Locations as Shown on the Drawings: Pre-applied, self-adhering, preformed 0.032 inch thick membrane with high-density polyethylene (HDPE) film and coated on one side with a layer of synthetic adhesive; "Preprufe 200."

2.03 ACCESSORY MATERIALS

A. Prefabricated Drainage Composite and Protection Course: Preformed 0.433 inch (11 mm) thick geocomposite drainage sheet system comprising a hollow studded polystyrene core, covered on one side with a nonwoven, needle punched polypropylene filter fabric and on the other side with a smooth polymeric film "Hydroduct 220."

B. Drainage Composite Tape for Post-applied Applications: "Hydroduct Tape."

C. Tieback Covers: Two-part cover used to maintain waterproofing integrity at soil retention tieback heads; "Preprufe Tieback Covers" which consist of both rigid plastic dome cover sized over tieback head and subsequent "Preprufe" dome cover.

D. Termination Bar: Stainless steel, 20 gage, 6 inches wide.

E. Fasteners, Sealants, Mastics, Primers, Cleaners, Adhesives, and Other Accessories: Provide as recommended by waterproofing membrane manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces to receive waterproofing are in condition acceptable to manufacturer's requirements.

B. Verify that pipes and other penetrations have been installed and securely attached.

3.02 PREPARATION OF SURFACES

A. Follow recommendations of sheet membrane waterproofing material manufacturer.

B. Mask off adjoining surfaces not to receive waterproofing.

3.03 INSTALLATION AT BACKFILLED CAST-IN-PLACE CONCRETE WALLS

A. Comply with manufacturer's installation instructions.

B. Cut membrane to fit snugly around penetrations. Completely fill any space between the penetration and membrane edge.

C. Terminate at grade with metal termination bar fastened 12 inches on center. Cover top edge of membrane with 1/2-inch thick and 2-inch wide layer of liquid membrane.

D. Inspect finished installation and repair any damaged material prior to protection board placement and backfilling. Assure that membrane and protection board are not displaced during backfill or soil compaction.

3.04 INSTALLATION AT HORIZONTAL APPLICATIONS

A. General:
   1. Install waterproofing system in accordance with manufacturer's procedures, recommendations and approved shop drawings loose laid over stable, compacted, and smoothed subgrade extending vertically 12 inches along the perimeter of the slab area.
   2. When slab is poured in sections, extend membrane at least 12 inches beyond slab edge so that it can be properly overlapped at subsequent pours.

B. Closely following membrane placement, clean membrane surface of dust, soil and other contaminants.

C. Penetrations: Waterproof penetrations using HDPE membrane, lap tape, and liquid waterproofing membrane as applicable and in accordance with system manufacturers instructions.

D. Examine in-place materials and repair damaged areas immediately before placing concrete.

3.05 MOLDED SHEET DRAINAGE PANEL INSTALLATION

A. Install drainage board in accordance with manufacturer's instructions including seaming, lapping filter fabric, and top termination.

B. Terminate bottom of the drainage board with specified base drain and outlet connection as shown.

C. At top termination, wrap the filter fabric over the top of the core and fasten.

3.06 BLINDSIDE WALL APPLICATION

A. General:
   1. Confirm that vertical surfaces to receive waterproofing system conform to manufacturer's requirements as applicable to the earth retaining system prior to commencing work.
   2. Install 1/2 inch thick asphaltic protection board over the shoring before installing waterproofing membrane.
   3. Ensure that membrane starter strip is installed to retaining system prior to placement of concrete over the horizontal membrane.
   4. Install waterproofing system in accordance with manufacturer's procedures, recommendations and specific project application instructions as applicable to the work.

5. Place membrane in a manner to ensure minimum handling. Fit closely to, and seal around penetrations and other projections.

B. Effect temporary termination at the top of the earth retention by folding excess material and tacking in place.

3.07 FIELD QUALITY CONTROL

A. Design Builder shall ensure that waterproofing installer is present during concrete placement to monitor work over the membrane and repair any damage to membrane prior to being covered with concrete.

B. Provide for site visits by qualified manufacturer's representative at times appropriate to the progress of the Work to observe the Work, provide advice and guidance to the waterproofing installer, and as required to certify acceptance in writing of the completed work as part of specified warranty.

END OF SECTION

SECTION 07 19 00

WATER REPELLENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fluid-applied water repellent coating for exterior architectural concrete, stone veneer, and exterior porcelain tile.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preconstruction Meeting: Prior to starting work, Design Builder shall arrange a site meeting with the manufacturer's technical representative and District's Design Consultant to examine surfaces to be treated, mockup location, and conditions under which water repellent will be applied.

1.03 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications, installation instructions, and general recommendations for water repellent coating material.

B. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Applicator qualifications.

B. Inspection report by manufacturer's representative indicating quantity of water repellent required and noting conditions of substrate which might affect application or performance of coating.

C. Post-application inspection report by manufacturer's representative, verifying work has been applied in compliance with specifications and manufacturer's written instructions.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Approved by manufacturer; with successful experience in application of water repellent of types to be used for at least 5 years.

B. Mockup:
   1. Treat each substrate at site, in accordance with water repellent manufacturer's recommendations.
   2. Coordinate size and location with the District's Design Consultant.
   3. Manufacturer's representative or designated representative shall review technical aspects; surface preparation, application, and workmanship of mockup.
   4. Allow water repellent to fully cure 5 to 7 days.

5. Conduct a RILEM Tube absorption test on cured mockups to verify that surface will repel moisture effectively. Adjust application rate and technique until required repellent performance is achieved.

1.06 AMBIENT CONDITIONS

A. Do not apply in rain or when rain is expected within 4 hours.

B. Do not apply above 96 degrees F, below 40 degrees F, or when temperatures are expected to fall below 40 degrees F within 4 hours.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE REQUIREMENTS

A. Water repellent shall not darken, stain, or discolor substrate.

B. Water repellent shall not change reflectivity of substrate by having a sheen or a gloss when dry.

C. Water repellent shall reduce water absorption of treated substrate to less than 25 percent of water absorbed by an untreated sample of the same material in a 24-hour water-absorption test.

D. Repellent shall be VOC compliant and meet applicable BAAQMD air quality regulations.

E. Stone and concrete surfaces shall be tested for moisture content in accordance with manufacturer's instructions to ensure that surface is sufficiently dry.

F. Do not apply water repellent to stone until mortar and grout has cured at least 30 days.

G. Apply sprayed material in such a way that it will not drift to other surfaces.

2.02 MATERIALS

A. Water-Repellent Coatings: High-performance, clear, VOC compliant, water-borne, by BASF as specified and the basis of design, or equal.
   1. Dense Stone: “MasterProtect H 177."
   2. Porous Stone: "MasterProtect H 185."
   3. Concrete: "MasterProtect H 200."

B. Application Equipment: Low-pressure airless sprayer and hoses as recommended by manufacturer. Pump shall not atomize material.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean and prepare substrates in accordance with manufacturer's instructions. Surfaces shall be clean, dry, structurally sound, and free of alkali and efflorescence.

B. Protect adjoining work from spillage or overspray. Cover nearby aluminum and glass where required.

3.02 INSTALLATION

A. Apply an initial mist coat of sealer immediately before application to help break surface tension, ensuring maximum penetration of sealer.

B. Apply a heavy saturation spray coating of water repellent using low-pressure airless spray equipment to properly cover surface and in accordance with water repellent manufacturer's instructions and recommendations.

C. Provide additional coat if recommended by manufacturer for Type of surface. Application of the second coat shall proceed with a wet-on-wet application.

END OF SECTION

SECTION 07 21 17

THERMAL BOARD AND BLANKET INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Batt insulation at exterior framed walls.
   2. Below grade board insulation.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications and installation recommendations for each type of insulation required.

B. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 QUALITY ASSURANCE

A. Thermal resistance factors (R-values) listed are aged values tested in accordance with ASTM C518 at 75 degrees Fahrenheit and 50 percent relative humidity for at least six months.

B. Regulatory Requirements:
   1. Insulation shall be certified by manufacturer to comply with state standards for insulating materials.
   2. Insulation shall comply with Flame Spread Rating and Smoke Density requirements of CBC Section 707.3.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Products shall be delivered to jobsite with labels clearly identifying manufacturer, contents, brand name, applicable standard, and R-value.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Sustainable Design: To be determined by District’s Design Consultant.

2.02 BLANKET INSULATION

A. Faced Miner-Fiber Blankets: Lightweight fiberglass, Kraft faced, formaldehyde free, conforming to ASTM C665 Type II, Class C, Category 2; Owens Corning “EcoTouch Insulation with Pure Fiber Technology,” or equal.
   1. Thickness and Insulating Values: Refer to wall assemblies on Architectural Drawings.
   2. Certification: “GREENGUARD” certified to be formaldehyde free.

2.03 BOARD INSULATION

A. Rigid Board Below Grade: Extruded polystyrene foam board complying with ASTM C578, Type VI; "Foamular 400" by Owens Corning Foam Insulation, LLC, or equal.
   1. Edge Condition: Square.
   2. Minimum Compressive Strength: 40 psi.
   3. Water Absorption: 0.3 percent by volume, maximum in accordance with ASTM C272.
   4. Board Thickness: 2 inches.

2.04 ACCESSORIES

A. Sill Sealer: Self-adhesive air and moisture barrier; “Triple Guard Energy Sill Sealer” by Protector Wrap, or equal.

B. String Wires for Batts: Minimum 18 gage galvanized steel wire.

C. Additional Fastenings, Straps, Adhesives, and Accessories: As acceptable to insulation manufacturer and required to secure insulation in place.

PART 3 - EXECUTION

3.01 INSTALLATION OF THERMAL BLANKETS

A. Install to fill all typical and odd spaces completely in framing where required, other than providing air space where indicated.

B. Install snugly between framing members with facing to building interior. Provide straps to prevent sagging at vertical applications exceeding 8 feet, and netting at horizontal applications, to prevent sagging. If faced batts have tabs, tape tabs to metal studs to prevent sagging.

C. Trim to required height and width in place.

D. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations. Split blankets around wires as required.

E. Shim space between framing and window and door jambs shall be filled solid with unfaced batt or foam-in-place insulation. Fill spaces completely to a uniform monolithic density without voids.

3.02 FIELD QUALITY CONTROL

A. Prior to applying overlying materials, obtain by observation District’s Design Consultant of insulation installation.

3.03 PROTECTION

A. Where coordination with other Sections is not practical, protect insulation by temporary covering or enclosure.

END OF SECTION

SECTION 07 46 46

FIBER-REINFORCED CEMENT SIDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: The following exterior cementitious products.
   1. Panel siding.
   2. Battens and trim.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-construction Conference: Design Builder, installer, and District's Design Consultant shall meet prior to beginning siding installation to review and finalize installation methods and procedures.

1.03 ACTION SUBMITTALS

A. Product Data: Manufacturer's recommended installation details and technical literature describing cementitious products, shop-applied coatings, and installation recommendations.

B. Samples:
   1. Panels, 6 inches by 12 inches minimum.
   2. Typical trim, 12 inches long.
   3. Exposed fasteners.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Certification that materials meet specified requirements.

1.05 CLOSEOUT

A. Extended warranty.

1.06 GUARANTY AND WARRANTY

A. Manufacturer: Furnish District with fiber cement manufacturer's non-pro-rated 30-year product warranty against manufacturing defects:

B. Design Builder: Furnish District with a 3-year extended guarnaty against defects in installation of manufactured fiber cement products.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Products shall not contain asbestos and shall be non-combustible when tested in accordance with ASTM E136.

B. Panels shall comply with ASTM C1186, Grade II, Type A.

2.02 MANUFACTURER

A. Cement Siding and Trim: James Hardie Building Products, Inc. as specified and basis of design, or equal.

2.03 CEMENT SIDING

A. Siding Panels:
   1. Type: “HardiPanel” Vertical Siding.
   2. Surface Texture: “Smooth.”
   3. Thickness: 5/16 inch.
   4. Panel Size: 4 feet wide by 8 feet long.

B. Trim and Battens:
   1. Type: “Harditrim XLD.”
   2. Surface Texture: “Smooth.”
   3. Thickness (Actual):
      a. Typical: 1 inch.
      b. Secondary Battens: 3/4 inch.
   4. Widths: Manufacturer’s standard widths.
   5. Length: 10 feet, unless otherwise standard with manufacturer.

C. Factory Finish on Cement Siding and Trim: Products shall factory sealed and primed.

2.04 ADDITIONAL MATERIALS

A. Fasteners: Stainless steel or hot-dip galvanized in accordance with ASTM A153 and of type as recommended by siding manufacturer.
   1. Length: As recommended by panel manufacturer for blind nailing and to penetrate sufficient depth into framing.
   2. Electro-galvanized and aluminum fasteners are not acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fiber-cement products shall be installed and finished in accordance with manufacturer's printed instructions and as required to maintain product warranty.

B. Field Prime-Painting:
   1. Seal all cut edges of factory-primed siding panels prior to installation.
   2. Siding visible in completion installation shall be back-primed.

C. Panels shall run full height of wall without horizontal joints unless wall height exceeds maximum available panel length. Location of horizontal joints, if required, shall be approved by the District's Design Consultant.

D. Panels, siding, and trim shall be field finish-painted as specified in Section 09 90 00, "Painting and Coating."

END OF SECTION

SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Modified bituminous roofing over wood roof deck.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Not less than one week prior to installation of roofing and associated work, Design Builder, District's Design Consultant, manufacturer's representative, roofing installer, sheet metal installer, and other installers whose work may affect quality of roofing shall meet at the Project site to coordinate related requirements and waterproofing work.
   1. Notify participants at least 2 working days before conducting meeting.
   2. Review construction documents and approved submittals; the schedule of work; existing conditions; base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system; and details of the work.
   3. Furnish a copy of record to each participant.

1.03 ACTION SUBMITTALS

A. Product Data:
   1. Manufacturer's published specifications for products to be used in roofing system and installation instructions.
   2. Sample copy of standard roofing system manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.

B. Sample:
   1. 12 inch square of finish ply sheet.
   2. 12 inch square of flashing sheet.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Certificates, signed by roofing system manufacturer, certifying that roofing system being proposed complies with specified performance requirements.

B. Statement of installer qualifications, if requested by District's Design Consultant.

C. Inspection reports by representative of roofing system manufacturer.

1.05 CLOSEOUT SUBMITTALS

A. Specified warranties.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primary roofing products, including each type of sheet, supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.

B. Installer Qualifications:
   1. Trained and approved by manufacturer of roofing materials.
   2. Workmen shall be skilled and experienced in installing the type of roof specified.
   3. Installer shall maintain a full-time supervisor/foreman at the jobsite during times that roofing work is in progress. Supervisor/foreman shall have a minimum of 5 years' experience in roofing work similar in nature and scope to work of this Project.

C. Design Builder-Applicator-Manufacturer Review: Design Builder and applicator shall review the Drawings and Specifications with agent of primary built-up roofing materials manufacturer and obtain written agreement, without exception, that selected systems are proper, compatible, and adequate for application shown and that conditions and details do not conflict with manufacturer's roofing and flashing warranty.

D. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials, and exercise care in ensuring that the finished application is acceptable to District and District’s Design Consultant.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers, with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original, undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Reject compromised or damaged materials and materials exhibiting signs of prolonged storage. Remove rejected materials from the jobsite on a daily basis and isolate from acceptable materials.

D. Protect roof insulation from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. All materials stored on the roof overnight shall be stored on pallets. Comply with insulation manufacturers written instructions for handling, storing, and protecting during installation.

E. Handle and store roofing materials in such a manner as to preclude damage and contamination with moisture or foreign matter, and place equipment in such a manner as to avoid permanent deflection of deck.

F. Comply with fire and safety regulations. Provide newly tagged fire extinguishers of the proper type and size in the rooftop work area and within 20 feet of each location where torches are used.

G. Fire Safety:

1. Persons handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractors Association (NRCA), and follow torch safety practices as required by the Design Builder's insurance carrier.
2. Design Builder shall designate one person on each crew to perform a daily fire watch. The designated person shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.

1.08 FIELD CONDITIONS

A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements. Do not apply roofing materials during precipitation or in the event there is a possibility of precipitation during application.

B. Protection:
1. Protect building surfaces, sidewalks, and surrounding work from damage by roofing materials and operations. Clean, repair, or replace damaged work.
2. Provide watertight seals at perimeter of work and at penetrations through the work daily. Remove such seals before continuing with roofing work.
3. Water entry and resulting damage to building, its contents, or to partially completed roofing work shall be deemed the responsibility of the Design Builder.
4. Prevent materials and debris from entering and clogging roof drains.
5. Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.

1.09 WARRANTY

A. Design Builder: Provide a written 5 year warranty for roofing system, agreeing to repair or replace roof that leaks water, deteriorates, or otherwise fails to perform as required within warranty period as a result of failure of materials or workmanship, at no expense to the District.

B. Manufacturer: In addition to Design Builder's warranty, submit executed copy of roofing system manufacturer's standard 20 year "labor and materials warranty" with a no-dollar-limit penal sum.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Roofing system, base flashing, and interface with other specified items shall be watertight; shall not permit passage of liquid water; and shall withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Roofing materials shall be compatible with one another and with other specified materials under conditions of service and installation required.

C. Membrane, base flashings, and component materials shall meet requirements of FM 4450 and FM 4470 as part of a roofing system and shall be listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable.

D. Installed system shall meet FM I-90 Windstorm Classification rating.

E. Exterior Fire-Test Exposure: Class A.

F. Comply with recommendations of the NRCA roofing manual, including any conditions not indicated on the Drawings.

2.02 SBS MODIFIED BITUMINOUS ROOFING SYSTEMS

A. Products and System: To be determined by District's Design Consultant..

2.03 OTHER MATERIALS

A. Cants: Preformed fiberboard, ASTM C208.
   1. Vertical Height above Roof Plane: 3 inches minimum and 4 inches maximum.
   2. Maximum Face Incline: 45 degrees to roof plane.

B. Base Sheet Fasteners: As approved by roofing membrane manufacturer and compatible with the specified wind uplift rating.

C. Sheet Metal Flashing, Edge Metal, and Trim: As provided or recommended by roofing system manufacturer and conforming to requirements of Section 07 62 00, "Sheet Metal Flashing and Trim."

D. Sealants and Calking: As recommended by roofing membrane manufacturer.

E. Walkway Surface: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface.

F. Miscellaneous Accessories and Materials: Provide primers, protection sheets, slip sheets, pourable sealers, membrane flashings, preformed cone and vent sheet flashings, pipe boots, and other accessories compatible with roofing membrane and recommended by roofing system manufacturer for specified system, fire resistance, and warranty.

2.04 FLASHING MEMBRANE SYSTEMS

A. Flashing Membrane Assembly: Prefabricated, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane with a continuous, channel-embossed metal-foil surfacing. The finish ply shall conform to ASTM D6298.
   1. Basis-of-Design: To be finalized by Design-Build Firm.

B. PMMA Penetration Flashing System (Catalyzed Acrylic Resin): A specialty flashing system consisting of a liquid-applied, fully reinforced, multi-component acrylic membrane installed over a prepared or primed substrate. The flashing system consists of a catalyzed polymethyl methacrylate primer, basecoat and topcoat, combined with a non-woven polyester fleece. The use of the specialty flashing system shall be specifically approved in advance by the membrane manufacturer for each application.
   1. Basis-of-Design: To be finalized by Design-Build Firm.

C. System Accessories:
   1. Elastomeric Sealant: A moisture-curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials.

2. Cleaning Solution/Solvent Resin Accessory: A clear solvent used to clean and prepare transition areas of in-place catalyzed resin to receive subsequent coats of resin and to clean substrate materials to receive resin.
3. Preparation Paste Resin Accessory: A PMMA-based paste used for remediation of depressions in substrate surfaces or other irregularities.

2.05 ROOFING ACCESSORIES

A. Bituminous Cutback Materials:
1. Primer for Self-Adhesive Sheets: A quick drying, low-VOC, water-based, high-tack primer specifically designed to promote adhesion of roofing and waterproofing sheets to approved substrates. Primer shall meet Bay Area Air Quality District and Ozone Transport Commission requirements.
2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs, if used, shall be removed when no work is taking place or when rain is forecast.

C. Provide temporary seals in order to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast.

D. Protect adjacent construction from damage during roofing operations.

3.02 ROOFING INSTALLATION

A. Apply base sheet and roofing membrane in accordance with roofing system manufacturer's instructions.

B. Visual Considerations: Construction of an aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. synthetic chips), and exercise care in ensuring that the finished application is acceptable to the District.

C. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

D. Apply all layers of roofing free of wrinkles, creases or fishmouths, and perpendicular to the slope of the deck.

3.03 FIELD QUALITY CONTROL

A. If defective or deficient work is observed, the District reserves the right to require the Design Builder to stop additional work until such defect or deficient work is corrected.

B. Upon completion of installation, a representative of roofing membrane manufacturer shall inspect in order to verify that roofing system has been installed in accordance with manufacturer's approved specifications and details.

3.04 PROTECTION

A. Protect roofing system from damage and wear during the remainder of construction period.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sheet metal for maintaining weather and water resistance of building enclosure
   2. Edge roof flashing.
   3. Rain drainage.
   4. Sealant work related to sheet metal flashing and trim.
   5. Requirements for miscellaneous sheet metal integral with products and systems included under other Sections.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Fully detailed, large-scale drawings of all specially fabricated sheet metalwork. Identify material, thickness or weight, and finish.

B. Product Data: Manufacturer's catalog cuts for manufactured items including roof vents and reglets.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification of fabricator, if requested by District’s Representative.

1.04 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installer shall have at least 5 years’ documented experience in installation of sheet metal flashing and trim on projects of size and scope similar to this project.
   2. Workers shall be skilled and experienced in installing the type of sheet metal specified.

B. Mockups:
   1. First installed example of each installation condition, if not illustrated by building mockup, shall serve as a mockup for review and approval by District’s Design Representative of workmanship, fit, and interface with adjacent construction.
   2. If requested, make modifications to mockups without additional charge to District.
   3. Do not proceed with remainder of installation until mockups have been approved.

1.06 FIELD CONDITIONS

A. Installation shall not proceed if an unusual condition is discovered or that will preclude work to be performed in accordance with the Drawings and Specifications. Design Builder shall immediately report this finding to the District's Representative for discussion and resolution.

1.07 GUARANTY AND WARRANTY

A. Design Builder: Furnish District with a written 2-year guaranty agreeing to repair or replace work that fails in materials or workmanship. Failure includes failure to perform as specified and/or deterioration of finish or construction in excess of that to be expected under normal weathering.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Industry Standards:
   1. Conform to applicable provisions of the "Architectural Sheet Metal Manual" of the Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA Manual), except where more stringent requirements are specified or shown.
   2. Conform to applicable provisions of NRCA "Roofing and Waterproofing Manual."

B. Installed flashing and sheet metalwork shall be weathertight.

C. At roofing applications, comply with specified standards as applicable. Roof edge flashing shall comply with ANSI/SPRI ES-1 and FM 1-90.

D. Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement resulting from the maximum ambient and surface temperatures expected, and exposure to weather without failure due to defective manufacturer, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

E. Provide materials that are compatible with one another under conditions or service and application required, as demonstrated by testing and field experience.

2.02 SHEET METAL

A. General:
   1. Thickness: As required by SMACNA for specific conditions and as shown on Drawings but not less than 24-gage.
   2. Thickness at continuous cleats shall be minimum 20-gage.

B. Metallic-Coat Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
   1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, Z275 (G90) coating designation; structural quality.
   2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, Class AZM150 coating designation, Grade 275 (Class AZ50 coating designation, Grade 40); structural quality; "Zincalume," "Galvalume," or "Zintro-Alum" manufactured under license from BIEC International, Inc., Vancouver, WA.

C. Aluminum: ASTM B209, alloy 3003, 0.025 inch thick, except as otherwise indicated or required by SMACNA.

D. Stainless Steel:
   1. Sheet: ASTM A240 / A240M or ASTM A666, Type 304, dead soft, fully annealed.
   2. Finish: 2D (dull, cold rolled).
   3. Thickness: 24 gage unless otherwise noted on the Drawings.

2.03 ADDITIONAL MATERIALS AND COMPONENTS

A. Fasteners: Hot-dip galvanized or 300 series alloy stainless steel.
   1. Pop rivets, made from same type material as metals to be fastened, may be used for metal-to-metal connections when future disassembly is not required and where not exposed to view.
   2. Provide stainless steel/EPDM washers at exposed fastener locations.

B. Solder:
   1. For Stainless Steel: ASTM B32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
   2. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

C. Slip Sheet:
   1. Rosin-sized, unsaturated building paper, 4-6 pounds per 100 square feet; FS UU-B-790, Type I, Grade A.
   2. Inorganic, high-performance, non-woven, non-perforated, spunbonded polyolefin; DuPont “Tyvek CommercialWrap.”

D. Pressure Bars and Termination Bars: Stainless steel or aluminum.

E. Draw Bands: Type 316 stainless steel sheet with Type 316 stainless steel screw.

F. Sealants:
   1. Exposed Joints: Low modulus, high performance, one-part polyurethane; Type JS-1.
   2. Concealed Joints: Sealant Type II, ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy-bodied for hooked-type expansion joints with limited movement.
   3. Concealed Sealant Tape: Sealant Type IV; pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, ton-toxic, non-staining tape 1/2 inch wise x 1/8 inch thick.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

2.04 FINISHES

A. Sheet metal shall be pretreated and factory primed for field painting.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Comply with details and profiles indicated on Drawings and SMACNA "Architectural Sheet Metal Manual" recommendations for installation of the work.
   2. Conceal fasteners, except those specifically indicated on the Drawings to be exposed.
   3. Conceal reinforcement within finished assembly.
   4. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, slip sheet, or other permanent separation as recommended by SMACNA.
   5. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated, and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

B. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.02 FIELD QUALITY CONTROL

A. Maximum Deviation from Alignment When Erected: 1/4 inch in 20 feet.

B. District may hire an inspector perform inspections and prepare reports to confirm that installed work complies with specified requirements.

C. Remove and replace system components where inspection or test results indicate that work does not comply with specified requirements.

D. Additional testing and inspection may be required to verify that replaced or additional work complies with specified requirements.

END OF SECTION

SECTION 07 65 00

FLEXIBLE FLASHING AND UNDERLAYMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sheet underlayment (building paper) and weather barrier under cement plaster.
   2. Sheet membrane underlayment at exterior wall cladding.
   3. Self-adhering sheet flashing and plastic sill pan flashing at perimeter of window and louver openings, and other locations where shown.

1.02 ACTION SUBMITTALS

A. Product Data: Provide a list of materials to be used on the Project. Indicate location of use for each product.

B. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 FIELD CONDITIONS

A. Temperature of air and surfaces to receive underlayment shall be within the range recommended by system manufacturer.

B. Substrate surfaces shall be dry at application.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Weather Barrier and Underlayment at Portland Cement Plaster:
   1. Weather Barrier: DuPont “Tyvek StuccoWrap WRB” or equal.
   2. Asphalt-saturated Kraft paper complying with FS UU-B-790a, Type I, Grade D, Style 2, 60 minute; "Jumbo Tex" by Fortifiber Corp. or equal.

B. Self-Adhering Sheet Underlayment under Horizontal Metal Flashings, Caps, and Copings: 30-mil-thick composite of aggressive butyl rubber based adhesive backed by a layer of high density cross laminated polyethylene; "Grace Ultra" by GCP Applied Technologies, or equal with a service temperature of up to 300 degrees F.

C. Self-Adhering Sheet Underlayment at Other Exterior Wall Conditions: 40-mil-thick composite of high-density, cross-laminated, polyethylene film, coated on one side with rubberized asphalt, with disposable release sheet; "Perm-A-Barrier Wall Membrane" by GCP Applied Technologies, or equal.

D. Self-Adhering Flashing: 40 mil thick, self-adhesive narrow width roll of rubberized asphalt integrally bonded to a high density, cross-laminated, polyethylene film; "Perm-A-Barrier Detail Membrane" by GCP Applied Technologies, or equal.

E. Plastic Sill Pan Flashing: High-quality, high-impact ABS plastic; “JamSill Guard” by Jamsill, Inc.; “Sure Sill Slopped Sill Pan” by SureSill, Ltd., “EZ-Pan” by Carlisle Coatings and Waterproofing, or equal.

2.02 ACCESSORIES

A. Mechanical Fasteners: Washer-type, as recommended by membrane manufacturer for attachment to substrate.

B. Penetration Flashing: Quickflash Weatherproofing Products, Inc., or equal.

C. Sealant for Flexible Flashing and Underlayment: Sealing mastic as provided or recommended by membrane manufacturer.

D. Additional Accessories: Provide as recommended by manufacturer for conditions of installation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prime substrates with primer suitable for each substrate and recommended for this use by membrane manufacturer.

3.02 INSTALLATION OF PAPER UNDERLAYMENT AT PORTLAND CEMENT PLASTER

A. Apply two layers of single-ply underlayment over substrate or one layer if a two-ply underlayment is used.
   1. Securely staple to substrate.
   2. Apply horizontally over entire surface in shingle fashion, lapping courses minimum 3 inches.
   3. Stagger vertical joints.
   4. Stagger joints between layers.
   5. Lap vertical joints minimum 6 inches.

B. Holes and tears shall be sealed with sealant or tape using products recommended by underlayment manufacturer.

3.03 INSTALLATION OF SELF ADHERING FLASHING AND UNDERLAYMENT

A. Install in accordance with manufacturer’s recommendations including overlapping of side and end seams.

B. At vertical surfaces, apply strips vertically.

C. Install 18 inch wide strip of flashing over paper underlayment at internal and external plastered building corners. Saddle over top of parapets and walls. Weather-lap ends 6 inches minimum and side laps a minimum of 3-1/2 inches.

D. Flashing at Openings: Comply with details and recommendations of manufacturer.

E. Patch tears and inadequately lapped seams.

F. Provide mechanical fasteners where recommended by membrane manufacturer. Fastener heads shall be sealed with liquid membrane.

G. Seal all top edges of self-adhesive membrane with liquid membrane.

H. Apply overlying materials within allowable exposure time limits specified and stated in manufacturer's instructions.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Exterior sealants and calking work required to weatherproof the building.
   2. Interior sealants and calking.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications, recommendations, and installation instructions, including cleaning of joint surfaces, for each sealant material to be used.

B. Samples: Color selection for each product exposed to view; manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Statement of qualifications for applicator of exterior sealant.

B. Results of field adhesion testing.

1.04 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.05 QUALITY ASSURANCE

A. Installer Qualifications for Exterior Sealants: A firm experienced in installing sealants similar to that those indicated for this Project, with a record of successful in-service performance, and acceptable to material manufacturers.

1.06 GUARANTY AND WARRANTY

A. General:
   1. Repair or replace joint sealants that fail to achieve airtight and watertight seal or otherwise fail to perform as intended because of leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining, loss of adhesion or cohesion, or do not cure within the specified warranty periods.
   2. Extended warranties specified in this Section exclude deterioration or failure of joint sealants from the following:
      a. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

b. Disintegration of joint substrates from natural causes exceeding design specifications.
c. Mechanical damage caused by individuals, tools, or other outside agents.
d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

B. Design Builder: Furnish District with a written 2-year guaranty agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

C. Manufacturer: Furnish District with manufacturer's written 20-year warranty for sealant Types 1A and 1B agreeing to furnish sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty shall include failure due to loss of adhesion, weather seal. In addition, Type 1B sealant warranty shall include staining.
2. Design Builder shall be responsible for scheduling, arranging, and providing any print review and testing required by manufacturer as a condition for issuance of its warranty.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Material Compatibility: Sealant materials shall be compatible with one another and with other specified and existing materials, under conditions of service and application required.

2.02 SEALANT MATERIALS

A. Colors:
1. Concealed Material: Any of manufacturer's standard colors.
2. Exposed Material: Manufacturer's standard colors, to be selected by District's Design Consultant.

B. Type 1A - Sealant for General Exposed Exterior Use: One part, neutral cure, gun-grade silicone conforming to ASTM C920, Type S, Grade NS, Class 25; Dow Corning "795 Building Sealant," or equal.

C. Type 1B - Sealant for Exterior Use at Concrete and Other Porous Surfaces: Non-bleed, reduced-stain type; one part silicone conforming to ASTM C920, Type S, Grade NS, Class 25; Dow Corning "765 SMS," or equal.

D. Type 2 - Concealed Bedding Conditions: One-part butyl-rubber calk conforming to FS TT-S-001657, Type I; Pecora "BC158," or equal.

E. Type 3 - Exterior and Interior Horizontal Joints Subject to Pedestrian Traffic: Two-part polyurethane conforming to ASTM C920, Class 25, Type M, self-leveling; Pecora "Urexpan NR-201," or equal.

F. Type 4 - Interior Nonwet Areas: One-component acrylic latex water-based sealant conforming to ASTM C834; "Tremco "Acrylic Latex," or equal.

G. Type 5 - Interior Wet Areas: One-part mildew-resistant silicone rubber conforming to ASTM C920, Type S, Class 25, Grade NS; Dow-Corning "786," or equal.

2.03 MISCELLANEOUS SEALANT MATERIALS

A. Sill Sealer: 3/8-inch thick closed cell polyethylene foam with a self-adhering waterproof membrane facing; “Protector Premium Energy Sill Sealer” by Protecto Wrap Company, or equal.

B. Perimeter Gap Sealant: Gun-dispensed, aerosol foam polyurethane or polyisocyanurate type conforming to ASTM C1620; Hilti “CF 810/812,” or equal.

C. Fiber Expansion Joint Material: Preformed cellular fiber complying with ASTM D1751, 1/2 inch thick unless otherwise noted; "SealTight Fiber Expansion Joint Filler" by W.R. Meadows, or equal.

D. Additional Sealant Materials: As specified in the respective Specification Sections.

2.04 SEALANT ACCESSORIES

A. Joint Primer/Sealer: As recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B. Sealant Backer Rod: Compressible, rod-stock, polyethylene foam; non-gassing, polyethylene-jacketed polyurethane foam; butyl-rubber foam; neoprene foam; or other flexible, permanent, durable, non-absorptive, closed-cell material as recommended for compatibility with sealant by sealant manufacturer.

C. Cleaner for Nonporous Surfaces: Nonstaining chemical cleaner acceptable to manufacturer of sealer and backing materials, harmless to substrates and adjacent nonporous materials.

D. Masking Tape: Nonstaining, nonabsorbent, compatible with joint sealants and adjacent surfaces.

E. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Comply with manufacturer's printed instructions, except where more stringent requirements are shown or specified.
   2. Comply with ASTM C1193 for installation of elastomeric joint sealants.

B. Use only proven installation techniques that will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Hollow metal doors and frames.

1.02 COORDINATION

A. Hardware supplier shall furnish steel door and frame manufacturer with accepted hardware schedule, hardware templates, and samples of physical hardware where necessary to ensure correct fitting and installation. Preparation includes sinkages and cutouts for mortise and concealed hardware.

1.03 ACTION SUBMITTALS

A. Schedule: Prepare using same reference numbers as those on Drawings and coordinated with door hardware schedule.

B. Product Data: Manufacturer's technical data substantiating that products comply with specified requirements.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports for each type of fire-rated hollow metal door and frame assembly.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Steel Doors and Frames: SDI Certified manufacturer.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Steel doors and frames shall comply with ANSI A250.8.

B. Work shall meet applicable requirements of the Hollow Metal Manufacturers Association (HMMA), a Division of the National Association of Architectural Metal Manufacturers (NAAMM).

2.03 MATERIALS AND COMPONENTS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A568 and ASTM A1011.

B. Cold-Rolled Steel Sheets: Commercial-quality carbon steel complying with ASTM A568 and A1008, exposed, matte finish, oiled.

C. Galvanized Steel Sheets: Commercial-quality zinc-coated carbon steel complying with ASTM A653 with A60 or G60 zinc coating.

D. Supports and Anchors: Not less than 18-gage galvanized sheet steel.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units.

F. Shop-Applied Paint: Rust-inhibitive primer, either air dried or baked on, suitable as a base for specified finish paints.

2.04 FABRICATION - GENERAL

A. Conform to requirements of SDI or NAAMM.

B. Exterior doors and frames shall be fabricated from specified galvanized-steel sheets.

C. Welding:
1. In accordance with AWS standards for high-grade hollow metal work.
2. Grind exposed beads smooth.

D. Fabricate exposed faces of doors only from cold-rolled steel.

E. Fabricate frames from either cold-rolled or hot-rolled steel (at fabricator's option).

F. Finish Hardware Preparation:
1. Prepare steel doors and frames to receive finish hardware in compliance with ANSI A115, where applicable, and SDI-107.
2. Provide minimum gage hardware reinforcing in accordance with Table 1 of ANSI A250.6.
3. Locate finish hardware in accordance with NBHA publication "Recommended Location for Builder's Hardware," and to meet accessibility requirements.

G. Shop Painting: Comply with ANSI A250.10, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.05 STEEL FRAMES

A. Gages:
1. Interior: 16 gage unless thicker gage is included in UL test procedure for rated frames.
2. Exterior: 14.

B. Construction:
1. Exterior: Factory-assembled and weld into a single unit by frame manufacturer. Saw-miter or cope and tab frame miters, and continuously weld at return, face, rabbet, and stop.
2. Interior: Welded or knock-down.

C. Profile bottom of jamb to contour of concrete at change in floor elevation occurring within jamb width.

D. Provide door silencers except on frames to receive seals provided under Section 08 7100, “Door Hardware.” Locate three on strike jamb for single doors and four on head for pairs of doors.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk, flat Phillips or Jackson heads for exposed screws and bolts.

2.06 STEEL DOORS

A. ANSI/SDI Classification:
   1. Exterior: Level 3 and Physical Performance Level A, Model 2, extra heavy-duty seamless construction.
      a. Face sheets shall be minimum 0.053 inches (16-gage).
      b. Insulated for a minimum “U” value of 0.24 except where opening into unconditioned spaces.
   2. Interior Non-Fire-Rated, if Used: Level 2 and Performance Level B, Model 2, heavy-duty seamless construction.
      a. Face sheets shall be minimum 0.042 inches (18-gage).
      b. Core: Honeycomb laminated to the inside of both face sheets.

B. The top and bottom of out-swinging exterior doors shall be closed with a suitable cap to provide protection from entry of water inside door.

C. Provide the following door clearances in accordance with ANSI/SDI A250.8.

PART 3 - EXECUTION

3.01 INSTALLATION OF FRAMES

A. Install frames in accordance with ANSI/SDI A250.11.

B. Knockdown frames shall rigidly interlock at joints so as to provide uniform alignment of parts.

3.02 INSTALLATION OF DOORS

A. Install steel doors in accordance with manufacturer's instructions and Project requirements.

B. Adjust operable parts for correct function.

END OF SECTION

SECTION 08 14 00

WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wood flush doors.
   2. Factory preparation (premachining) for finish hardware.
   3. Factory finishing.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Submit door schedule indicating the following minimum information:
   1. Opening-identifier using same identification as on Drawings.
   2. Location and sizes of each door.
   3. Door type and grade.
   4. Elevation of each kind of door.

B. Product Data: Manufacturer's specifications for each type of wood door proposed for use on this Project. Indicate door core and edge materials and construction; veneer species, type, and characteristics; trim for openings; and factory finishing and machining criteria.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Sample of manufacturer’s warranty.

1.04 CLOSEOUT SUBMITTALS

A. Special warranty.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain wood doors from single manufacturer.

1.06 WARRANTY

A. Door Manufacturer:
   1. Submit written agreement on door manufacturer's standard form signed by manufacturer, installer, and Design Builder, agreeing to repair or replace defective doors which warp (bow, cup, or twist), which show telegraphing of core construction in face veneers, or which do not conform to tolerance limitations of specified quality standards.
   2. Include reinstallation if required owing to repair or replacement of defective doors where defect was not apparent prior to hanging.
   3. Warranty Period: Lifetime of the original installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Member of WI, AWI or WDMA.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Except as otherwise specified or standard with manufacturer, doors shall be manufactured in accordance with Section 9 of the "North American Architectural Woodwork Standards (NAAWS)," published jointly by WI and AWMAC, and referenced WDMA Standards where noted.

B. Allowable Tolerances for Fabrication of Doors: In accordance with referenced NAAWS standard.

C. Condition doors to average prevailing humidity in installation area prior to hanging.

D. Replace or rehang doors which are hinge bound and do not swing or operate freely.

E. Refinish or replace finished doors damaged during installation as directed by the District's Representative.

2.03 FLUSH DOORS

A. Door Appearance Grades:
   1. Transparent Finish: Premium.
   2. Opaque Finish: Custom.

B. Face Veneers:
   1. Doors to Receive Opaque Finish: Medium-density overlay (MDO).
   2. Doors to Receive Transparent Finish: To be determined by District's Design Consultant.

C. Cores: Solid, 5-ply, of type optional with manufacturer, in accordance with NAAWS or WDMA I.S.1-A.

2.04 DOOR FABRICATION

A. Performance Duty Level (WDMA):
   1. Typical: Heavy.
   2. Restroom and Other High Use Openings: Extra Heavy Duty.

B. Prefit and premachine doors. Comply with the tolerance requirements of NAAWS or WDMA for prefitting.

2.05 FINISHING

A. Doors shall be finished as follows:
   1. Transparent Finish:
      a. System: UV curable polyurethane or equivalent, in gloss level to match approved submittal.
      b. Provide factory finishing only; field finishing will not be permitted.
   2. Opaque Finish: Provide factory priming. Doors shall be shop or field finish painted in accordance with Section 09 9000, "Painting and Coating."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and requirements of NAAWS or WDMA Standards.

B. Door Bevel at Nonrated Doors: Bevel 1/8 inch in 2 inches.

C. Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Interior access doors in walls and ceilings.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Indicate locations of required access doors not shown on the Drawings.

B. Product Data: Manufacturer's specifications and installation instructions.

C. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metal Access Doors for Walls and Ceilings: Karp Associates Inc.as specified and the basis of design, Milcor Inc., J. L. Industries, Jay R. Smith Manufacturing, or equal.

2.02 WALL AND CEILING ACCESS DOORS AND PANELS

A. General:
1. Provide attachment devices and fasteners of type required for specific project conditions.
2. At sound-rated conditions use "fire-rated"-type doors.
3. Products specified in Division 22, 23, 26, 27 and 28 that meet the requirements of this Section are acceptable.

B. Gypsum Board Partitions – Non-rated: Karp Model KDW.
1. Style: Flanged type for flush mounting with concealed frames.
2. Frame: 16-gage galvanized steel, except as otherwise specified.
3. Door: Not lighter than 14-gage galvanized steel, except as otherwise specified.
4. Hinges: Continuous piano type or concealed spring, allowing opening to 175 degrees.

C. Gypsum Board Partitions – Non-rated, Tile or FRP Paneling: Stainless steel; Karp Model DSC-214M, or equal.
1. Trim Style: 3/4-inch wide, flush flange.
2. Frame: 16 gage.
3. Door: Not lighter than 14-gage.
4. Hinges: Continuous piano type or concealed spring, allowing opening to 175 degrees.

D. Locking Devices:
1. Nonpublic Areas: Allen key or screwdriver-operated latch.

2. Areas Accessible to Public: Key-operated cylinder lock. Provide two keys per lock and key locks alike, unless otherwise scheduled or directed by the District's Design Consultant.

E. Finish:
1. Typical: Factory-applied rust-resistant prime coat. Doors shall be field finish painted to match adjacent wall finish.
2. At Tile and FRP Paneling: Stainless steel, AISI No. 4 satin finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions for installation of access doors.

B. Set frames accurately in position. Securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

C. Adjust hardware and doors after installation for proper operation.

END OF SECTION

SECTION 08 38 00

RIGID TRAFFIC DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Double-acting stainless steel-faced doors.

B. Related Requirements:
   1. Door Hardware: Section 08 71 00.

1.02 ACTION SUBMITTALS

A. Schedule: Prepare using same reference numbers as those on Drawings and coordinated with door hardware schedule.

B. Product Data: Manufacturer's technical data substantiating that products comply with specified requirements.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

D. Product Data: Specifications, installation recommendations, and construction details, including fabrication, finishing, hardware, and other components. Data shall be specifically marked or annotated to show doors being provided for this Project including:
   1. Location and sizes of each door.
   2. Glazing.
   3. Accessories.

1.03 CLOSEOUT SUBMITTALS

A. Warranty as specified.

1.04 WARRANTY

A. Manufacturer: Provide District with manufacturer’s standard 2-year warranty for traffic doors against defects in materials and workmanship including parts replacement.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Double-Acting Door: Medium-impact, non-labeled, double-swinging, manually operated doors; by Eliason Corp. as specified, or equal.
   1. Door Sizes: As scheduled on Drawings.
   2. Construction: Wood core with 18 gauge full length stainless steel panel (both sides).
   3. Window:
      a. Size: As shown on Door Schedule.

b. Glazing: Clear acrylic.
c. Molding: Black rubber.

4. Accessories: Jam guards.

2.02 HARDWARE AND ACCESSORIES

A. Hardware: Manufacturer's standard fabricated from 11-gage steel with standard polymer-coated zinc plating.

B. Hinges: Double Action Easy Swing(r) proprietary hinges.

1. Finish: Zinc coated.

C. Door shall be provided as manufacturer's complete package, including hanging hardware and gaskets.

D. Doors shall be capable of locking with standard hardware.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Steel frames installed under Section 08 1113, “Hollow Metal Doors and Frames,” shall be set accurately in position, plumb, square, level, and in alignment and shall be securely anchored in accordance with manufacturer's directions and accepted shop drawings.

B. Install doors on metal frames with surface-applied hardware in accordance with door manufacturer's instructions.
1. Install top and bottom brackets.
2. Slip door over bottom pin, and lift door so top pod assembly rests on bearing plate.
3. Door shall be completely self-supporting.
4. Insert bolts from top, threads down, adjust door alignment, and tighten lock nuts.

C. Doors shall be hung accurately with proper clearances.

D. Final adjustment shall be made for proper and easy operation of the door. Comply with the additional requirements in Section 08 7100, “Door Hardware.”

3.02 PROTECTION AND CLEANING

A. After installation, doors and frames shall be protected from damage during subsequent construction activities.

B. Upon completion, metal surfaces shall be cleaned, following the procedures recommended by the door manufacturer.

END OF SECTION

SECTION 08 42 13

ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Aluminum and glass exterior swing entrances.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Show elevations, dimensions, member profiles, details of interface with storefront framing, reinforcement, and glazing materials and methods. Manufacturer's standard drawings modified to show clearly that actual Project conditions and proposed work are acceptable.

B. Product Data: Manufacturer's literature for each door configuration, factory-applied finish, and for hardware items provided by door manufacturer.

C. Samples: 12-inch-long section of typical stile extrusions in required width and with specified finish.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Verification of compliance with specified performance criteria if not included with product data submittal.

B. Statement of fabricator/installer qualifications, if requested by District's Design Representative.

1.04 CLOSEOUT SUBMITTALS

A. Extended Warranties.

1.05 WARRANTY

A. Manufacturer: Furnish District with the following manufacturer warranties.
   1. Entrances: 2-year extended warranty agreeing to repair or replace work that fails in materials or workmanship.
   2. Finish: 20-year extended warranty for baked on high-performance coating agreeing to replace components that show evidence of finish deterioration.
   3. Insulating Glass: as specified in Section 08 80 00, "Glazing."

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Swing Entrances: NAAMM "Medium Stile."
   1. Door Thickness: See Door Schedule on Drawings.
   2. Vertical Stiles and Top Rail: Face dimensions as standard with manufacturer.
   3. Bottom Rail Height: 10 inches.
   4. Glazing Stops: Square profile.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Design Builder shall engage a single manufacturer to assume undivided responsibility for producing aluminum-framed entrances and storefront for this Project with a record of successful in-service performance.

B. Comply with recommendations of AAMA “Aluminum Store Front and Entrance Manual” except where more stringent requirements are specified or required by applicable codes.

C. Performance Requirements:
   1. Air Infiltration, ASTM E283:
      a. Pairs of Doors: Maximum of 2.3 cfm per linear foot of perimeter crack at a pressure differential of 1.56 psf.
      b. Single Doors: Maximum of 2.0 cfm per linear foot of perimeter crack at a pressure differential of 6.24 psf.
   2. Expansion/Contraction: Provide for expansion and contraction of door components caused by a temperature range of 170 degrees F over a 12-hour period without causing detrimental effect.
   3. Meet resistance to corner racking when tested by the Dual Moment Load test.

D. Coordinate installation of aluminum entrances with storefront framing so as to produce a weatherproof and waterproof installation.

E. Weatherstripping shall be locked into extruded grooves in door frame.

F. Maximum Allowable Door Gaps:
   1. Gaps between doors and headers and doors and jambs are to be a maximum of 1/8 inch.
   2. Gaps between double doors and doors and thresholds are to be a maximum of 1/4 inch with a gap over 1/4 inch to be covered by a surface applied brush seal.

2.03 HARDWARE - GENERAL

A. Coordinate hardware and door application requirements of manufacturer with hardware supplied by Section 08 71 00, “Door Hardware.”

2.04 FINISHES

A. Exposed Aluminum: High-performance fluoropolymer coating containing 70 percent minimum polyvinylidene fluoride (PVDF) resin ("Kynar 500"/"Hylar 5000"), meeting or exceeding all the requirements of AAMA 2605 and with a pencil hardness of H-2H.
   1. Colors: Custom, as selected by District’s Design Consultant.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions and reviewed submittals. Erection shall be plumb, level, square, and in proper alignment and relationship to other work.

B. Glazing shall comply with requirements of Section 08 80 00, "Glazing."

C. Adjust entrances for proper operation of each door and its mechanical hardware.

D. Finished work shall be free of waves, buckles, dents, or other defects.

E. Touch up field abrasions and damage to factory-painted finish.
   1. Touch-up shall be unnoticeable in completed installation.
   2. Entrances with damage to finish, as determined as unacceptable by the District's Design Representative, shall be replaced at no additional cost to District.

END OF SECTION

SECTION 08 43 13

ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Aluminum storefront framing system including:
   1. Glazing.
   2. Operable windows in storefront framing.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting:
   1. Design Builder shall schedule a job meeting to review storefront work prior to installation.
   2. Conference shall be attended by District's Design Consultant, and by representatives of the Design Builder, storefront installer, and other installers whose work may affect quality of installation.

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Show elevations, dimension, member profiles, details of composite members, details of interface with other building construction, reinforcement, expansion provisions, method and location of attachment to structural system, and glazing materials and methods.
   2. Show entrances included as part of storefront system.

B. Product Data: Provide component dimensions describe components within assembly, anchorage and fasteners, glass, internal drainage details, hardware, and other components.

C. Samples:
   1. Aluminum Components: Typical 12 inch long extrusion, with specified finish.
   2. Glass and Glazing Accessories: As specified in Section 08 80 00, "Glazing."

D. Delegated Design: Provide engineering calculations by the engineer in responsible charge retained by the Design Builder to demonstrate compliance with CBC and specified performance requirements. Where specifications and code differ, the more severe requirements shall govern.

E. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Reports:
   1. Results of field water leakage tests by independent inspector.
   2. Manufacturer's reports from independent testing laboratory verifying conformance with AAMA and ASTM performance requirements specified if not included with product data.

1.05 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.06 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: Company specializing in work of this Section, with not less than 10 years' experience on jobs of similar type and complexity, and approved by manufacturer.

B. Manufacturer's Field Representative: A technical field representative of the manufacturer shall be at project site, as a minimum, at start, during middle, towards end of each of storefront installation, and during field testing.

C. Mockup: First installed bay of system shall serve as a mock-up for review and approval by District's Design Consultant of workmanship and visual effect.

1.07 WARRANTY

A. Manufacturer: Furnish District with the following manufacturer warranties.
   1. System: 2 year warranty agreeing to repair or replace work which fails in materials or workmanship.
   2. Finish: 20-year extended warranty for baked on high-performance coating agreeing to replace components that show evidence of finish deterioration.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Comply with recommendations of AAMA "Aluminum Store Front and Entrance Manual", except where more stringent requirements are specified or required by applicable codes.

B. To assure single source responsibility, swing entrances specified in Section 08 42 13, "Aluminum-Framed Entrances," shall be by same manufacturer as entrances.

C. Design Criteria for Storefront Framing:
   1. Air Leakage: Maximum 0.06 cfm/sf, ASTM E283, at differential static pressure of 6.24 psf.
   2. Water Penetration/Leakage:
      a. Static Pressure, ASTM E331: None, when subjected to water spray at 5 gallons per hour per square foot, at static pressure of 12 psf.
      b. Dynamic Pressure, AAMA 501.1: None, when subjected to water spray at 5 gallons per hour per square foot and wind from a wind generator at static pressure of 12 psf.
   3. Strength: Design system to withstand wind loads acting normal to plane of wall as required by CBC.
      a. Deflection: Maximum L/175 with full recovery of glazing materials, when measured in accordance with ASTM E330.
      b. Safety Factor: Unless otherwise specified, design parts and assemblies (including glazing stops, gaskets, adhesives, and sealants) for safety factor not less than 1.65.
   4. Energy Performance: Storefront system shall have certified energy performance ratings in accordance with NFRC standards and approved software. The following parameters shall be documented:
      a. Value for U-factor to be not more than 0.63.

b. Value for SHGC shall be as specified for the Glass Type scheduled and specified in Section 08 80 00, “Glazing.”

5. Expansion/Contraction: System shall provide for expansion and contraction within system components caused by a temperature range of 180 degrees F over a 12-hour period without detrimental effect to system components.

D. Design Criteria for Windows:
1. Conformance to C-AW80, AP-AW80 specifications in AAMA/NWWDA 101/I.S. 2/A440-8.
2. Air Infiltration: Accordance with ASTM E 283 at a static air pressure difference of 6.24 psf. Air infiltration shall not exceed .30 cfm per square foot.
3. Water Resistance: Accordance with ASTM E331/ASTM E547 at a static air pressure difference of 12 psf. No water leakage.
4. Uniform Load Structural: Aluminum window systems comply with AAMA/WDMA/CSA 101/I.S.2/A440-08, Voluntary specifications for aluminum windows. Guidelines for specified AW rated product.
5. Component testing: Accordance with procedures described in AAMA/NWWDA 101/I.S. 2/A440-08.
6. Forced Entry Resistance: All windows shall conform to CAWM 301-90.
7. Condensation Resistance Test: (CRF) when tested in accordance with AAMA 1503.1-88, the condensation resistance factor shall not be less than 51.
8. Thermal Transmittance Test: Accordance with AAMA 1503.1-88, (U-Value) not more than 0.59 BTU/hr/sf/ºF.
9. Thermal Movements: Allow thermal movement resulting from the following maximum change (range) in ambient temperature.
a. 120 degrees F, ambient; 180 degrees F, material surfaces.

E. Safety Glass Standard: Comply with CBC and CPSC 16 CFR 1201, and pass ANSI Z97.1.

F. Expansion/Contraction: System shall provide for expansion and contraction within system components caused by a temperature range of 180 degrees F over a 12-hour period without causing detrimental effect to system components.

G. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

H. Anchors, Clips, and Concealed Reinforcing; Comply with ASTM B456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B633 for SC 3 severe service conditions or other suitable zinc coating.

I. Exposed fasteners are not permitted unless unavoidable. If necessary, exposed fasteners shall be finished to match aluminum framing.

2.02 STOREFRONT SYSTEM

A. Description: Stick-fabricated, pressure-equalized, thermally broken.
1. Mullions: 2 inches by 6 inches deep.
2. Glazing: Offset, 4-side captured.
3. Finish on Exposed Aluminum: As specified below.

2.03 OPERABLE WINDOWS

A. Heavy Commercial Windows: Hinged compression sealed, non-thermal, zero-sightline, aluminum-framed windows for insertion into the aluminum storefront system.
1. Depth: 2 inches.

2. Operation: As indicated on the Drawings.

B. Hardware: As standard with manufacturer and as follows.
1. Cast white bronze cam locking handles.
2. Stainless steel 4-bar hinges.

C. Finish on Exposed Aluminum: To match storefront framing.

D. The frame and ventilator shall be factory fabricated and assembled.

E. Screens: Manufacturer's standard.

2.04 MATERIALS

A. Aluminum:
1. Extruded: ASTM B221, 6063-T5 alloy and temper, size, and shape as required by design criteria but not less than 0.125 inch thick.
2. Sheet: ASTM B209. Aluminum sheet for formed members shall be not less than 0.05 inch thick.
3. Structural: ASTM B308, 6063-T6 alloy and temper.

B. Steel: ASTM A36.

C. Glass: Insulating, as specified in Section 08 80 00, "Glazing," tempered where required by code.

D. Glazing Materials:
1. General: Materials shall achieve weather, moisture, and air infiltration requirements and comply with requirements of Section 08 80 00, "Glazing."
2. Gaskets: Elastomeric, as recommended or provided by system manufacturer.

2.05 ACCESSORIES

A. Coating for Separation of Dissimilar Metals: Cold-applied asphalt mastic, zinc chromate paint, or other nonconductive, non-absorptive material.

B. Fasteners: Aluminum, nonmagnetic stainless steel or other non-corrosive material compatible with aluminum, trim hardware, anchors, and other components.
1. Provide reinforcement where fasteners are screwed into aluminum members of less than 1/8 inch thickness.
2. Do not use exposed fasteners.

C. Anchoring Devices: Corrosion resistant type capable of supporting entrance system and superimposed design loads; design to allow adjustments of system prior to being permanently fastened in place.

D. Steel Reinforcement and Brackets: Manufacturer's standard with minimum 2 oz. hot-dip zinc coating, ASTM A123, applied after fabrication.

E. Concrete Inserts: Cast iron, malleable iron, or hot-dip galvanized steel complying with ASTM A123.

F. Miscellaneous Concealed Metal Members: Aluminum or nonmagnetic stainless steel.
   1. Members that are not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A123.
   2. Galvanized members located in internal drainage channels shall be completely coated with dissimilar metal coating.

2.06 PROTECTIVE COATINGS AND FINISHES

A. General:
   1. Perform all finishing prior to shipping to Project site.
   2. Protect against galvanic action where dissimilar metals are in contact, except in case of aluminum in contact with galvanized steel, zinc, or relatively small areas of stainless steel or nickel silver (white bronze).

B. Exposed Aluminum: High-performance fluoropolymer coating containing minimum 70 percent polyvinylidene fluoride (PVDF) resin and meeting or exceeding all the requirements of AAMA 2605.
   1. Colors: Custom, as selected by the District's Design Consultant.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install aluminum framed storefront assemblies in accordance with manufacturer's recommendations and installation requirements for weathertight installation.

B. Erection shall be plumb, level, square, and in proper alignment and relationship to other work.
   1. Maximum Variation from Plane or Location: 1/8 inch in 12 feet, with maximum 1/2 inch variation in total length.
   2. Maximum Offset between Members: 1/16 inch.

C. Install glass in accordance with Section 08 80 00, "Glazing," and manufacturer's instructions in order to achieve performance criteria.

3.02 FIELD QUALITY CONTROL

A. Field Tests: To be determined by District's Design Consultant.

B. Tests not meeting specified performance requirements and units having deficiencies shall be corrected at no additional cost to District.

C. Manufacturer's representative shall periodically inspect material and installation to insure installation is proceeding in accordance with manufacturer's recommendations and warranty requirements. Representative shall submit a written report of each visit indicating observations, findings, and conclusions of inspection.

END OF SECTION

SECTION 08 43 30

ALUMINUM-FRAMED FOLDING STOREFRONT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Glazed, exterior, aluminum folding panel system.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Show layout, elevations, dimensions, and typical details.

B. Product Data: Manufacturer's specifications and installation recommendations for hardware.

C. Samples:
1. 12 inch long section of typical stile extrusions in required width and finish.
2. Operating hardware for swing doors.

A. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Fabricator/installer qualifications.

B. Laboratory test reports showing compliance with design criteria.

C. Design calculations to demonstrate compliance of members, connections and anchorages with applicable codes and specified structural requirements.

1.04 CLOSEOUT SUBMITTALS

A. Specified warranty.

1.05 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: Company specializing in work of this Section, with documented successful experience on jobs of similar type and complexity, and approved by manufacturer.

B. Sustainable Design Requirements:
1. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
2. When available, furnish materials extracted, processed, and manufactured within 500 miles of Project.

1.06 WARRANTY

A. Manufacturer: Furnish District with the following manufacturer warranties.

1. Assembly, 2 years.
2. Rollers, 10 years.

B. Warranty for Insulating Glass: As specified in Section 08 80 00, “Glazing.”

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Monumental, aluminum-framed, folding paired panels system by Nana Wall Systems, Inc., or equal.
   1. System: To be determined by District’s Design Consultant.

2.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. System:
   1. Accommodate temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components.
   2. Low profile saddle sills.
   3. Reinforced to resist deflection and vertical and lateral forces required by the CBC.

B. Thermal Performance: Rated, certified and labeled in accordance with NFRC 100.

C. Air Infiltration: Maximum air leakage of 0.30 cfm/sq ft when tested in accordance with ASTM E283 and NFRC 400 at a static air pressure difference of 1.57 psf and 6.24 psf.

D. Water Penetration: ASTM E547:
   1. With 1 inch high interior water trough and weep holes through channel in sill: No uncontrolled water entry at 3.75psf (39 mph).
   2. With 1 inch high interior water trough and drainage under sill: No controlled water entry at 5.25 psf (45 mph).

E. Finish hardware shall comply with applicable fire and building codes, including provisions for accessibility by the physically handicapped required by the CBC.

2.03 MATERIALS AND COMPONENTS

A. Panel Frames, Head, Jamb and threshold Frames: Thermally broken extruded aluminum.

B. Fasteners and Miscellaneous Fastening Devices: Stainless steel or other non-corroding and non-corrosive material.

C. Glass: Insulating, as specified in Section 08 80 00, “Glazing.”

D. Finish on Exposed Aluminum: Shop-applied, 2-coat, high-performance polyvinylidene fluoride (PVDF) coating meeting or exceeding AAMA 2605 weatherability and chemical resistance requirements.
   1. Color: Custom color to be selected by District’s Design Consultant. Coordinate with entrances, storefronts and windows for color match.

2.04 HARDWARE

A. Sliding/Folding Hardware:
   1. Carriages and Guides: Manufacturer's standard.
   2. Hinges: Stainless steel with stainless steel security hinge pins and set screws.
   3. Provide two point locking hardware operated by 180 degree turn of handle between each pair of folding panels.

B. Threshold: Low profile saddle sills.

C. Weatherstripping: Manufacturer's standard.

D. Cylinders, Keying and Additional Hardware: As specified in Section 08 71 00, "Door Hardware."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panels, hardware, and other components in accordance with manufacturer's instructions and as required for proper fit and operation.

B. Set units plumb, level, and true to line, without warp or rack of frames or sash.

C. Adjust operating doors and hardware for smooth operation and snug closure.

D. Leave manufacturer's labels in place, intact and legible until installation is reviewed and accepted.

E. After initial inspection, remove labels, protective coating from glass and wood surfaces.

END OF SECTION

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Aluminum windows of the Types shown on the Drawings and not installed into the aluminum storefront framing system.

1.02 ACTION SUBMITTALS

A. Schedule for Windows. List of each opening using same opening designations shown on Drawings giving rough opening and unit size dimensions, finish, and glass type and thickness.

B. Product Data: Manufacture's descriptive literature for each window Type including hardware and glazing, finishes, and documentation confirming compliance with specified performance criteria.

C. Samples: Typical section of aluminum window frame in specified finish and selected color.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Results of field testing.

1.04 CLOSEOUT SUBMITTALS

A. Extended warranties.

1.05 WARRANTY

A. Manufacturer:
   1. Windows: Furnish to District the manufacturers' extended 2-year warranty against all defects in materials and workmanship.
   2. Finish: 20-year extended warranty for baked on high-performance coating agreeing to replace components that show evidence of finish deterioration.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440.

B. Window Certification: AMMA certified with label attached to each window.

C. Performance Class and Grade:
   1. Casements: Type AP.
      a. Minimum Performance Class: AW.
      b. Minimum Performance Grade: 80.

2. Fixed: Type FW.
   a. Minimum Performance Class: AW.
   b. Minimum Performance Grade: 55.

D. Handle windows and accessories in accordance with AAMA CW-10.

E. Windows shall be shop-glazed with specified insulating glass in accordance with glazing requirements specified in Section 08 80 00, “Glazing.”

F. Glazing stops shall have concealed fasteners.

G. Exposed aluminum fasteners shall be finished to match aluminum work.

H. Installed windows shall be plumb, level, and true to line, without warp or rack of frames or sash.

2.02 ALUMINUM WINDOWS

A. Manufacturers: Heavy Commercial, thermally broken.

B. Configurations and Operating Types: As indicated on Drawings:

C. Frames and Sashes: Thermally improved aluminum extrusions.

2.03 MATERIALS AND COMPONENTS

A. Glass: Insulating; Type GL-1 as specified in Section 08 80 00, “Glazing.”

B. Hardware:
   1. General: Manufacturer's standard hardware fabricated from aluminum, stainless steel, and carbon steel complying with AAMA 907.
   2. Hinges:
      a. Typical: Stainless steel, 4-bar Anderberg type certified to AAMA 904.1, capable of holding sash in any position.
      b. Fasteners: Stainless steel.
   3. Locking: Cast white bronze cam locking handles.
   4. Weatherstripping: Continuous material, resistant to weathering, around outside of sliding panel. Pile shall conform to AAMA 701.2.

C. Fasteners: Except as otherwise specified, non-corrosive and compatible with window members, trim, hardware, anchors, and other components.

2.04 INSECT SCREENS

A. Provide an insect screen, integrated with window frame, at each operable sash.

B. Screen Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire with wire-fabric finish.

2.05 FINISHES

A. Exposed Aluminum: High-performance fluoropolymer coating containing minimum 70 percent polyvinylidene fluoride (PVDF) resin and meeting or exceeding all the requirements of AAMA 2605; two-coat system.
   1. Color: Custom, as selected by the District’s Design Consultant.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coat surfaces to be placed in contact with cement plaster with clear methacrylic lacquer if not organically coated.

3.02 INSTALLATION

A. Install window units, hardware, and other components of work in accordance with manufacturer's instructions and for weather-tightness and water-tightness.

B. Adjust operating sash and hardware to provide a tight fit at contact points and at weatherstripping for smooth operation and weathertight closure.

C. Touch up field abrasions and damage to factory-painted finish. Touch-up shall be unnoticeable in completed installation.

3.03 FIELD QUALITY CONTROL

A. Water Leakage: Windows shall be field tested to evaluate installed performance.
   1. Initial test shall be at first windows of each Type installed on Project.
   2. Test in accordance with AAMA 502 after completion of installation and curing of sealants.
   3. Tests shall be observed by the District’s Design Consultant and an independent inspector at Design Builder's expense.
   4. Correct deficiencies, and modify system at no additional cost to District. Retest to assure no leakage.
   5. Testing does not relieve warranty responsibility required for watertightness.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:
1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames
3. Division 8: Hollow Metal Doors and Frames.
4. Division 8: Wood Doors.
5. Division 26 Electrical
6. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80 -Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
8. ICC – International Building Code

D. Intent of Hardware Groups
1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances
1. Refer to Division 1 for allowance amount and procedures.

F. Alternates
1. Refer to Division 1 for Alternates and procedures.

1.02 SUBSTITUTIONS:

A. Comply with Division 1.

1.03 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:
1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.
1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)
1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
1. Operating and maintenance manuals: Submit 3 sets containing the following.
2. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
3. Catalog pages for each product.
4. Name, address, and phone number of local representative for each manufacturer.
5. Parts list for each product.

    a. Copy of final hardware schedule, edited to reflect, "As installed".

b. Copy of final keying schedule

c. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.

d. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.04 QUALITY ASSURANCE

A. Comply with Division 1.
1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
4. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
5. Hardware Schedule shall be prepared and signed by an AHC.
6. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
7. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
8. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
9. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
10. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.
1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.06 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.07 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:
1. Closers: Ten years
2. Exit Devices: Five Years
3. Locksets & Cylinders: Three years
4. All other Hardware: Two years.

1.08 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.09 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Item:	Manufacturer:	Approved:
Hinges	Stanley	
Continuous Hinges	Stanley	
Locksets	Best	No Substitution
Cylinders	Best	No Substitution
Exit Devices	Precision	Von Duprin
Closers	Stanley D-4550	LCN4040XP, Norton 7500
Automatic Operators	Stanley D-4990	No Substitution
Push/Pull Plates	Trimco	Don Jo, Hager
Push/Pull Bars	Trimco	Don Jo, Hager
Protection Plates	Trimco	Don Jo, Hager
Overhead Stops	ABH	Rixson, Glynn Johnson
Door Stops	Trimco	Don Jo, Hager
Flush Bolts	Trimco	Don Jo, Hager

Coordinator & Brackets	Trimco	Don Jo, Hager
Threshold & Gasketing	National Guard	Reese, Pemko

2.02 MATERIALS:

A. Hinges: Shall be Five Knuckle Ball bearing hinges
1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings
12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
15. UL10C listed for Fire rated doors.

B. Geared Continuous Hinges:
1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings

    a. Sufficient size to permit door to swing 180 degrees

C. Door Closers shall:
1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1½“ minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.

D. Low Energy Operators shall:

1. Conform to ANSI/BHMA A156.19 as a low energy power opening device.
2. Be listed under UL228, UL325, UL10B, UL10C, UBC 7.2 and FCC listed.
3. Shall be non-handed.
4. Be rated for door panels weighing up to 350 lbs (160 kg).
5. The manual door closer within the Low Energy Operator shall be adjusted to meet Americans with Disabilities Act (ADA) 5 lbs opening force [Push-Side applications only]
6. Operator shall be isolated from mounting plate with rubber mounts to mitigate the transmission of forces between the door and the operator.
7. Shall have a position encoder to communicate with microprocessor.
8. Incorporate a resetable powered operation counter that tracts both powered and non-powered cycling of the Operator.
9. Incorporate the following adjustable settings:
   a. Hold Open Timer, to 28 seconds
   b. Open Speed
   c. Backcheck Speed
   d. Vestibule Sequence Timer
10. Include DIP switch controls for:
    a. On board diagnostics
    b. Power close
    c. Push and Go operation
    d. Time delay logic for electrified hardware components
11. Include terminals for auxiliary controls including:
    a. Activation devices; provide two discrete inputs
    b. Vestibule sequencing
12. Control switches including:
    a. Day/Night open (illuminated)
    b. Power On-Off
13. Includes adhesive Low Energy Operator mounting templates.
14. R-14 Aluminum Allow Materials
15. For non-powered operation, the unit shall function as a standard door closer with adjustable spring force size 1 thru 6.

E. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

F. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

G. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

2.03 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.04 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:
1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

a. Recommended locations for Architectural Hardware for flush wood doors (DHI).

b. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.03 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.04 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
1. Check and adjust closers to ensure proper operation.
2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

   a. Verify levers are free from binding.

   b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.05 SCHEDULE OF FINISH HARDWARE:

Manufacturer List

Code	Name
NA	National Guard
LC	LCN Door Closers
ST	Stanley
TR	Trimco
PR	Precision
PE	Pemko
BY	By Others

Option List

Code	Description
MC	Metal Cover
B4E	Beveled 4 Edges
CSK	Counter Sunk Screw Holes
LDW	Less Door Width

Finish List

Code	Description
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
US26D	Chromium Plated, Dull

Hardware Sets

SET #1

Doors: 112A, 200A, 200B, 200C, 200D

6 Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
2 Exit Device	TBD	PR	
2 Door Closer	4040XP Rw/PA MC	689 LC	
1 Floor Stop	TBD	626 BY	
1 Door Shoe	215AV	PE	1 Gasketing

SET #1.1

Doors: 210B

3 Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
1 Exit Device	TBD	PR	1 Door Closer
1 Floor Stop	TBD	626 BY	
1 Door Shoe	215AV	PE	
1 Gasketing	S88D Head & Jambs		

SET #2

Doors: 104, 106, 107A, 107B, 113, 115, 203, 204, 205, 206, 207, 212, 213, 214

3 Hinges	FBB179 4 1/2 X 4 1/2	US26DST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		1Door Closer
2 Kick Plate	K0050 10" x 2" LDW B4E CSK	630 TR	
1 Wall Bumper	1270 CVSV	626 TR	
1 Gasketing	S88D Head & Jambs	PE	

SET #3

Doors: 100, 101, 102, 103, 210C

3 Hinges	FBB179 4 1/2 X 4 1/2	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		1Wall Bumper
1 Gasketing	S88D Head & Jambs	PE	

SET #4

Doors: 111, 211

3 Hinges	FBB179 4 1/2 X 4 1/2	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
2 Kickplate	K0050 10” x 2” LDW B4E		
1 Wall Bumper	1270 CVSV	626 TR	
1Gasketing	S88D Head & Jambs	PE	

SET #5

Doors: 105

6 Hinges	FBB179 4 1/2 X 4 1/2	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
2 Door Closer	4040XP Rw/PA MC	689 LC	
1 Floor Stop	TBD	626 BY	
1 Door Shoe	215AV	PE	1Gasketing S88D Head & Jambs PE

SET #6

Doors: 201

4 Hinges	FBB179 4 1/2 X 4 1/2	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
2 Kick Plate	K0050 10" x 2" LDW B4E CSK	630 TR	
1 Gasketing	See Acoustical Report		

SET #7

Doors: 216, 217

3 Hinges	FBB179 4 1/2 X 4 1/2	US26D ST	
2 Kick Plate	K0050 10" x 2" LDW B4E CSK	630 TR	
1 Door Closer	4040XP Rw/PA MC	689 LC	
1 Wall Bumper	1270 CVSV	626 TR	
1 Gasketing	See Acoustical Report		

SET #8

Doors: 208

3 Hinges	FBB179 4 1/2 X 4 1/2	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
1 Kick Plate	K0050 10" x 2" LDW B4E CSK	630 TR	
1 Wall Bumper	1270 CVSV	626 TR	
1Gasketing	S88D Head & Jambs	PE	

SET #9

Doors: 209A, 209B
All Hardware by Eliason Door Mfg.

SET #10

Doors: 114, 209C

6 Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D ST	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
2 Door Closer	4040XP Rw/PA MC	689 LC	
1 Floor Stop	TBD	626 BY	
1Door Shoe	215AV	PE	1 Gasketing S88D Head & Jambs PE

SET #11

Doors: 112B, 215

6 Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D ST	
2 Flushbolts	3917-12	US26D TR	
1 Secure All Lock System	by Owner (Best 9Kseries 15D lever)		
1 Door Closer	4040XP Rw/PA MC	689 LC	
1 Overhead Stop/Holder	4420 Series	630 AB	
1 Floor Stop	TBD	626 BY	
1 Dust Proof Strike	3910N	626 TR	
2 Door Shoe	215AV	PE	1Gasketing S88D Head & Jambs PE

SET #12

Doors: G1

8 Hinges	FBB199 52 X 4 1/2 NRP	US32D ST	
2 Door Pull	1165 x 40” O/A	UC32D TR	
1 Padlock	A6460	AM	Hasp A825 AM 1 Cane Bolt SP 1009-24” ST

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Glass and glazing materials.
   2. Insulating glass with integral functional wood insert.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's literature substantiating that glass and glazing materials comply with specified requirements.

B. Samples: 12 inches square of each insulating Glass Type.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 CLOSEOUT SUBMITTALS

A. Extended warranty for insulating glass.

1.04 QUALITY ASSURANCE

A. Qualifications for Fabricator/Installer of Exterior Storefront Glazing: Company specializing in work of this Section, with not less than 10 years' documented experience on jobs of similar type and complexity.

1.05 WARRANTY

A. Manufacturers:
   1. Furnish District with the following manufacturer warranty for sealed insulating glass units in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period.
      a. Vertical Glazing: 10 years.
      b. Horizontal Glazing: 5 years.
   2. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions
   3. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Comply with applicable design and performance requirements of related Sections for systems in which glazing is installed.

B. Regulatory Requirements:
   1. Comply with CBC Chapter 24, Section 2406.
   2. Where safety glass is indicated or required by CBC, provide type of products indicated that comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category I or II materials, as applicable.
   3. Mirrors shall meet CPSC or ANSI safety glazing requirements and shall be certified by the Safety Glazing Certification Council (SGCC).
   4. City of Novato Ordinance Adoption of the Wildlife Urban Interface (WUI) requirements.

C. Industry Standards:
   1. Comply with GANA "Glazing Manual," except where more stringent requirements are indicated.
   2. Comply with applicable provisions of the AAMA "Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual."

D. Tempered glass shall be horizontally tempered with roller ripples in horizontal direction with an inconspicuous but visible permanent identifying label on each pane in accordance with ANSI Z97.1.
   1. Fused to glass.
   2. Include manufacturer's name or trademark, glass type, thickness, and designation of treatment.
   3. Label shall be upright and located in a lower corner.

E. Insulating Glass: Meet Class CBA requirements when tested in accordance with ASTM E773 and ASTM E774.

F. Compression gaskets shall provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
   1. Miter-cut at corners.
   2. Gaskets shall protrude slightly out of channel so as to eliminate dirt and moisture pockets.

2.02 GLASS MATERIALS

A. Annealed Float Glass: ASTM C1036, Type I, Class 1, Quality q3 or better.

B. Heat-Strengthened and Tempered Float Glass: ASTM C1036, Type I float glass as specified above and conforming to requirements of ASTM C1048 and as specified.
   1. Tempered glass shall meet ANSI Z97.1 test requirements.
   2. Glass shall be tempered using the roller hearth method.
   3. Heat-strengthened glass shall have surface compression levels between 3500 and 7000 psi.

C. Spectrally Selective Glass: Specified float glass with a spectrally selective Low-E coating that will provide highest visible transmittance, low shading coefficient, and high UV radiation blockage.

2.03 ADDITIONAL GLASS MATERIALS

A. Insulating Glass: "Oakawood", insulating glass system with integral wooden grid, by Okalux North America, LLC, White Plains, NY, Tel: 914-202-0274, or equal.
   1. Certified under IGMA-approved program and meeting Test Class CBA requirements when tested in accordance with ASTM E773 and ASTM E774.

2.04 GLAZING ACCESSORIES

A. Sealants at Interior Locations, If Not Dry Glazed: One-part, gun grade; Tremco "Mono," Pecora "60 Plus," or equal.

B. Joint Backer: Diameter size at least 25 percent larger than joint width; type and material as recommended, in writing, by glass and sealant manufacturer.

C. Glazing Materials:
   1. Glazing Blocks and Spacers: Closed-cell neoprene complying with ASTM C509, in black color.
   2. Glazing Gaskets: As standard with manufacturer door, window, and storefront manufacturer.
   3. Provide silicone setting blocks, jamb blocks, and sealant joint backer or spacers in lieu of neoprene, if recommended by sealant manufacturer, for compatibility with sealant. Corners, sizes, profiles, and color as specified for neoprene glazing materials.

D. Glazing Tape: Butyl rubber type, black color.

E. Additional Accessories: Provide clips and fastenings as required and as standard with window, door, or framing manufacturer.

2.05 GLASS TYPES

A. GL-1: Insulated, tempered storefronts, entrances, and windows.
   1. Exterior Light: Laminated.
      a. Outer Ply: Specified low E glass, 1/8 inch (3mm) thick, with low coating on the #2 surface.
      b. Interlayer: Clear, 0.030 inch thick, "SentryGlas" ionoplast interlayer.
      c. Inner Ply: Clear float, 1/8 inch (3mm) thick.
   2. Air Space: 1/2 inch.
   3. Interior Light: Clear float, 1/4 inch (6mm) thick, tempered where required by code.

B. GL-2: Insulating Glass: "Oakawood", insulating glass system with integral wooden grid.
   1. External pane: Thermally treated glass:
      a. Glass type and thickness shall be according to static requirements.
   2. Air Space: 3/4 to 1-inch wood faced vacuum insulated panel.
      a. Wood Finish: Oak
   3. Interior pane: Thermally treated glass:
      a. Glass type and thickness shall be according to static requirements.

PART 3 - EXECUTION

3.01 GLAZING

A. Comply with combined printed recommendations of glass manufacturers and manufacturers of sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Remove and dispose of glass with edge damage or other imperfections of any kind that, when installed, would weaken glass and impair performance and appearance.

C. Provide edge blocking to comply with requirements of GANA "Glazing Manual," except where otherwise required by glass fabricator.

D. Set units in each series with uniformity of pattern, draw, bow, and similar characteristics.

E. Do not apply markers to surfaces of glass.

F. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

END OF SECTION

SECTION 08 91 10

METAL WALL LOUVERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Steel wall louvers with bird screen.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Indicate layout plan and elevations, head, jamb, and sill details; blade configuration; screens; blank-out areas required; and anchorage and interface with adjoining materials.

B. Product Data: Manufacturer's installation instructions and descriptive data of louvers, including standard drawings and free area.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Quality Control: Manufacturer's certification that wall louvers comply with requirements and are licensed to bear the AMCA seal, based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA Certification for architectural louvers.

1.05 PROJECT CONDITIONS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Louvers comply with requirements and bear the AMCA seal based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

B. Fabricated louvers shall maintain equal blade spacing.

C. Ensure moisture shed from flashings and louver is diverted to exterior.

2.02 METAL WALL LOUVERS

A. Formed Sheet Metal Louvers: Stationary, weatherproof blade profile.

1. Material: Minimum 22 gage galvanized steel, ASTM A653, commercial quality, coating designation G90.
2. Blade Type: Continuous.
3. Frame Thickness: 18 gage (nominal 0.05 inches).
4. Blade Thickness: 18 gage (0.05 inches).
5. Frame Depth: 4 inches.
6. Blade Angle: 45 degrees.
7. Free Area: 53 percent minimum.
8. Provide with manufacturer's flange option for mounting at framed walls.

B. Finish: Manufacturer's standard pretreatment and thermosetting acrylic enamel complying with AAMA 2603 in custom colors as selected by the District's Design Consultant.

2.03 ACCESSORIES

A. Bird Screens at Louvers:
1. Mesh: 1/2-inch by 0.063-inch-diameter aluminum wire, with factory-applied black finish.
2. Frame: Folded, 16 gage galvanized steel, interior mounted, finished to match louver.

B. Blank-out Sheeting, if Required: Provide on interior of frame.
1. Type: Non-insulated.
2. Finish on Exterior Surface: Manufacturer's standard high-performance baked enamel finish, black color.

C. Fasteners:
1. Screens: Stainless steel.
2. Louver Frames: Hot-dip galvanized as recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install louver assembly level and plumb following procedures in manufacturer's recommended installation instructions.

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Portland cement plaster with integral color acrylic finish coat.
   2. Portland cement base coat plasters to receive adhered stone veneer and tile.
   1. Metal lath.
   2. Metal accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Prior to installation of portland cement plaster work, Design Builder, District's Design Consultant, plaster installer, and other installers whose work may affect quality of installation shall meet at the Project site to coordinate related requirements and review plastering installation procedures.

1.03 ACTION SUBMITTALS

A. Product Data: Manufacturer's published literature containing complete description for lath, metal accessories, plaster base and finish coats.

B. Samples: 12 inch square panel showing finish coat texture. Finish coat shall be applied over primer, if applicable, and base coats.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Statement of applicator qualifications.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Documented experience in application of specified plaster system on at least three projects equal in scope to this Work.

B. Industry Standards: Comply with applicable requirements of ASTM C847, ASTM C897, ASTM C926, and ASTM C1068.

1.06 AMBIENT CONDITIONS

A. Cold-Weather Requirements: Do not apply cement plaster, unless minimum ambient temperature has been at least 50 degrees F for at least 48 hours prior to application and temperature is forcast to be maintained at that level until plaster is cured.

B. Hot-Weather Requirements: Protect cement plaster from uneven and excessive evaporation during hot, dry weather.

C. Wind Requirements: Do not apply portland cement plaster when wind speeds over 20 mph are occurring or forecast.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Comply with requirements of CBC Article 25 and all local amendments.

B. Comply with applicable requirements of ASTM C847, ASTM C897, ASTM C926, and ASTM C1068.

C. Apply protective coverings to prevent application or spilling of plaster on surfaces not intended to receive plaster.

D. Sufficient staging and workers shall be employed to accomplish a uniform appearance. All applicators shall use the same tools, equipment and techniques to achieve uniformity.

2.02 LATHING MATERIALS

A. Self-Furring Welded Wire Lath: Galvanized welded steel-wire fabric complying with ASTM A653, 17-gage minimum, with openings not to exceed 1.5 inches, and conforming to ASTM C933. “Megalath” by Structa Wire, or equal.
   1. Weight: Not less than 1.95 pounds per square yard.
   2. Provide with crimped cross wires forming a continuous 1/4-inch-deep furring crimp at nominal 3-inches on center.

B. Diamond Mesh Reinforcing Lath: Expanded galvanized-steel sheets, ASTM C847.
   1. Flat: Not less than 2.5 pounds per square yard.
   2. Self-Furring: 3.4 pounds per square yard with dimpled indentations or continuous with 1/4-inch self-furring groove rolled lengthwise of sheet at maximum 6 inches on center to hold mesh 1/4 inch away from supporting surface.

2.03 FURRING AND LATHING ACCESSORIES

A. Zinc and Zinc-Coated (Galvanized) Accessories:
   1. General:
      a. Conform to material requirements for accessories of ASTM C1063.
      b. Provide in maximum possible lengths.
   2. Casing Beads: Non-perforated; equivalent to Model 66N by ClarkDietrich Building Systems.
   3. External Corner Beads: Small, rigid nosed, not exceeding 3/16 inch, with expanded flanges at least 2-1/2 inches wide equivalent to Model 1A by ClarkDietrich Building Systemsl.
   4. Internal Corner Beads: Straight edge equivalent to Model ICT by Stockton Products.
   5. Control Joints: Double “V” style with expanded flanges equivalent to “#15” by ClarkDietrich Building Systemsl.
   6. Expansion Joints: Double “J” style with expanded flanges equivalent to “#XJ-15” by ClarkDietrich Building Systems.

7. Internal Corner Reinforcing: Expanded metal lath or manufactured product equivalent to "Cornerite" by ClarkDietrich Building Systems.
8. Wall Drip Screed: Equivalent to Model #FHA-7 by ClarkDietrich Building Systems but without perforations

B. Aluminum Accessories: Extruded; Fry Reglet Corp., or equal.
1. Profiles: Reveal Channel Screed.
2. Finish: Manufacturer's standard paint coating in custom colors to match appearance of portland cement plaster at location of use.

C. Tie Wire: ASTM A641; 0.0625-inch nominal diameter (No. 16 W&M gage) minimum.

2.04 BASE COAT MATERIALS

A. Premixed Fibered Base Plaster: Factory prepared blend of portland cement, sand, reinforcing fibers, and lime conforming to ASTM C926; LaHabra "Fiber-47 Fastwall" by Parex USA, Inc., "BMI 690F" by BMI Products, or equal.

2.05 FINISH COAT MATERIALS

A. Finish Coat Primer: Color matched by manufacturer of finish coat; "LaHabra Acrylic Primer" by ParexLahabra, Inc., or equal.

B. Finish Coat with Integral Color: Factory-mixed, integral color, water-based formulation of 100 percent acrylic binder, colorfast mineral pigments, quartz sand aggregate; with dirt-pickup-resistant (DPR) finish; "LaHabra Acrylic Finish" by Parex USA, Inc., or accepted equal.
1. Finish Coat Primer: Color matched by manufacturer of finish coat.
2. Color: To be determined by District's Design Consultant.
3. Texture: To be determined by District's Design Consultant.

2.06 ACCESSORIES

A. Water: Potable and free from substances harmful to plaster.

2.07 MIXES

A. Mix factory prepared plasters in accordance with manufacturer's written instructions.

PART 3 - EXECUTION

3.01 INSTALLATION OF METAL LATH

A. Furring and lathing shall be installed in accordance with ASTM C1063 and manufacturer's recommendations.

B. Stagger ends of lath to avoid continuous joints on same support. Lap ends at supports.

C. Reinforce lath bent around internal and external angles.

3.02 INSTALLATION OF METAL ACCESSORIES

A. General:

1. Fasten in place using wire ties or galvanized staples to prevent dislodging or misalignment by subsequent plastering operations.
2. Connect lengths of accessories as recommended by manufacturer to assure a continuous line.
3. Where plaster abuts dissimilar materials, terminate with plaster casing bead.
4. Install diagonal strip reinforcing at corners of openings.
5. Seal all fasteners not driven squarely into substrate or exhibiting gaps around penetration through underlayment.

B. Control Joints: Layout shall be reviewed and approved by the District's Design Consultant and so as to provide plaster panels not exceeding 144 square feet with no dimension exceeding 18 feet or a length-to-width ratio of 2-1/2 to 1.

C. Cornerite: Install at plastered interior angles where both converging wall surfaces are plastered. Do not install:
1. Where metal lath continues onto converging surface of an angle at least 4 inches.
2. Where juncture of abutting surfaces is to be unrestrained.

D. External Corner Bead: Provide at external angles where plastered on both sides of angles.

E. Drip Screed: Install at based of plaster wall.

3.03 APPLICATION OF PLASTER - GENERAL

A. Comply with ASTM C926.

B. Interrupt cement plaster only at junctions of plaster planes, at openings, and at control joints. Do not make cold joints in plaster.

C. Plaster Thickness Measured from Back Face of Lath: 7/8 inch typical.
1. First (Scratch) Coat: 3/8 inch minimum, 1/2 inch maximum.
2. Second (Brown) Coat: 1/4 inch minimum, 3/8 inch maximum.
3. Third (Finish) Coat: 1/8 inch minimum.

3.04 APPLICATION OF PLASTER BASE COATS

A. General:
1. Apply scratch and brown coats by hand.
2. Dampen scratch coat immediately before applying brown coat, and brown coat immediately before applying finish coat.

B. Apply scratch coat with sufficient material to embed and fill all spaces of lath and to form keys through metal lath.
1. Allow the scratch coat to set slightly, then score surface using metal scratching tool with teeth 1 inch apart.
2. Score surfaces in direction perpendicular to direction of supporting framing.

C. Apply brown coat to scratch coat, bringing out to grounds, flat to true surface.
1. Reconsolidate brown coat by floating or brushing to eliminate "slick spots" and assure a good mechanical bond with finish coat.
2. Where brown coat forms the substrate for adhered stone veneer or tile, finish with a wood float and level within 1/8 inch in 8 feet with no abrupt offset greater than 1/16 inch in 3 feet.

3. After brown coat is rodded and set but white it is still workable, check for 1/8 inch tolerance with a 10 foot straightedge. Correct deficiencies.
4. Completed brown coat shall be free of imperfections that would reflect in finish coat.

3.05 CURING OF PORTLAND CEMENT BASE COATS

A. Moist-cure scratch and brown coats by fine fog spray.
   1. Moist-curing conditions shall be continuously maintained.
   2. Moisture curing on weekends and holidays is required only in the event of temperatures exceeding 95 degrees F and/or winds in excess of 25 miles per hour.

B. Apply brown coat as soon as scratch coat is sufficiently rigid to resist cracking but a minimum of 48 hours after application of scratch coat.

C. Permit brown coat to cure minimum 7 days after application prior to applying finish coat. Extend cure time for brown coat up to 21 days if recommended by manufacturer to reduce cracking of smooth finish coat.

D. The above curing times and methods shall be adjusted by Design Builder for environmental conditions during the curing period as recommended in ASTM C926, Appendix. When such conditions occur, provide written notification and justification to District's Design Consultant.

3.06 APPLICATION OF FINISH COAT

A. Do not apply until portland cement base coats have been allowed to cure as specified.

B. Comply with in accordance with manufacturer's instructions, ASTM C926, and specified requirements to minimum 1/8 inch thickness.

C. Apply finish coat to achieve approved appearance, color, and texture at each location.

D. Cure proprietary finish in accordance with manufacturer's instructions.

3.07 FIELD QUALITY CONTROL

A. Slump Test: Design Builder shall be responsible for controlling the fluidity of each plaster mix. Mix may be subject to slump testing by the District, to verify proper fluidity, in accordance with ASTM C143 using a slump cone 2 inches by 4 inches by 6 inches high. Slump shall be between 2-1/2 and 3 inches.

B. Installation Tolerances: Maximum deviation from true plane of 1/8 inch as measured from the line of a 10-foot straightedge placed at any location on surface unless lessor tolerance of 1/4 inch is determined as acceptable to District's Design Consultant.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Gypsum board, including finishing.

1.02 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C11 and GA-505 for definitions of terms for gypsum board construction not defined in this Section or in other referenced standards.

1.03 ACTION SUBMITTALS

A. Product Data: Manufacturer's product data for each board material to show compliance with requirements.

B. Samples: Each type or configuration of extruded aluminum reveal, finished as specified, including intersections and other special components.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.04 INFORMATIONAL SUBMITTALS

A. Statement of installer qualifications, if requested by Architect.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in work similar to that required on this Project, with not less than 5 years of documented experience.

B. Notify Architect prior to covering or enclosing framing, ducts, and pipes in sound-rated construction in order to allow for on-site review and correction as required.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature and humidity conditions in installation area in accordance with GA-216 requirements.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Regulatory Requirements:
   1. Fire-Resistance Ratings:

a. Comply with fire-resistance ratings as indicated and required by governing authorities and codes.
b. Provide materials, accessories, and application procedures that have been listed by a nationally recognized testing agency or tested according to ASTM E119 for type of construction shown.

2. Comply with the CBC, Chapter 25.

B. Industry Standards: Work shall comply with the applicable requirements of GA publication GA-216 and GA-214.

C. Provide products manufactured by or recommended by manufacturer of gypsum board in order to maintain single-source responsibility.

D. Provide materials in accordance with ASTM C840.

E. Provide boards in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.02 INTERIOR GYPSUM BOARD

A. Fire Rated Gypsum Board: ASTM C1396, Type X, unless more stringent type required by code; USG “Sheetrock Firecode Core,” or accepted equal.
1. Thickness: 5/8 inch, unless otherwise noted.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Fire-Rated Moisture- and Mold-Resistant Board: ASTM C1396, Type X, unless more stringent required by code; USG “Sheetrock Mold Tough Firecode Core,” or accepted equal.
1. Thickness: 5/8 inch, unless otherwise noted.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
3. Mold Resistance: 10 on scale of 10 in when tested accordance with ASTM D3273.
4. Moisture Resistance: The average water absorption for panels shall not exceed 5 percent by weight after two-hour immersion when tested in accordance with ASTM C473.

2.03 ACCESSORIES

A. Adhesives:
1. Laminating Adhesive: As recommended by gypsum board manufacturer for laminating gypsum board together in fire-rated construction.
2. Adhesives shall comply with required VOC regulations.

B. Fasteners:
1. Screws: Phillips head with bugle shape, Type W, conforming to ASTM C1002.
2. Sizes of fasteners shall be as required by code and as recommended by wallboard manufacturer.

C. Concealed Metal Reinforcements and Casing: Electrogalvanized, conforming to ASTM C1047. Provide products equivalent to the following:
1. Exterior Corner: United States Gypsum (USG) "Dur-A-Bead."
2. Intersection of Gypsum Board with Dissimilar Material: USG No. 200-B "L" shaped trim and 200-A "J" shaped trim.
3. Control Joint: USG No. 093.

D. Joint-Treatment Materials: Comply with ASTM C475 and with manufacturer's recommendations for specific project conditions

1. Manufacturer: Same as gypsum board.
2. Provide compound specifically recommended or permitted by manufacturer of backing board at joints and fasteners in moisture-and-mold-resistant gypsum backing board intended for tile surfacing,

PART 3 - EXECUTION

3.01 APPLICATION OF GYPSUM BOARD

A. General: Comply with ASTM C840, GA-216, and CBC. Where UL designs are indicated on the Drawings for fire-rated partitions, comply with UL requirements, except where exceeded by other requirements.
   1. Wherever possible, install gypsum board in such a manner as to minimize butt end joints.
   2. Install wall boards in such a manner as will minimize butt end joints in center of wall area. Stagger vertical joints on opposite sides of walls. Stagger horizontal joints where required by governing code.
   3. Place wrapped edges adjacent to one another. Do not place cut edges or butt ends adjacent to wrapped edges.
   4. Support all edges and ends of each board on framing or by solid substrate, except that long edges at right angles to framing members in non-fire-rated construction may be left unsupported, unless required by governing code.

B. Single-Layer Application: Install gypsum board by means of screw attachment.

C. Double-Layer Application:
   1. Apply base layer vertically, offsetting vertical joints at least one stud space between layers.
   2. Install base layer by means of screw attachment. Provide fire taping only.
   3. Fit face layer by laminating to base layer with adhesive.
   4. At Contractor's option, provide permanent support by attaching face layer to base layer with screws in accordance with manufacturer's instructions.

D. Installation of Backing Board: Install specified moisture-and-mold-resistant board at partitions to receive tile in accordance with manufacturer's recommendations for installation, including minimum clearances and sealing of penetrations and edges.

E. Metal Trim:
   1. Apply trim at all exterior corners and at interior corners where gypsum board intersects metal or other dissimilar material.
   2. Provide control joints in accordance with ASTM C840 recommendations.
   3. Edges:
      a. Apply applicable shape of metal edge trim at exposed edges of wallboard.
      b. Gypsum Board Abutting Other Materials: Install edge trim with 1/8-inch clearance to allow for sealant.
      c. Apply neoprene tape to assure sealed joints at abutting surfaces.

3.02 FIELD QUALITY CONTROL

A. Construction Tolerances:
   1. Gypsum board surfaces to be painted shall have no measurable variation in any 2-foot direction and a maximum variation of 1/8 inch in 10 feet 0 inches when a straightedge is laid on the surface in any direction.
   2. See Section 09 30 00, “Tiling” for tolerances required for surfaces to receive tile.

3. Do not exceed 1/16-inch offset between planes of abutting sheets at edges or ends.

3.03 TAPING AND FINISHING

A. General Requirements:
   1. Apply finishing compounds in accordance with manufacturer's directions. Do not apply tape and joint compound over joints containing acoustical sealant until the sealant has completely cured.
   2. Conceal flanges of metal reinforcement with minimum two coats compound. Compound shall extend 8 to 10 inches each side of metal nosing.

B. Level of Finishes: In accordance with GA-214.
   1. At Locations Indicated to Receive "Fire-Taping" and at Unexposed Gypsum Board Applications: Level 1.
   2. Locations to Receive Paneling: Level 3.
   3. Typical Locations to Receive Flat or Eggshell Paint, or Wall Coverings: Level 4.
   4. Surfaces to Receive Semi-Gloss or Gloss Paint (Except Utilitarian Areas such as Storerooms): Level 5.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Interior floor and wall tile.
   2. Grouting of tile.
   3. Waterproofing and crack isolation membrane.
   4. Cementitious backer board.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Submit for custom tile patterns and layouts.

B. Product Data: Manufacturer's product literature and installation instructions for manufactured products. Include certified laboratory or field tests for slip resistance for floor tile.

C. Samples for Verification Purposes:
   1. Each color, size, and type of tile and grout specified and selected, mounted on plywood or hardboard backing, grouted.
      a. Size: Varies based on tile size, but sufficient to show and intersecting grout joint.
      b. For products with color and texture variation, submit sets showing full range of variations expected.
   2. Samples of each type of edge trim and accessory, 6 inches long, in each color.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Statement of installer qualifications. Include list of completed projects with project names, addresses, and names of architects and owners.

B. Master grade certificates for each shipment, type, and composition of tile, signed by the manufacturer and installer.

1.04 CLOSEOUT SUBMITTALS

A. Extended warranty for setting and grouting products.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Successful completion of tile installations similar in material, design, and extent to that required for this Project.

B. Mockups: Install tile in designated areas for verification by Design Builder of slip-resistance and for review by District's Design Consultant of workmanship, detailing, grouting, and general appearance.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Comply with minimum temperature recommendations of manufacturers for bonding and grouting materials. If manufacturer has no recommendations, maintain temperature at not less than 50 degrees F during tile installation and for at least 7 days after completion of installation.

1.07 WARRANTY

A. Manufacturer: Furnish District with the following manufacturer warranties.
   1. Setting and Grouting Materials: 5-years for the installation, covering replacement of materials and labor.
   2. Waterproofing Materials: Not less than 10 years against defects in materials and workmanship including water leakage.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Slip Resistance: Floor tile shall provide a value equal to or greater than 0.42 when tested in accordance under dry conditions with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6, and under wet conditions with DCOF AcuTest procedure of ANSI B101.3. Laboratory tests shall be made on a minimum of three tiles of each material and finish proposed for use.

B. Within any given tile setting system, use the products of a single manufacturer to insure compatibility and single source responsibility.

C. Except where more stringent requirements are specified, conform to applicable ANSI Standards as follows:
   1. Ceramic Tile: ANSI A137.1 "Standard Grade."
   2. Tile Installation Materials: Comply with ANSI standard referenced with products and materials specified for setting and grouting.

D. Allowable Tolerances of Surfaces to Receive Tile:
   1. Maximum Variation in Vertical Surfaces: 1/8 inch in 8 feet.
   2. Maximum Variation in Horizontal Surfaces: 1/8 inch in 10 feet.

2.02 TILE MATERIALS

A. Restroom Wall Tile: "Retroactive – American" by Crossville, as the basis of design products and as scheduled on the Drawings.
   1. Size: 3 inches x 12 inches
   2. Color: To be determined by District's Design Consultant.

B. Restroom Floor Tile: "Unity Color Body Porcelain" by Daltile, as the basis of design products and as scheduled on the Drawings.
   1. Size: 12 inches x 24 inches
   2. Color: To be determined by District's Design Consultant.

C. Trim Shapes and Bases:
   1. Provide cove base, bullnose, returns, trimmers, and other standard shapes as available for scheduled tiles to finish installation.
   2. Color and finish of trim shapes shall match adjacent tile. Base shall match wall tile or floor tile as selected by District's Design Consultant.

D. Exterior Porcelain Tile: Daltile, as the basis of design products and as scheduled on the Drawings, or equal.
   1. Artic Brick Accent, model # EV02
   2. Grigio, model # P402
      a. Size: 12 inches x 24 inches.
      b. Color: To be determined by District's Design Consultant.

2.03 WATERPROOFING, CRACK ISOLATION, AND UNDERLAYMENT MATERIALS

A. Liquid-Applied Waterproofing and Crack Isolation Membrane: "Redgard" by Custom Building Products, or equal meeting ANSI A118.12 for crack isolation membranes and ANSI 118.10 for waterproofing membranes.

B. Cementitious Backer Board: ANSI A118.9; "Durock" by U.S. Gypsum, as specified and basis of design, or equal.
   1. Thickness: 5/8 inch,
   2. Fasteners: Rust-resistant drywall screws.

2.04 MORTAR BED MATERIALS

A. Bond Coat for Mortar Bed to Concrete Substrate: Portland cement slurry coat.
   1. Concrete substrate shall have a texture equivalent to a fine broom finish and is free of curing compounds, oils, or other emollients that would inhibit bond.

B. Site-Mixed Portland Cement Mortar Bed: ANSI A108.1A; one part portland cement and six parts damp sand by volume.
   1. Portland Cement: ASTM C150, Type I-II, low alkali type to reduce efflorescence.
   2. Sand: ASTM C144.

C. Premixed Polymer Modified Portland-Cement Mortar Bed: ANSI A118.1; "CUSTOM SpeedSlope" Rapid Setting Sloping Mortar" by Custom Building Products, or equal.

D. Reinforcing Mesh for Mortar Bed: ASTM A185, 2-inch-x-2-inch-x-16/16-gage welded-wire fabric.

2.05 SETTING AND GROUTING MATERIALS

A. Manufacturer: Custom Building Products as specified and the basis of design or equivalent products by Laticrete, Mapei, or equal.

B. Latex Portland Cement Mortar: ANSI A118.4.
   1. Porcelain Tile: "Porcelain Tile Fortified Thin-Set Mortar."
   2. Ceramic Wall Tile: "VersaBond" Fortified Thin-Set Mortar.

C. Chemical Resistant Epoxy Mortar at Quarry Tile: "EBM-Lite" Premium Epoxy Bonding Mortar."

2.06 GROUTING MATERIALS

A. Epoxy Grout at Quarry Tile: ANSI A118.3; "CEG-Lite" 100% Solids Commercial Epoxy Grout.

B. Polymer-Modified Cementitious Grout at Porcelain and Glazed Tile: ANSI 118.6; factory-prepared; "Polyblend."
   1. Provide sanded for joint widths 1/8 inch or more.
   2. Provide unsanded for joint widths less than 1/8 inch.

C. Grout Colors: To be selected by the District's Design Consultant.

2.07 ADDITIONAL MATERIALS

A. Sealant: As provided or approved by grout manufacturer.
   1. Color: To match color of grout in adjacent joints.
   2. Provide sanded or nonsanded type as required to match type of grout.

B. Water: Clean and potable.

C. Tile Cleaners and Sealers: Product specifically acceptable to tile manufacturer and grout manufacturer for application intended and as recommended by National Tile Promotion Federation (NTPF) for Ceramic Tile Institute (CTI).

D. Metal Edge Protection and Transition Strips: Extruded aluminum.
   1. Profiles: To be finalized.
   2. Height: As required by tile installation.

E. Protective Paper: Non-staining laminated and reinforced Kraft paper with bituminous or latex binder.

F. Provide primers, levelers, and other products recommended by manufacturers of setting materials or required for a complete installation.

PART 3 - EXECUTION

3.01 INSTALLATION OF RUBBER WATERPROOFING/CRACK ISOLATION MEMBRANE

A. Install membrane in accordance with ANSI A108.13, manufacturer's instructions for a crack isolation and waterproofing membrane, and to effect specified warranty.

B. Installation shall be reviewed by District's Design Consultant before installation of overlying materials.

3.02 TILE INSTALLATION - GENERAL

A. Work shall conform to the recommendations and listed installation methods included in the "Handbook for Ceramic, Glass, and Stone Tile Installation" published by the Tile Council of North America, Inc.

B. Laying out Tile Work:
   1. Lay out tile work so that, insofar as possible, no tile less than half full size occurs.
   2. Lay out wall tiles so that fields and patterns center exactly on individual wall areas.
      c. Exterior angles shall be bullnose.

d. Cap shall be bullnose, same size as wall tile.

3. Align joints vertically and horizontally.
4. When floor and wall tiles are the same size, align joints. If it is not possible, based on configuration of walls and spaces, to comply with requirement that no tile less than half full size occurs while at the same time aligning wall and floor joints, confer with District's Design Consultant to arrive at an acceptable solution prior to installing the tile.

C. Set no cut edge against any fixture, cabinet, or other tile without a joint at least 1/16 inch wide.

D. Fit tile around electric outlets, plumbing pipes, fixtures, and fittings close enough to permit standard plates and collars to overlap tile.

E. Allow tile to set at least 48 hours prior to grouting.

F. Grout tile to comply with requirements of ANSI A108.10.

G. Install sealant in perimeter joints and around floor drains and penetrations in accordance with installation requirements for sealants specified in Section 07 92 00, "Joint Sealants."

3.03 INSTALLATION METHOD

A. Wall Tile at Dry Areas: TCNA Method W243.
1. Thin-set tile over moisture- and mold-resistant gypsum board specified in Section 09 2900, "Gypsum Board," with latex Portland cement mortar in accordance with ANSI A108.5.
2. Install latex portland cement grout in accordance with ANSI A108.10.

B. Wall Tile Behind Cooking Equipment in Foodservice Areas: TCNA Method W244.
1. Install cement backer board over framing in accordance with ANSI A108.11.
e. Horizontal and vertical joints shall have a 1/8-inch space, filled with latex Portland cement mortar.
f. Embed 2-inch glass-fiber-mesh tape in skim coat of mortar at joints.
2. Thin-set wall tile over cement backer board, using latex Portland cement mortar in accordance with ANSI A108.5.
3. Install latex Portland cement grout as specified.

C. Floor Tile - Typical: TCNA Method F122/F122A.
1. Install waterproofing and crack isolation membrane over concrete in accordance with manufacturer's instructions and TCNA method specified.
2. Thin-set tiles over membrane in bond coat of latex portland cement mortar in accordance with ANSI A108.5. Exercise care so as to avoid damage to membrane.
3. Install epoxy grout as specified.

D. Floor Tile – Quarry Tile: Similar to TCNA Method F112.
1. Install bond coat over concrete substrate.
2. Install reinforced mortar bed in accordance with ANSI A108.1A.
g. Form slope to drain at locations shown on the Drawings.
h. Control thickness to assure finished surface of tile is at required elevation.
3. Install waterproofing and crack isolation membrane over mortar bed in accordance with manufacturer's instructions and TCNA method specified.
4. Thin-set tile over membrane in a bond coat of epoxy mortar in accordance with ANSI A108.5.
5. Install epoxy grout as specified.

E. Control, Contraction, Construction, and Isolation Joints: Locate joints, and install in accordance with TCNA Method EJ171.

3.04 ADJUSTMENT, CURING, AND SEALAING

A. Remove cracked, stained, discolored, broken, or damaged tile. Replace with new tile.

B. Keep traffic off floors during the curing period (7 days).

C. Do not permit cement grouts to dry out until cured at least 72 hours.

D. Apply sealer to quarry tile after finial cleaning in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Suspended acoustical ceiling panels.
   2. Ceiling suspension system.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Suspension grid layout for each ceiling panel Type and details verifying compliance with CBC. Show access doors, light fixtures, supply and exhaust grilles and diffusers, sprinkler heads, speakers, detection devices, and all other items to be installed in suspended acoustical ceilings.

B. Product Data: Manufacturer's catalog cuts for suspension system components and acoustical panels.

C. Samples: Not less than 6-inch x 6-inch sample of each type of acoustical panel required.

D. Delegated Design: Seismic and structural design engineering calculations prepared by the engineer in responsible charge retained by the Design Builder shall be submitted to demonstrate compliance with CBC and adequacy of suspension system to withstand specified seismic and structural loading. Engineer shall be a California licensed civil or structural engineer.

1.03 CLOSEOUT SUBMITTALS

A. Warranties as specified.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of three installations of extent comparable to Project.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Comply with acoustic panel manufacturer’s requirements.

1.06 WARRANTY

A. Manufacturer: Furnish District the following extended product warranties from manufacturer:
   1. Acoustical Panels: 10 years.
   2. Suspension Grid: 10 years.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Develop and coordinate locations of work supported by or penetrating through ceiling with the other Sections involved prior to making shop drawing submittal. In particular, note partitions that are to be installed prior to ceiling installation.

B. Coordinate with finishing of caps for concealed sprinkler heads that are to be finished to match color of ceiling panels.

C. Seismic Requirements:
   1. Ceilings shall comply with CBC requirements for seismic bracing of ceiling suspension system.
   2. Ceiling Compression Struts:
      a. Provide struts as shown on Drawings and as required by code, placed maximum 12 feet on center in both directions and within 6 feet of each wall.
      a. Bracing system shall be adequate to support nonbearing ceiling-height partitions spaced at 10 feet on center.

D. Fire Performance Characteristics:
   1. Surface Burning Characteristics: Provide products complying with ASTM E 1264 for Class A products and meeting the following when tested in accordance with ASTM E84.
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 50 or less.

E. Tolerances:
   1. Deflection, ASTM C635: Maximum 1/360 of span. Applies to suspension system components, hangers, and fastening devices supporting light fixtures, ceiling grilles, and to acoustical panels.
   2. Allowable Tolerance of Finished Acoustical Ceiling System: Level within 1/8 inch in 12 feet.

2.02 SUSPENSION SYSTEMS

A. Comply with ASTM C635.

B. Structural Classification: Heavy-duty.

C. Material: Hot-dip galvanized cold-rolled steel.

D. Main and Cross Members: Double-web design with rolled-steel cap.

E. Edge Molding Profile: Channel or angle, minimum flange width of 15/16 inch.

F. Suspension Wire: ASTM A641, Class 1 zinc coating, soft temper, size as prescribed by CBC.

G. Attachment Devices: Size for five times design load required by ASTM C635, Table 1, Direct Hung, unless otherwise indicated.

H. Hold-Down Clips: Concealed, spring-loaded, fully accessible.

I. Finish:
   1. Steel components shall be Bonderized and given a coat of rust-inhibitive paint.

2. Exposed surfaces of components shall have factory-applied semi-gloss white enamel finish, unless otherwise noted.
3. Grid Color: White.

J. Suspension and Grid Types: As specified under Article 2.5 below.

2.03 ACOUSTICAL PANELS

A. Acoustical Panel Types: As specified under Article 2.5 below.

2.04 CEILING TYPES

A. Type ACT-1:
1. Grid: Direct-hung, exposed tee grid, 9/16-inch face.
2. Lay-in Panels: 24 inches x 48 inches x 1 inch thick fiberglass with plant based binders, complying with the following.
a. Edge: Beveled tegular.
b. Texture: Fissured Fine.
c. Finish: Acoustically-transparent scrim with factory-applied paint.
d. NRC: 0.70
e. Light Reflectance: 0.90.
f. Color: White.
g. Fire rating: Class A in accordance with ASTM E84.

B. Type ACT-2:
1. Grid: Direct-hung, exposed tee grid, 9/16-inch face.
2. Lay-in Panels: 24 inches x 48 inches x 1 inch thick fiberglass with plant based binders, complying with the following.
a. Edge: Square tegular.
b. Texture: Fissured Fine.
c. Finish: Acoustically-transparent scrim with factory-applied paint.
d. NRC: 0.95
e. Light Reflectance: 0.86.
f. Color: White.
g. Fire rating: Class A in accordance with ASTM E84.
h. Meet USDA/FSIS guidelines for use in food preparation/kitchens.

C. Refer to Acoustic Report for additional acoustic ceiling tile options.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Patterns shall be accepted by District's Design Consultant before installation of suspension system.

B. Install suspension system, including necessary hangers, grillage, and other supporting hardware in accordance with CBC, ASTM C636 and ASTM E580, manufacturer's instructions, and as specified. The most stringent requirements shall govern.

C. Lay-in Acoustical Panels:

1. Install in grid system in accordance with manufacturer's recommendations and procedures in CISCA publication "Acoustical Ceiling Use and Practice." CBC shall govern if in conflict or more restrictive than CISCA publication.
2. Install in level plane in straight line courses.
3. Minimum Width of Border Panel: One-half panel dimension, unless shown on approved layout.

END OF SECTION

SECTION 09 61 20

CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Clear sealer applied to exposed interior concrete at locations not scheduled to receive an applied flooring material.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for each type of steel stud as may be required to show compliance with specified requirements.

B. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Results of field slip-resistance testing.

1.04 QUALITY ASSURANCE

A. Mockup: Select a text area, in coordination with the District's Design Consultant, as a test area to evaluate application procedure, appearance, and to determine if more than one coat will be required. Test area shall be used by Design Builder to test slip resistance.
   1. Document application rate used for test area.
   2. Allow 5 to 7 days after application before evaluating test area.

PART 2 - PRODUCTS

2.01 PERFORMANCE AND DESIGN CRITERIA

A. Slip Resistance: Dynamic Coefficient of Friction (DCOF) range of 0.35 to 0.45 under wet conditions when measured according to ANSI B101.3. Individual tests shall be made for each contiguous area. Test results shall be reported in writing.

B. Sealer shall not be applied over stains, layout markings, oils, grease, wax, and other contamination caused by Contractor's construction activities subsequent to installation of concrete.

2.02 MATERIALS

A. Sealing Compound at Exposed Concrete Flatwork: Low odor, VOC compliant, waterborne, penetrating water, oil and stain repellent; Consolideck "Concrete Protector WB" by Prosoco, or equal designed to seal and dustproof concrete.

PART 3 - EXECUTION

3.01 PREPARATION

A. Concrete surface shall be examined and prepared in accordance with the surface preparation requirements included in the manufacturers; printed application instructions.

3.02 APPLICATION OF CLEAR SEALER

A. Apply specified sealer in minimum two coats using a low-pressure, non-atomizing spray applicator or by pouring followed by a squeegee or a broom for even distribution in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 64 28

PREFINISHED ENGINEERED WOOD FLOORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Prefinished, engineered, wood flooring.
   2. Acoustic underlayment.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's literature for wood flooring, underlayment pad, and adhesives.

B. Samples:
   1. Random selection from stock, assembled into minimum 18 inch x 24 inch panels of wood flooring for review of appearance.
   2. Indicate if the sample is representative or from the exact lot/unit to be purchased.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Statement of installer qualifications.

1.04 CLOSEOUT SUBMITTALS

A. Manufacturer’s recommended maintenance and cleaning procedures and materials.

B. Manufacturer’s extended warranty.

1.05 QUALITY ASSURANCE

A. Qualifications: Flooring installer shall be acceptable to flooring manufacturer and shall have a minimum of 5-years’ experience installing flooring of the Type specified.

1.06 FIELD CONDITIONS

A. Environmental Conditioning of Space: Maintain relative humidity and ambient temperature planned after occupancy for at least 5 days prior to delivery of wood flooring to site.

B. Wood Flooring Conditioning: Move wood flooring into pre-conditioned spaces of each Unit where it will be installed to allow the moisture content of wood to achieve equilibrium with its environment.
   1. Remove flooring from sealed packages to facilitate acclimation. Stack with sticks between rows.

2. Take the necessary moisture readings to verify the flooring has reached the proper moisture content and when no further changes occur. Moisture content shall be between 9 and 12 percent.
3. Do not install flooring until it reaches a moisture content that is in equilibrium with the conditioned space where it is to be installed.
4. Design Builder shall allow not less than 10 days to allow wood flooring to acclimate at site.

C. Maintain relative humidity and ambient temperature planned for final occupancy of the space throughout conditioning period, installation, remainder of construction period, and until project is turned over to District.

1.07 WARRANTY

A. Manufacturer: Furnish District with manufacturers' written 5-year Commercial Warranty against defects in materials, workmanship, and installation.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide proper end joint stagger of flooring boards.

B. In addition to manufacturers' instructions, comply with the recommendations of the Maple Flooring Manufacturers Association (MFMA) and National Wood Flooring Association (NWFA) as applicable.

C. Installation procedures shall comply with flooring manufacturer's instructions as required to effect the specified warranty.

2.02 MATERIALS

A. Wood Flooring: Prefinished, engineered wood strip or plank flooring, defect free with no knots, sap and pitch.
1. Basis of Design Manufacturer and Product: To be determined by District's Design Consultant.
2. Construction:
   a. Minimum Thickness of Wear Layer: Not less than 4mm.
   b. Total Thickness: 5/8 inch (15mm), minimum.
3. Finish: All natural, VOC compliant system as standard with manufacturer.
4. Additional Field-Applied Topcoat: To be determined by District's Design Consultant.

B. Acoustical Underlayment: "Impacta-ProBase 5" by Impacta Flooring Division of Sound Seal as specified and the basis of design, or equal.
1. Composition: Recycled rubber.
2. Thickness: 5/16 inch (10mm).
3. Perimeter Isolation Strips: Peel and stick as provided by underlayment manufacturer.
4. Provide adhesives and other accessories recommended by membrane manufacturer.

C. Adhesives:
1. Acoustic Underlayment: Low VOC, single component urethane construction adhesive, water-resistant type; "SikaBond-T55," or equal.

2. Wood Flooring:
   a. Typical Locations: Water-resistant type; “Titebond III” premium wood glue by Franklin International, “Bostik’s Best,” or equal.
   b. At Locations over Unheated Spaces: One-part, trowel-applied, moisture cure urethane membrane designed to reduce moisture vapor transmission from substrate; Bostik “MVP4” or equivalent 100 percent waterproof urethane mastic.

D. Cleaner: As recommended by flooring manufacturer.

E. Additional Materials: As recommended by flooring manufacturer and as selected by installer to meet Project requirements.

PART 3 - EXECUTION

A. Adhesives: Mix and apply adhesives uniformly over surface in accordance with manufacturer's instructions.

B. Acoustic Underlayment:
   1. Unroll and allow underlayment to acclimate for 24-48 hours in climate control setting. Do not install product if temperature is below 65 degree F.
   2. Install perimeter isolation strip at wall perimeter of the entire subfloor to isolate or break the vibration transmission path between the floor and the wall.
   3. Install acoustic underlayment pad over substrate with specified adhesive in accordance with manufacturer’s printed instructions with butt joints and without overlapping.

C. Wood Flooring:
   1. Install flooring over acoustic underlayment using adhesive in accordance with manufacturer's instructions.
   2. Pull boards from several boxes at once to mix and hide any color variations.
   3. Set in direction shown or, if not shown, as provided by District’s Design Consultant.
   4. Perimeter:
   5. Allow 3/8 inch clearance for expansion joint between the flooring and walls. Expansion joint shall be covered with scheduled base secured to wall only.

3.02 PROTECTION

A. Close area to traffic for at least 24 hours after installation is complete.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING ANED BASE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Resilient sheet flooring.
   2. Resilient base.
   3. Resilient edge trim and accessories.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Layout and seaming diagrams for resilient sheet flooring. In preparing seaming diagram, keep seams to a minimum, and comply with the following:
   1. Flooring shall be laid in the same direction.
   2. Seams run length of area.
   3. Seams are away from areas subject to pivoting traffic.
   4. Seams are not perpendicular to doorway openings.
   5. Seams parallel to doors are centered directly under door.
   6. Seams at corridor change of direction follow wall line parallel to direction of flooring.

B. Product Data: Manufacturer's technical data for each resilient product required.

C. Verification Samples:
   1. Sheet: 12 inches square or larger if requested by Architect.
   2. Accessories: 9 inches long by full dimension.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Statement of installer qualifications.

B. Verification that flooring meets specified requirements for slip-resistance.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data, including list of recommended maintenance products and procedures for each type of resilient flooring material.

B. Manufacturer’s extended product warranties.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: At least three installations of extent comparable to this Project.[Documented experience in installation of resilient flooring products similar to those specified.]

B. Slip Resistance: Flooring shall provide a value equal to or greater than 0.42 when tested in accordance with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6.

1.06 FIELD CONDITIONS

A. Ambient Conditions:
   1. Maintain temperature in spaces to receive resilient flooring between 70 and 90 degrees F for at least 24 hours before installation, during installation, and 48 hours after installation.
   2. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation.
   3. Maintain minimum temperature of 55 degrees F for remainder of construction period.
   4. Do not install flooring when relative humidity exceeds 45 percent.

B. Install resilient flooring products after other finishing operations, including painting, have been completed.

1.07 WARRANTY

A. Manufacturer: Furnish District with manufacturer's written warranties as available for the products furnished.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Flooring shall:
   1. Be uniform in thickness and size.
   2. Have edges cut accurately and square.
   3. Be uniform in color, with variations in variegated patterns kept to a minimum.

B. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

C. Provide each type of resilient product by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

D. Slip Resistance: Flooring, after application of any specified finishes, shall provide a value equal to or greater than 0.42 when tested in accordance with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6.
   1. If manufacturer of selected flooring does not have test data to substantiate compliance with DCOF AcuTest value, provide alternative testing to verify compliance, including static coefficient value of 0.60 for level surfaces as determined by testing identical products in accordance with ASTM C1028, if acceptable to governing authorities.
   2. Laboratory tests shall be made on a minimum of samples of each material and finish proposed for use.

E. Install resilient flooring products after other finishing operations, including painting, have been completed.

F. Finished floors shall be smooth and free from buckles, cracks, breaks, waves, and projecting edges.

2.02 MATERIALS

A. Sheet Linoleum: Acoustic backed; to be determined by District's Design Consultant.
   1. Pattern: To be determined by District's Design Consultant.
   2. Color: To be determined by District's Design Consultant.
   3. Roll Width: 79 inches (2m).
   4. Gage: 0.17 inches (4.3mm).

B. Resilient Base: ASTM F1861, Type TS, vulcanized rubber.
   1. Provide premolded internal and external corners ordered from same color run as base.
   2. Lengths: Roll
   3. Profiles: Coved base at resilient flooring and other hard surfaces, straight base at carpet tile.
   4. Height: To be finalized by District's Design Consultant.
   5. Color: To be determined by District's Design Consultant.

2.03 ACCESSORIES

A. Adhesives: VOC compliance adhesives as recommended by manufacturer of resilient flooring material for conditions of installation and for each type of flooring.

B. Floor Patch-and-Leveling Compound: Latex cementitious paste for patching, leveling, and ramping. Compound shall be acceptable to manufacturer of resilient flooring material.

C. Heat Welding Rod for Linoleum: As provided by flooring manufacturer.
   1. Color: As selected by District's Design Consultant.

D. Edge Strips: Molded vinyl in profiles as selected by Architect from manufacturer's standards. Unless otherwise specified, match thickness of abutting flooring material.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Perform moisture, alkalinity, and relative humidity tests on cementitious subfloors to verify that substrate meets requirements of carpet manufacturer.

B. Do not proceed with installation until substrate conditions that do not meet requirements of the carpet manufacturer have been corrected or mitigated.

3.02 PREPARATION

A. Comply with ASTM F710 and manufacturer's recommendations for surface preparation.

B. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive.

3.03 INSTALLATION OF SHEET FLOORING

A. Install flooring using adhesives in accordance with manufacturer's instructions and reviewed submittals.

B. Lay sheets with seams square to room axis. Match patterns at seams.

C. Provide welded seams complying with manufacturer's recommendations for welding.

3.04 INSTALLATION OF BASE AND EDGE STRIPS

A. General:
   1. Match edges at seams, or double-cut adjoining lengths.
   2. Install with tight butt joints.

B. Top-Set Base:
   1. Cut into accurate lengths as required for minimum number of joints.
   2. Use premolded corners for internal and external corners.

C. Edge Strips:
   1. Provide edge strips where resilient flooring terminates, exposing edge of covering, and a edge termination is not provided with adjacent flooring material.
   2. Center edge strips under doors where resilient flooring terminates at a door opening.
   3. Install reducer strips where required to provide smooth transition between resilient flooring and other finish.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Carpet tile.
   2. Carpet accessories.

B. Related Requirements:
   1. Portland Cement Underlayment: Section 03 5415; leveling compounds.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Data on proposed products, describing physical and performance characteristics; sizes, patterns, colors, and method of installation.
   2. Product literature for each type of installation accessory required.

B. Samples:
   1. Tile: Full-size carpet tile of each type and color required.
   2. Edge Stripping: 9-inches-long of each type.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Installer qualifications.

1.04 CLOSEOUT SUBMITTALS

A. Extended warranties.

B. Maintenance instructions.

C. Extra stock.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Firm specializing in carpet installation, with not less than 5 years of experience in installation of carpeting similar to that required for this Project.

1.06 AMBIENT CONDITIONS

A. Store carpet tiles at least 3 days prior to installation in area of installation to achieve temperature stability.

B. Follow CRI 104 Standard for room temperature and relative humidity. Maintain these conditions at least 48 hours prior to installation and 72 hours after completion

1.07 GUARANTY AND WARRANTIES

A. Contractor: Furnish District with a written 2-year guaranty, co-executed by the installing subcontractor, agreeing to repair, replace, or reset carpeting that fails in installation materials or workmanship within the specified warranty period. Guaranty shall include removal, replacement, and installation of new carpet tile at no cost to District.

B. Manufacturers: Provide District with the following manufacturer warranties.
   1. Carpet Fiber Manufacturer:
      a. 10 years against surface pile abrasive wear (fiber loss) in excess of 10 percent from date of installation.
      b. Lifetime antistatic.
   2. Carpet Manufacturer:
      a. Subfloor Warranty: Submit carpet manufacturer's warranty that backing material will not react adversely with subfloors over which carpet is to be installed including adhesives, concrete, and other chemicals.
      b. Latent and Patent Defects: Carpet manufacturer shall warrant carpet tiles against product failure after installation including, but not necessarily limited to:
         1) Tiles not being cut true and square.
         2) Pile fuzz.
         3) Dimensional instability such as shrinkage, cupping and doming which adversely affect the ability of the tile to lay flat.
         4) Delamination.
         5) Edge ravel.

1.08 MAINTENANCE

A. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including recommended methods and cleaning frequencies for maintaining optimum conditions of materials under anticipated traffic and exposures.

B. Replacement Materials: After completion of work, deliver not less than 10 percent, to next full carton, of each carpet tile type, color, and pattern installed.
   1. Furnish from same production run as materials installed.
   2. Package replacement materials in full cartons of approximately 20 tiles, clearly identified by appropriate labels including dye lot number.
   3. Deliver and store in accordance with instructions provided by the District.

PART 2 - PRODUCTS

2.01 CARPET TILE

A. Carpet Tiles (CPT): Multi-level pattern loop, eco fiber and backing, 100 percent solution dyed, by Shaw Carpets, Interface Carpets, or equal.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Performance Requirements:
   1. Dimensional Stability (AATCC-16E): Equal or greater than 0.2 percent.
   2. Flammability:

a. DOC FF-1-70: Pass.
b. NFPA 258 (Smoke Density): 450 or less.
c. ASTM E648 (Floor Radiant Panel Test): 0.45 or higher.

3. Static Control: AATCC 134 (Electrostatic Propensity of Carpet). Carpet shall develop less than 3.5 kilovolts of static at 70 degrees F and 20 percent humidity.
4. Colorfastness, Xenon Arc, AATCC 16E: Not less than 4.
5. Atmospheric Fading: AATCC Test Method 129 - Ozone, and AATCC Test Method 23 - Burnt Gas; Minimum shade rating after two cycles in each shall be no less than an International Grey Scale Rating of 3.
6. Crockfastness: AATCC Test Method 164. Minimum stain ratings, International Grey Scale shall be: Wet -4; Dry - 4.

B. Odor: Materials used in construction of carpet tiles shall not give off any odors which could be unpleasant or hazardous to building occupants. This shall include offgassing and chemical migration in backing materials.

C. Pattern Application, if Applicable to Scheduled Carpet Tiles:
1. Registration shall be precise so that no pattern mismatch is evident after installation.
2. Definition of pattern shall be sharp with no halo or bleeding of color; match definition quality of approved samples.
3. Consistency shall be such that any tile shall be interchangeable with any other tile, within a dye lot, with no visual difference.

D. Carton Labeling: Mark each carpet tile carton according to style, color, pattern, pile direction and dye lot.

2.03 ACCESSORIES

A. Adhesives: Release type, waterproof, with no adverse effects on indoor air quality, acceptable to the carpet and carpet backing manufacturers, and meeting the VOC requirements.

B. Resilient Edge Strips:
1. Material: Anodized aluminum edge by Schluter Systems, or equal.
2. Profiles: To be approved by the District’s Design Consultant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Perform moisture, alkalinity, and relative humidity tests on cementitious subfloors to verify that substrate meets requirements of carpet manufacturer.

B. Do not proceed with installation until substrate conditions that do not meet requirements of the carpet manufacturer have been corrected or mitigated.

3.02 PREPARATION

A. Follow carpet manufacturer's recommendations and instructions to ensure that each substrate is properly prepared to receive the approved type of carpet tile.

B. Apply sealer on porous concrete surfaces where required to prevent dusting.

3.03 INSTALLATION

A. Apply in accordance with manufacturer's instructions and requirements of CRI 104.

B. Integrate and blend carpet tiles from different cartons to ensure minimal variation in color match.

C. Install tiles from same dye lot within each continuous carpet area.

D. Layout: As recommended by manufacturer to approved carpet tile. Where there are multiple layout options, coordinate preferred layout with the District's Design Consultant.

E. Install carpet tiles with 100 percent adhesive coverage at:
   1. Perimeter of spaces.
   2. Cut tiles.
   3. High traffic lanes.

F. After installation, carpet tiles within a continuous carpet area exhibiting a difference in appearance due to color or light reflectance variation attributed to the manufacturing process shall be selectively relocated or replaced.

3.04 FIELD QUALITY CONTROL

A. Snugness Testing:
   1. Measure distance along ten installed tiles. There should be a 1/4 inch gain in distance along ten installed tiles.
   2. If gain is less than 1/4 inch, peaking of tiles can occur. A wide gap between tiles may occur if gain is more than 1/4 inch.

END OF SECTION

SECTION 09 82 00

ACOUSTICAL INSULATION AND SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Acoustic batt insulation.
   2. Acoustical sealants and accessories.
   3. Sound isolation requirements.

B. Related Requirements:
   1. Acoustical Report in Appendix.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications for each type of insulation and sealant.

B. Samples: Each type of pipe isolation system or product.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Comply with Flame Spread Rating and Smoke Density requirements of CBC Section 707.

B. Sound Isolation:
   1. Ceilings – General:
      a. Provide a minimum 25 percent open area by spacing slats appropriately
      b. Provide 1 inch thick black faced duct liner boards or mats directly on top of the wood slats.
   2. Walls – General:
      a. Provide sound absorbent material having an NRC of approximately 0.7.
         1) Actual area to cover and material to be determined.
   3. At Platform Space:
      a. Ceiling to be covered for approximately 50 percent of the area with acoustic clouds.
      b. Walls to be lined with sound absorbing panels having an NRC of approximately 0.7 to 0.9 for between 30 percent and percent of their area.
   4. Corridors leading to Banquet Hall:
      a. Perforated gypsum wallboard at entire ceiling surface area with minimum NRC of 0.7.
   5. Seal sound-insulated partitions airtight with acoustical sealant, in accordance with ASTM C919 and manufacturer's recommendations.
   6. Install acoustical sealant at sound-rated partitions.

7. Intersections: Hold gypsum board back a maximum of 1/4 inch from intersecting gypsum board with floor or other surfaces, and apply a bead of acoustical sealant. Caulk void full and airtight with acoustical sealant.
8. Penetrations:
   a. Penetrations by conduits, ducts, pipes, and around electrical junction boxes shall be sealed airtight.
   b. Holes smaller than 1 inch but too large to seal with sealant shall first be packed with mineral fiber and then sealed airtight.
   c. Holes larger than 1 inch shall first be packed with glass or mineral fiber, then sealed over with acoustical putty pads, and then sealed airtight.
   d. Backs of electrical junction boxes in acoustically rated construction shall be sealed airtight with specified pads.
9. Install pipe isolation system wherever a pipe penetrates a stud or framing member.

2.02 MATERIALS

A. Sound-Control Batt: Unfaced, friction fit, preformed slag mineral or glass fiber with thermosetting resin binders, conforming to ASTM C665, Type I.
   1. Manufactured Products:
      a. OCF QuietR
      b. JM LinAcoustics
      c. CertainTeed Tough-Guard
      d. Thermafiber
      e. Or equal.
   2. Thicknesses at Wall Cavity: Full thickness.
   3. Surface Burning Characteristics: ASTM E84.
      a. Smoke Developed: 50 or less.
      b. Flame Spread: 25 or less.
   4. Combustibility: Pass ASTM E136.

B. Sound-Control Batt at Platform Ceiling:
   1. Manufactured Products:
      a. Conwed
      b. G&S Cloud Diffusers
      c. Or equal.

C. Sound-Control Batt at corridors leading to Banquet Hall:

D. Platform Ceiling:
   1. Manufactured Products:
      a. CertainTeed Gyptone
      b. GypSorb
      c. VOGL by Pyrok
      d. Or Equal.

E. Sealant Backer Rod: Compressible, rod-stock, polyethylene foam; nongassing, polyethylene-jacketed polyurethane foam; butyl-rubber foam; neoprene foam; or other flexible, permanent, durable, nonabsorptive, closed-cell material as recommended for compatibility with sealant by sealant manufacturer.

F. Miscellaneous Fastenings and Accessories: As acceptable to insulation manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION OF ACOUSTICAL INSULATION

A. Install to fill completely all typical and odd spaces in framing where required.

B. Install snugly between framing members. Fit ends snugly between units and against adjacent construction.

C. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.

D. At doorframes, cut additional strips of insulation, and hand-pack as necessary to fill voids thoroughly.

E. Install glass fiber batt insulation, R=11 minimum, in otherwise uninsulated wall or ceiling cavities containing plumbing pipes.

F. Prior to closing walls, obtain observation of insulation installation by District's Design Consultant.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Painting and painter's finish on exposed exterior and interior surfaces to complete the finishing of the Work.

1.02 ACTION SUBMITTALS

A. Schedule: Proposed manufacturers products grouped by System using same System identification included in these Specifications.

B. Product Data: Manufacturer's technical information for each product scheduled including paint label analysis and application instructions.

C. Color Samples:
1. Appropriately label and identify each sample, including location and application. Include manufacturer's name, color number, and gloss units.
2. Each sample shall have stepped finish, clearly showing each coat and build-up of specified finish. Submit separate samples for each required gloss level.
3. Resubmit samples as requested until sheen, color, and texture are acceptable to the District’s Design Consultant.

D. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance materials.

1.04 MAINTENANCE MATERIALS

A. At completion of the Work, deliver to District extra stock of paint of each color used in each coating material used in full, tightly sealed, and clearly marked containers.

B. Provide the following quantities:
1. Field Colors: One 5-gallon container.
2. Accent Colors: One 1-gallon container.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications:
1. Not less than 5 years of documented experience in painting work similar in scope to work of this Project.
2. Maintain a crew of painters who are fully qualified to satisfy requirements of this Section.

B. Field Samples:
   1. Request review, by the District's Design Consultant, of first finished area, room, space, or item of each finish type or color scheme required for color, texture, and workmanship.
   2. Modify selected colors, if requested by District's Design Consultant, to achieve desired effect.
   3. Use accepted surface as the Project standard for each color scheme.

1.06 AMBIENT CONDITIONS

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.

1.07 GUARANTY

A. Color and Life of Film:
   1. At the end of 1 year, colors of surfaces shall have remained free from serious fading. Variations (if any) shall be uniform.
   2. Materials shall have their original adherence at end of 1 year. There shall be no evidence of blisters, running, peeling, scaling, chalking, streaks, or stains at end of this period.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Single-Source Responsibility:
   1. To the maximum extent practicable, select a single manufacturer to provide all materials required by this Section, using additional manufacturers to provide systems not offered by the selected principal manufacturer.
   2. For each individual system:
      a. Provide primer and other undercoat paint produced by same manufacturer as finish coat.
      b. Use thinner within manufacturer's recommended limits.

B. If more than one quality level of product type is marketed, use material of highest quality.

C. Primers:
   1. Provide finish coats that are compatible with prime paints used.
   2. Provide barrier coats over incompatible primers, or remove and re-prime as required.

D. Deliver paints and stains ready mixed to jobsite.

E. Finish coats shall be smooth and free from brush marks, streaks, laps or pileup of paints, and skipped or missed areas.

F. Edges of paint adjoining other materials or colors shall be clean and sharp with no overlapping.

G. Top and bottom edges of doors shall receive same paint system finish required for door faces.

H. Do not paint over fire-rating labels, fusible links, or sprinkler heads.

I. For field-applied coatings, adjust natural finishes as necessary to obtain identical appearance on veneers and solid stock.

J. Items without factory finish such as conduits, pipes, access panels, and items of similar nature shall be finished to match adjacent wall and ceiling surfaces, unless otherwise directed.

2.02 MANUFACTURERS AND PRODUCTS

A. Acceptable Manufacturers: PPG Glidden Professional, Benjamin Moore, Sherwin-Williams, Kelly Moore, Dunn-Edwards, Vista, or equal.

2.03 COLORS

A. The District's Design Consultant will prepare a color schedule with samples for guidance of the Design Builder and reserves right to select, allocate, and vary colors on different surfaces throughout building. Selected colors may be from manufacturer's standard palette or be custom mixed.

PART 3 - EXECUTION

3.01 PREPARATION

A. General: Protect hardware, nameplates, switch plates, lighting fixtures, stainless steel, aluminum, and other surfaces that are not to be painted by masking, by removal, or by other means to ensure a neat job.

B. Wood - General:
   1. Cleaning and Sanding:
      a. Remove handling marks and effects of exposure to moisture with a thorough, final sanding over all exposed surfaces, using 150-grit or finer sandpaper.
      b. Clean and vacuum before applying sealer or finish.
      c. Do not sand resawn surfaces.
   2. Wood to Receive Opaque Finish: Fill nail holes, cracks, open joints, and other defects with filler after priming coat has dried. Color shall match finish color.
   3. Wood to Receive Transparent Finish:
      a. Remove any material that would adversely affect penetration or appearance of finish.
      b. Do not seal wood surfaces to receive transparent finish.

C. Gypsum board shall be prepared and finished for painting as specified in Section 09 29 00, "Gypsum Board."

D. Metals:
   1. Remove mill scale, rust, and corrosion.
   2. Clean oils, grease, and dust from surfaces.
   3. Soluble Salts: Removal of soluble salts from bare metal and galvanized metal surfaces, both interior and exterior, is required prior to application of primer coats to preclude premature coating failure and accelerated corrosion.
      a. Removal shall be in accordance with SSPC-Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates."
      b. Abrasive blasting, where specified as a required surface preparation procedure, shall be performed after removal of soluble salts. Abrasive blasting is not an acceptable procedure for removal of soluble salts.

3.02 APPLICATION

A. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

B. Shop-fabricated and finished metal and millwork items shall be shop spray finished to the greatest extent possible.

C. Application:
   1. Apply paint with suitable brushes, rollers, or spraying equipment.
   2. Hollow metal doors and doorframes, and other exposed metal requiring field finish painting, shall be sprayed to the fullest extent conditions will permit. If brush or roller application is used, surface finish shall be subject to review by the District's Design Consultant for complying with the appearance requirements specified herein.
   3. Apply coatings in accordance with manufacturer's recommendations.
   4. Rate of application shall be within limits recommended by paint manufacturer for respective substrate.

D. Spray-Gun Application - Standard Coatings:
   1. Spray-apply standard paints only with airless sprayer.
   2. When necessary, follow by brushing to ensure uniform coverage and to eliminate wrinkling, blistering, and air holes.

E. Comply with recommendation of product manufacturer for drying time between succeeding coats.

F. Refinish whole area where portion of finish is not acceptable.

G. Paint visible surfaces behind vents, registers, or grilles flat black.

3.03 PAINT SYSTEMS

A. General:
   1. Only major areas are scheduled, but miscellaneous and similar items and areas within room or space shall be treated with suitable system.
   2. This Specification shall serve as guide and is meant to establish procedure and quality. Confer with the District's Design Consultant to determine exact finish desired.
   3. Number of coats scheduled is minimum. Additional coats shall be applied at no additional cost as required to hide base material completely, produce uniform color, and provide required and satisfactory finish.

B. Surfaces Not to Be Painted:
   1. Prefinished wall, ceiling, and floor coverings.
   2. Items with factory-applied final finish.
   3. Concealed ducts, pipes, and conduit.
   4. Surfaces specifically scheduled or noted on the Drawings as not to be painted.

C. Acceptance of Final Colors: Final coat of paint for both exterior and interior shall not be applied until colors have been accepted by the District's Design Consultant.

D. Gloss and Sheen Ratings: Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following limits in conformance with Master Painters Institute, Inc. (MPI) Standards according to ASTM D523. Not all of the Gloss Levels are necessarily scheduled or used on this Project.

1. Gloss Level 1: Matte or Flat; not more than 5 units at 60 degrees and 10 units at 85 degrees.
2. Gloss Level 2: Velvet or Low Sheen; not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
3. Gloss Level 3: Eggshell; 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
4. Gloss Level 4: Satin; 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
5. Gloss Level 5: Semi-gloss; 35 to 70 units at 60 degrees.

E. Clarification of System Terminology:
1. Interior paint Systems are specified and identified herein by initial letters “INT.”
2. Exterior paint Systems are specified and identified herein by initial letters “EXT.”
3. Initial numbers for each System identify the substrate to be coated.
4. Letter following substrate numbers identify the general finish coat chemistry summarized as follows:

CODE	DESCRIPTION
A	Standard acrylic
F	Epoxy
H	Aliphatic Polyurethane
M	High dispersion acrylic polymer
S	Semi-Transparent Preservative Stain

5. Hyphenated suffix identifies the topcoat gloss levels.

F. Interior Painting Systems: To be determined by District’s Design Consultant.

I INT 3.1A-1
Standard Performance Latex on Concrete - Gloss Level 1

1 coat	Acrylic Primer-Sealer
1 coat	Vinyl Acrylic Flat

INT 5.1A-5
Standard Performance Acrylic on Shop-Primed Metal - Gloss Level 5

2 coats	100% Acrylic Semi-Gloss

NT 5.2A-5
Standard Performance Acrylic Latex on Galvanized Metal - Gloss Level 5

1 coat	DTM Metal Primer-Red
2 coats	100% Acrylic Semi-Gloss

INT 5.3M-3
Premium Performance Acrylic on Decorative Metal – Gloss Level 5

Surface Preparation and Shop Primer	As specified in respective metal Section in Division 05.
1 coat	High dispersion pure acrylic polymer applied 2.0 to 3.0 mils DFT

Note: Provide additional topcoat if required to achieve complete hiding.
Modify scheduled topcoat if other than specified gloss level is selected by Architect.

INT 6.3D-1
Transparent Finish on Base and Trim - Gloss Level 1 (Flat/Matte):

2 coats	To be finalized by Architect

System components as required to match Architect’s control sample.

INT 6.3A-5
Standard Performance Acrylic on Dressed Lumber - Gloss Level 5

1 coat	Acrylic Primer
2 coats	Latex Semi-Gloss

INT 9.2A-1
Standard Performance Acrylic on Gypsum Board - Gloss Level 1

1 coat	Acrylic Primer
2 coats	100% Acrylic Flatl

INT 9.2A-3
Standard Performance Acrylic on Gypsum Board - Gloss Level 3

1 coat	Acrylic Primer
2 coats	100% Acrylic Eggshell

INT 9.2A-5
Standard Performance Acrylic on Gypsum Board - Gloss Level 5

1 coat	Acrylic Primer
coats	100% Acrylic Semi-Gloss

INT 9.2F-5
Waterborne Epoxy-Modified Latex on Gypsum Board - Gloss Level 5

1 coat	Primer/sealer tinted to finish color
1 coat	Waterborne Semi-gloss Epoxy Polyamide

G. Exterior Painting Systems: To be determined by District's Design Consultant.

EXT 5.3A-5
Acrylic on Shop Primed Hollow Metal Doors and Frames - Gloss Level 5

2 coats	Acrylic Semi-gloss

EXT 5.3H-5
High-Performance Aliphatic Polyurethane on Galvanized Decorative Metal - Gloss Level 5

1 coat	Two-component, VOC compliant, water-based epoxy tinted to match color of topcoat (if primer not shop applied)
2 coats	VOC compliant polyester-acrylic aliphatic polyurethane

Note: Provide additional topcoat if required to achieve manufacturer's recommended total DFT (primer plus finish coats), or to achieve complete hiding for selected color.

EXT 6.3S-1
Semi-Transparent Finish on Wood Siding - Gloss Level 1 (Flat/Matte):

1-coat	"LifeTime" Wood Treatment"	Non-toxic wood stain by Valhalla Wood Preservatives Ltd.

System components as required to match District's control sample.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: The following signage:
   1. Stainless Steel exterior building signage.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Full-scale drawings for each sign indicating materials, lettering layout, and colors.

B. Product Data: Manufacturer's specifications, recommendations, and installation instructions for each sign Type.

C. Samples:
   1. One sample of each sign Type. Signs acceptable to the District's Design Consultant may be installed as part of the work.
   2. Sample letter, as selected by the District's Design Consultant, of exterior pin-mounted letters.
   3. Complete typeface fonts.
   4. Samples of letter and word spacing for each letter size.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Signage shall conform to the following:
   1. ANSI A-117.1 and the Americans with Disabilities Act (ADA).
   2. ATBCB Design Guidelines for Signage in relation to the Americans with Disabilities Act.
   3. California Code of Regulations, Titles 19 and 24.
   4. Signage shall conform to CBC Sections 1003, 1103.2.4, and 1117B.5 and the Authorities Having Jurisdiction.
   5. Uniform Sign Code.

B. California Grade 2 Braille shall be used whenever Braille symbols are specifically required. Refer to CBC Section 1117B.5.2.

2.02 MATERIALS AND COMPONENTS

A. General: Materials listed below are not necessarily all-inclusive, nor are all materials listed necessarily required to be used based on final designs and layouts provided by District's Design Consultant.

B. Photopolymer: BASF, Jet, or equal.

C. Acrylic Sheet: ASTM D702, Type III.

D. Stainless Steel: Provide stainless-steel plate, sheet, and strip, Type 302 or Type 304, complying with ASTM A666.

E. Steel Sheet: Commercial-quality, cold-rolled, stretcher-leveled, carbon-steel sheet complying with ASTM A366, Class I, matte finish, galvanized.

F. Anchors and Inserts: Nonferrous metal or hot-dipped galvanized anchors and inserts as required for corrosion resistance.

G. Silk-Screen Ink: Opaque enamel; Series 1100 “Sty-Ra-Lac,” by Naz-Dar, Matthews Screen “MAP,” or equal. Screen materials and methods to be in accordance with manufacturer’s specifications.

H. Adhesive: As recommended by sign manufacturer.

2.03 METAL FINISHES

A. General:
1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
3. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved samples and are assembled or installed to minimize contrast.

B. Stainless Steel:
1. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
2. Appearance: Bright, directional polish, No. 4 finish.
3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
1. Exterior signage shall be mechanically fastened.
2. Install signs level and plumb with sign surfaces free from distortion or other defects in appearance.
3. Coordinate final locations with the District’s Design Consultant.

B. Applied Copy Signs and Graphics:
1. Apply signage and graphics centered and level, in line, in accordance with manufacturer's recommendations.

2. Job site applied vinyl graphics shall be applied and pre-spaced on application tape prior to installation.

3.02 FIELD QUALITY CONTROL

A. In addition to review by the District's Design Consultants, Design Builder shall arrange to have signs field inspected after installation in accordance with CBC 11B-703.1.1.2 Inspection.

B. Damaged signs shall be repaired to the satisfaction of the District's Design Consultant, or shall be replaced.

3.03 SIGNAGE SCHEDULE

A. To be provided by the District's Design Consultant.

END OF SECTION

SECTION 10 21 13

STAINLESS STEEL TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Floor anchored stainless steel toilet partitions.
   1. Wall-hung stainless steel urinal screens.

B. Related Requirements:
   1. Toilet Accessories: Section 10 28 13; accessories mounted on partitions.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Show elevations of partitions with relationship to adjacent construction, full-size sections, anchorage and attachment to other work, hardware, and other related items and installation details.

B. Product Data: Manufacturer's data sheets, parts list, installation instructions, and maintenance procedures.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.04 WARRANTY

A. Manufacturer: Furnish District with manufacturer’s 5-year warranty against corrosion or discoloration of stainless steel and compartment components.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the ADA “Standards for Accessible Design, CBC and ICC A117.1 for toilet compartments designated as accessible. Where a conflict occurs, comply with the most stringent.

2.02 METAL TOILET COMPARTMENTS

A. Toilet-Enclosure Style: Floor anchored.

B. Urinal-Screen Style: Wall supported flat panel type, manufacturer’s standard size unless otherwise shown.

C. Finish: Stainless steel mechanically polished to No. 4 satin appearance.

2.03 COMPONENTS

A. Doors and panels shall be not less than 1-inch thick, constructed of two sheets of minimum 22-gauge, stretcher-leveled quality stainless steel formed and bonded under pressure with a non-toxic adhesive to a resin-impregnated, sound-deadening full-face honeycomb core.

B. Pilasters shall be not less than 1-1/4-inch thick, constructed of two sheets of minimum 18-gauge stainless steel, formed and bonded under pressure with a non-toxic adhesive to a full resin-impregnated, sound-deadening full-face honeycomb core.

C. Hardware and Fittings: Stainless steel, type 304, satin finish. Provide for each compartment:
   1. Top and Bottom Hinges: Self-closing, self-lubricating, swing as indicated, gravity-return movement, adjustable to hold door open at any angle up to 90 degrees.
   2. Latch: Combination rubber-faced door strike and keeper, equipped for accessible and emergency access. U-shaped handle below latch and sliding latch.
   3. Coat Hook: Combination unit with hook and rubber-tipped pin; mounted 48 inches above finish floor.
   4. Door Pull: Inswing door type on inswinging doors, outswing door type on outswinging doors. Install on both sides, below latch, of door to accessible compartment.
   5. Hardware shall be ADA compliant and meet CBC accessibility requirements.

D. Pilaster Shoes: Plinths, one piece, 4 inches high, hemmed top and bottom, formed to fit pilaster, with concealed clips.

E. Wall Brackets:
   1. Panels: Two-ear "T" style.
   2. Angle may be used where "T" style will not fit in space available.

F. Fasteners: As recommended by partition manufacturer. Provide theft-resistant, one-way heads, finished to match hardware, at exposed fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Install partitions rigidly, straight, plumb, and level.
   2. Provide clearances of not more than 1/2 inch between pilasters and panels.
   3. Provide clearances of not more than 1 inch between panels and walls.
   4. Secure panels to walls with not less than two wall brackets per panel, attached near top and bottom of panel.
   5. Conceal evidence of drilling, cutting, and fitting to room finishes.
   6. Fastening shall be to solid backing; do not use toggle bolts.

B. Install pilasters with anchors into structural floor.

C. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Erection Tolerances:
   1. Maximum Variation From True Position: 1/4 inch.

2. Maximum Variation From Plumb: 1/8 inch.

END OF SECTION

SECTION 10 26 12

CORNER GUARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Resilient corner guards, mounting hardware, and accessories.

1.02 SUBMITTALS

A. Product Data: Manufacturer's catalog cuts and data sheets, including installation details and instructions, for each item specified.

B. Samples:
   1. Initial Samples: Complete chart of manufacturer's available colors for selection by District's Representative.
   2. Verification Samples:
      a. 6-inch section long section of crash rail in selected color. Include mounting and end cap.
      b. 6-inch-square samples of solid surfacing in each selected color.

1.03 INFORMATIONAL SUBMITTALS

A. Manufacturer's certification that PETG products meet specified physical and performance requirements. Results of tests specified shall accompany certification.

1.04 QUALITY ASSURANCE

A. Mockups:
   1. First installed example of each product shall serve as a mockup for review by District's Representative of workmanship, installation, and visual effect.
   2. Coordinate location of mockup with District's Representative.
   3. Make modifications when requested.
   4. Accepted mockups may remain as part of completed work.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Do not deliver or install impact-resistant wall protection products until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 degrees F for not less than 72 hours before beginning installation and for the remainder of the construction period.

B. Store materials in area of application; allow three days for material to reach same temperature as area.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Flammability: ASTM E84.
   1. Smoke Developed: Less than 450.
   2. Flame Spread: 25 or less.

2.02 CORNER GUARDS

A. Corner and Edge Guards: High impact polycarbonate, 0.1 inch thick, mechanically attached to substrate with screws; Model CGLS fabricated of “Lexan” by Nystrom, Minneapolis, MN, 800-547-2635 as specified and the basis of design, or equal.
   1. Corner Angle: 90 degrees, standard
   2. Wing Size: 2 inches by 2 inches.
   3. Height: 48 inches.
   4. Corner Radius: 1/ 8 inch.
   5. Mounting: Screws though pre-drilled holes.
   6. Locations: As noted on the Drawings.
   7. Color: Clear.

B. Fasteners: #6 chrome plated pan head screws, 1-1/4 inch long.

PART 3 - EXECUTION

3.01 EXAMINATION

A. After finish painting of walls is complete, examine areas and conditions under which guards are to be installed to assure that substrate is complete and ready to receive corner guards and wall base has been installed.

B. Do not proceed until discovered defects have been corrected by other trades and surfaces are ready to receive corner guards.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's installation instructions and as shown on the Drawings.

B. Place the corner guard in position with bottom at top of resilient base and secure to solid backing using specified fasteners though pre-drilled holes.

3.03 CLEANING

A. Prior to time of final acceptance, strip protective coverings, and clean in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 28 13

TOILET ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Contractor furnished and installed toilet and bath accessories.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices and cutout requirements in other work.

B. Product Data: Manufacturer's catalog cuts and data sheets, complete parts list, and installation requirements for each accessory item specified.

C. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance data and operating instructions.

B. Keys for each locking unit.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Regulatory Requirements: Meet applicable requirements of CBC and ADA Standards for Accessible Design.

B. Locked Dispensing Units shall be keyed alike.

C. Adhesive shall meet VOC requirements.

2.02 TOILET ACCESSORIES

A. Manufacturer: Bobrick Washroom Equipment, Inc. as specified and the basis of design, or equal.

B. Toilet Tissue Dispenser: Professional Combo Unit Toilet Paper Dispenser (in Black / Smoke), by Kimberly Clark, Model # 09551.

C. Toilet Seat Cover Dispenser: Stainless steel; Bobrick “Contura Series” #B-4221.

D. Grab Bars: 1-1/2 inch diameter, stainless steel, with snap flanges; Bobrick Series #B-5806.
1. Lengths as indicated.

E. Recessed Sanitary Napkin/Tampon Dispenser: Bobrick #B-37063C.

F. Surface-Mounted Sanitary Napkin Disposal: Stainless steel; Bobrick Contura Series #B-270.

G. Surface-Mounted Paper Towel Dispenser: Surface mounted roll towel dispenser, stainless steel, pull-towel mechanism; Bobrick #B-262.

H. Lavatory-Mounted Soap Dispenser: Bobrick #B-822.

I. Mop/Broom Holder: Stainless steel; Bobrick #B-223 x 24 inches
   1. Provide at Janitor Room mop sink locations.

J. Semi-Recessed Trash Receptacle: Bobrick #B-3644 with 18-gallon stainless steel receptacle, 368-60.

K. Coat Hook: Steel fork kook, stainless steel, Model #RU-50 by Sugatsune, (in restrooms and changing rooms).

L. Baby Changing Station: Horizontal changing station, Model KB200-SS, in stainless steel, by Koala Kare.

2.03 ADDITIONAL MATERIALS AND PRODUCTS

A. Fastenings:
   1. Type: As standard with the accessory item manufacturer and as recommended by manufacturer for each substrate.
   2. If not concealed, provide theft-proof type to match accessory item finish.
   3. Hot-dip galvanize ferrous metal anchors and fastening devices.

B. Concealed Anchor Plates for Grab Bars Bobrick "Series 256," or equal.

C. Exposed Plumbing Insulation at Lavatories: Molded closed cell vinyl, ADA conforming P-trap and angle valve under sink protective pipe covers; "Lav-Guard" by Truebro, Inc., 800-340-5969, or equal.
   1. Finish: Standard white.
   2. Provide with required accessories.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's recommendations and code accessibility requirements, plumb, true to line, complete with all required fasteners and accessories, securely anchored to backing, blocking, or building structure.

B. Trademarks shall not be visible in the finished installation.

C. Attach grab bars to backing installed in walls to withstand loads prescribed by CBC.

END OF SECTION

SECTION 10 31 20

GAS FIREPLACE APPLIANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Prefabricated, gas fireplace appliance.
   2. Metal exhaust flue for vented appliance.
   3. Accessories as specified.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Submit for installation configuration showing relationship to adjacent construction, flue, gas and electrical stub-out locations, and location of wall control and gas shut-off valve.

B. Product Data: Manufacturer's specifications and installation instructions for appliance. Clearly indicate accessories to be provided and finishes.

C. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 CLOSEOUT SUBMITTALS

A. Manufacturer's printed instructions for operation and safe use of fireplace and components.

B. Extended warranty.

1.04 WARRANTY

A. Manufacturer: Furnish District with manufacturer’s Limited Lifetime Warranty for gas units, including fiber logs, stainless steel burner, firebox, and heat exchanger.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Prefabricated fireplace units shall be UL listed and local code approved.

B. Flue system shall be tested and conform to UL-441.

2.02 DIRECT VENT APPLIANCE

A. Manufacturer and Type: “Primo” direct vent gas fireplace, by Heat & Glo, a brand of Hearth & Home Technologies Inc., Lakeville, MN, Tel: 888-427-3973, or equal.

B. Components, Venting, Controls and Accessories: To be provided by fireplace manufacturer as a complete package, including venting and flue.
   1. Framing Kit: Manufacturer's framing kit of noncombustible material. Zero clearance to combustible materials.
   2. Gas valve control: Wall mounted control system and hand held programmable remote.
   3. Ignition System: Electronic.
   4. Additional Accessories: *To be finalized by Architect.*

C. Vent: Provide required starter sections, exterior vent terminations, and other accessories for installation.

D. Fasteners and Anchors: Galvanized or stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install fireplace and accessories in accordance with manufacturer's printed instructions, and as required by local governing agencies.

B. Maintain required minimum clearance between fireplace appliance and flue and combustible materials.

3.02 TESTING

A. After installation, test fireplace operation as recommended by manufacturer and make required adjustments for proper operation.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fire extinguishers, hangers, and cabinets.

1.02 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for fire extinguishers and cabinets required.

B. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance data for fire extinguishers to include in maintenance manuals.

B. Warranty as specified.

1.04 WARRANTY

A. Manufacturer: Furnish District with manufacturer’s 6-year written warranty in which manufacturer agrees to repair or replace fire extinguishers that fails in materials or workmanship within specified warranty period. Failure includes, but is not limited to, the following:
1. Failure of hydrostatic test according to NFPA 10.
2. Faulty operation of valves or release levers.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Fire extinguishers and cabinets shall be furnished from only one manufacturer.

B. Fire extinguishers shall be UL listed, conforming with ANSI/UL 711, and bear UL "Listing Mark" for type, rating, and classification of extinguisher.

C. Cabinets shall meet “ADA Standards for Accessible Design” requirements for mounting height and projection from wall.

D. Fire Extinguishing Agent: Provide clean agent which does not contain halons or HCFCs.

2.02 EQUIPMENT

A. Fire Extinguishers:
   1. Typical: Multipurpose dry chemical type, 5-pound capacity, UL Rating 2A-10B:C.
   2. Kitchen: Class K in accordance with CFC Section 904.11.5.
   3. Mechanical and Electrical Rooms: Multipurpose dry chemical type, UL Rating 4A:20BC.

B. Fire Extinguisher Cabinets – Public Spaces: Larsen's "Architectural" Series, or equal.
   1. Mounting: Fully-recessed.
   2. Size: To fit specified extinguishers.
   3. Cabinet Trim: Square, 5/16-inch, flat.
   4. Door Style: "Vertical Duo," with acrylic panel.
   5. Latching Device: Zinc-plated pull handle with self-adjusting roller catch.
   6. Material: Steel with white baked enamel finish suitable to receive topcoat in custom color selected by District's Design Consutlant.
   7. Provide mounting clips, suitable for extinguishers being provided, in each cabinet.

C. Fire Extinguisher Cabinets – Back of House: Larsen's "Architectural" Series or accepted equal.
   1. Mounting: Semi-recessed.
   2. Size: To fit specified extinguishers.
   3. Cabinet Trim: Square, 1-1/4 inch.
   4. Door Style: "Vertical Duo," with acrylic panel.
   5. Latching Device: Zinc-plated pull handle with self-adjusting roller catch.
   6. Material: Steel with white baked enamel finish.
   7. Provide mounting clips, suitable for extinguishers being provided, in each cabinet.

D. Mounting Brackets for Surface-Mounted Extinguishers at Utility Areas: Larsen's 821, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cabinets and extinguishers where i as required by the City Fire Department with final locations coordinated with the District's Design Consultant.

B. Provide fire extinguisher in each cabinet.

C. Determine the date of Substantial Completion of the Work. Inspect, charge, and tag the fire extinguishers within 10 days before the Substantial Completion date.

END OF SECTION

SECTION 11 40 00

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. The work referred to in this section consists of furnishing all labor and material required to provide and deliver all food service equipment hereinafter specified into the building, uncrate, assemble, hang, set in place, level, and completely install, exclusive of final utility connections. Final utility connections to all equipment, shall be part of the work under additional appropriate sections of the work and not part of the food service work.
   1. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. Parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement and repair.
   2. The materials or products specified herein by trade names, manufacturer's name or catalog number shall be provided as specified. Substitutions will not be permitted unless approved by owner's representative in writing no later than 10 days prior to bidding. This stipulation applies to all equipment and materials.
      a. Any request for substitution or alternate will include documentation supporting that the requested substitution/alternate will perform in all aspects as well as the original specification.
      b. Should no request for substitution be received and approved as stated above, the project is to be provided as specified.
   3. The food service equipment contractor shall be responsible for all costs associated with the acceptable alternate or approved alternate items, if the item requires additional space or specific utilities that differ from specifications or drawings. The FSEC is responsible for all coordination, documentation and costs associated with any alternate item that was not submitted for approval and accepted by the consultant prior to bid. The FSEC shall be responsible for any costs associated with building changes, utility changes and drawings changes.

B. Coordinate Owner and Vendor-supplied equipment noted on the drawings or in the specifications as NIFSEC, "not in food service equipment contract". Show on roughing in Plans and sizes, utilities, and other requirements as furnished in the specifications, by owner or appropriate supplier in submittals as if the equipment is contractor furnished.

C. Bidders shall carefully examine the specifications and the project site including location and condition of existing equipment to determine cost for each "Existing-Reset" and "Existing-Modify" item to cover removal, modification (including materials), cleaning, inspection for damage, repair and resetting.

D. Field measurements shall be made prior to fabrication or installation of any equipment item.

E. The cutting of holes in equipment for pipe, drains, electrical outlets, etc., required for this installation, shall be part of this work. Work shall conform to the highest standards of workman-ship and shall include welded sleeves, collars, ferrules and escutcheons.

F. Repair of all damage to the premises as a result of the equipment installation as well as the removal of all debris left by the work of this section.

G. Food service equipment and fixtures shall be cleaned and ready for operation at the time the facility is turned over to the Owner for final inspection by the Owner's Representative.

H. Food Service Equipment Contractor shall be responsible for coordinating with the Architect and Contractor in submitting all applicable documents.

I. All bidders shall submit with their costing a list of the subcontractors that are included in their bids and a complete "schedule of values" for all equipment and labor.

1.02 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Work In Other Sections by appropriate trades include the following:
   1. Division 5 Section "Metal Fabrications" for equipment supports.
   2. Division 6 Section "Interior Architectural Woodwork" for wood casework and plastic laminate substrates.
   3. Refer to Division 23 Sections for supply and exhaust fans; exhaust ductwork; service roughing-ins; drain traps; atmospheric vents; valves, pipes, and fittings; fire extinguishing systems; and other materials required to complete food service equipment installation.
   4. Refer to Division 26 & 28 Sections for connections to fire alarm systems, wiring, disconnects, and other electrical materials required to complete food service equipment installation.

C. All electric services including wiring to, and final connections to, the fixtures except, as specified differently in the specifications, drawings, or herein.

D. All water, waste and gas services to the fixtures including shut-off valves, trim, traps, etc., and final connections to the fixtures, except as specified differently in the specifications, drawings, or herein.

E. All hood or ventilator duct work above the connection position on such exhaust hoods or exhaust ventilators, except as specified differently in the specifications, drawings, or herein. Final welded connections at the junction point of exhaust hoods or exhausts ventilators, shall be part of the food service work.

F. Floors, quarry tile, concrete bases, walls, ceilings, finishes and related building work, except as specified differently in the specifications, drawings or herein.

1.03 DEFINITIONS

A. Terminology Standard: Refer to NSF 2, "Food Equipment", NSF 4, Heated Cabinets, NSF 7, Refrigerated Equipment, or other applicable NSF standards for definitions of food service equipment and installation terms not otherwise defined in this Section or in other referenced standards.

B. FSEC: Food Service Equipment Contractor

C. Owner-Furnished Equipment: Where indicated, Owner will furnish equipment items.

D. Vendor-Furnished Equipment: Where indicated the Owner's or operator's vendor will furnish equipment items.

E. NIFSEC: Not Included in Food Service Equipment Contract.

1.04 SUBMITTALS

A. Regardless of drawing formats provided it will remain the responsibility of equipment supplier to develop submittals in accordance with the Specific Conditions and assume all required responsibilities there to. The consultant is not to be liable for errors or omissions by the FSEC's use of electronic data provided by the Consultant or the development of date used in the submittal approval process. Checking product data, rough-in drawings, wall backing drawings, shop drawings, and refrigeration drawings by Designer is for design concept only, and does not relieve the Food Service Equipment Contractor of responsibility for compliance with Contract Documents, verification of utilities with equipment requirements for conformity and location, verification of all dimensions of equipment and building conditions or reasonable adjustments due to deviations.

B. The Food Service Equipment Contractor shall review and provide an affidavit with each submittal that such review has been completed by an authorized agent of the contractor.

C. Product Data: For each type of food service equipment indicated. Include manufacturer's model number and accessories and requirements for access and maintenance clearances, water and drainage, power or fuel, and service-connections including roughing-in dimensions.

D. Shop Fabrication Drawings: For food service equipment not manufactured as standard production and/or catalog items by manufacturers the fabricator of the equipment shall prepare and submit through the Food Service Equipment Contractor one electronic file or two bond or original prints of all shop drawings showing all information necessary for the fabrication and installation of the work of this section. Include plans, elevations sections, material schedule, roughing-in dimensions, fabrication details, service requirements and attachments to other work. All drawings to be fully detailed and dimensioned to a minimum scale of ¾ inch to the foot for plan and elevation views and 1 ½ inch to the foot for section views. Reduced or enlarged drawings are not acceptable. Drawings not submitted in the proper format will not be reviewed.
   1. Wiring Diagrams: Details of wiring for power, signal, and control systems and differentiating between manufacturer-installed and field-installed wiring.
   2. Piping Diagrams: Details of piping systems and differentiating between manufacturer-installed and field-installed piping.

E. Coordination Drawings: For locations of food service equipment and service utilities. Key equipment with item numbers and descriptions indicated in Contract Documents. Include plans and elevations of equipment, access- and maintenance-clearance requirements, details of concrete, masonry or metal bases and floor depressions, and service-utility characteristics. Ventilation requirements for refrigerated equipment shall be identified in these drawings.

F. Contract Document Drawings:

G. Drawings furnished, constitute a part of these specifications and show locations of equipment and general arrangement of mechanical and electrical services. Necessary deviation from the illustrated arrangements to meet structural conditions, shall be considered a part of the work of this section. Such deviations shall be made without expense to the owner. Equipment drawings are definitive only and should not be used as construction documents or shop details.
   1. The drawings are for the assistance and guidance of the Food Service Equipment Contractor. Exact locations shall be governed by the building configuration. The Food Service Equipment Contractor shall accept his contract with this understanding.

2. Should there be a conflict between the drawings and the specifications, the FSEC shall submit a “Request for Information” (RFI) for clarification.

H. Utility Roughing-in Drawings:
1. The Food Service Equipment Contractor shall prepare and submit one electronic file or two bond or a valid prints, of all roughing-in drawings, showing information necessary for the roughing-in of refrigerant lines, syrup/beer lines, plumbing, steam, mechanical and electrical utility requirements. Drawings shall also include construction requirements necessary for all equipment including floor depressions, raised bases, wall blocking, wall recesses and any critical dimensions for specific equipment requirements. Acceptance will be made upon the electronic file or one print which will be returned to the Food Service Equipment Contractor for reproduction purposes. Drawings not properly submitted in this format, will not be reviewed. Drawings without an “Accepted” or ”Accepted as noted” stamp, will not be considered an authorized shop drawing and will not be allowed on the job site.
a. Furnish four (4) sets “Accepted” and/or “Accepted as Noted” shop drawings, for distribution to the field, as directed.

I. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for exposed products with color finishes.

J. Samples for Verification: Of each type of exposed finish required, minimum 4-inch- (100-mm-) square or 6-inch- (150-mm-) long sections of linear shapes and of same thickness and material indicated for work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

K. Product Certificates: Signed by manufacturers of refrigeration systems, refrigerated equipment or their authorized agents certifying that systems furnished comply with NSF 7 requirements and will maintain operating temperatures indicated in the areas or equipment that they will serve.

L. Maintenance Data: Operation, maintenance, and parts data for food service equipment to include in the maintenance manuals specified in Division 1. Include a product schedule as follows:
1. Product Schedule: For each food service equipment item, include item number and description indicated in Contract Documents, manufacturer's name and model number, and authorized service agencies' addresses and telephone numbers.

1.05 QUALITY ASSURANCE AND LAWS AND ORDINANCES

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing food service equipment, who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing food service equipment similar to that indicated for this Project and with a record of successful in-service performance.

C. Source Limitations: Obtain each type of food service equipment through one source from a single manufacturer.

D. Product Options: Drawings indicate food service equipment based on the specific products indicated. Other manufacturers' equipment with equal size and performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

E. Regulatory Requirements: Comply with the following National Fire Protection Association (NFPA) codes:
   1. NFPA 17, "Dry Chemical Extinguishing Systems."
   2. NFPA 17A, "Wet Chemical Extinguishing Systems."
   3. NFPA 54, "National Fuel Gas Code."
   4. NFPA 70, "National Electrical Code."
   5. NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations."
   6. The FSEC shall certify that all work and materials comply with Federal, State and Local laws, ordinances, and regulations and is confirmed by the local inspector having jurisdiction.
      a. US PUBLIC HEALTH SERVICE
      b. LOCAL HEALTH DEPARTMENT
      c. NATIONAL BOARD OF FIRE UNDERWRITERS
      d. OSHA
      e. UL
      f. HACCP
      g. NFPA 96 – Current
      h. ADA
      i. OSHPD
      j. DSA

F. Listing and Labeling: Provide electrically operated equipment or components specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

G. AGA Certification: Provide gas-burning appliances certified by the American Gas Association (AGA).

H. ASME Compliance: Fabricate and label steam-generating and closed steam-heating equipment to comply with ASME Boiler and Pressure Vessel Code.

I. ASHRAE Compliance: Provide mechanical refrigeration systems complying with the American Society of Heating, Refrigerating and Air-Conditioning Engineers' ASHRAE 15, "Safety Code for Mechanical Refrigeration."

J. Food Service Equipment: Where provided, check-out aisles, sales counters, service counters, food service lines, queues, and waiting lines shall comply with CBC Sections11B-227 and 11B-904. The top of tray slides shall be 28” minimum and 34” maximum above finish floor. Space and elements within food service employee work areas shall meet the requirements of CBC Section 11B-203.9. Food service equipment required to be accessible shall conform to all reach requirements in CBC Figures 2013, 11B-403.5.1, 11B-227.4, 11B-904.5, 11B-904.5.1, and 11B-904.5.2.

K. NSF Standards: Comply with applicable NSF International (NSF) standards and criteria and provide NSF, UL Sanitation or ETL Sanitation Certification Mark on each equipment item, unless otherwise indicated.

L. ANSI Standards: Comply with applicable ANSI standards for electric-powered and gas-burning appliances; for piping to compressed-gas cylinders; and for plumbing fittings, including vacuum breakers and air gaps, to prevent siphonage in water piping.

M. SMACNA Standard: Where applicable, fabricate food service equipment to comply with the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) "Food Service Equipment Fabrication Guidelines," unless otherwise indicated.

N. Seismic Restraints: Provide seismic restraints for food service equipment according to the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) "Food Service Equipment Fabrication Guidelines," appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment," unless otherwise indicated.

O. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

P. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Review methods and procedures related to food service equipment including, but not limited to, the following:
   1. Review access requirements for equipment delivery.
   2. Review equipment storage and security requirements.
   3. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
   4. Review structural loading limitations.
   5. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

Q. Walk-in cooler and/or freezer shall comply with CBC Figures 2013, 11B-404.2.4, 11B-404.2.4.4. 11B-404.2.7 and 11B-309.4.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver food service equipment as factory-assembled units with protective crating and covering.

B. Store food service equipment in original protective crating and covering and in a dry location.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of food service equipment installation areas by field measurements before equipment fabrication and indicate measurements on Shop Drawings and Coordination Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish required dimensions and proceed with fabricating equipment without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.
   2. Food service aisles shall be a minimum 36” wide and tray slides shall be mounted at 34” maximum above the floor. CBC Section 1104B.5, item 5.
   3. Pass-thru windows for food service shall conform to the reach and access requirements of CBC sections 1118B: 1122B.5; 1104B.3.12 and 1104B.4.2 for accessible transaction areas. Accessible pass-thru shelves shall not exceed 34-inch height above interior finished floor surface or exterior pavement.

1.08 COORDINATION

A. Coordinate equipment layout and installation with other work, including light fixtures, HVAC equipment, and fire-suppression system components.

B. Coordinate location and requirements of service-utility connections.

C. Coordinate size, location, and requirements of concrete bases, positive slopes to drains, floor depressions, and insulated floors. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

D. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.09 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Warranty period: 1 year from date of completion.

B. Refrigeration Compressor Warranty: 5 years from date of completion. Submit a written warranty signed by manufacturer agreeing to repair or replace compressors that fail in materials or workmanship within the specified warranty period.

PART 2 - PRODUCTS

2.01 MATERIALS - METAL

A. Submit a certified copy of the mill analysis of materials if requested by the Architect.

B. Finish for exposed surfaces to be #4 polished, unless otherwise specified.

C. Protective covering shall be provided on all polished surfaces of stainless steel sheet work, and retained and maintained until time of final testing, cleaning, start-up and substantial completion.

D. Stainless-Steel Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304, stretcher leveled, and in finish specified in "Stainless-Steel Finishes" Article.

E. Stainless-Steel Tube: ASTM A 554, Grade MT-304, and in finish specified in "Stainless-Steel Finishes" Article.

F. Zinc-Coated Steel Sheet: ASTM A 653, G115 (ASTM A 653M, Z350) coating designation; commercial quality; cold rolled; stretcher leveled; and chemically treated.

G. Zinc-Coated Steel Shapes: ASTM A 36 (ASTM A 36M), zinc-coated according to ASTM A 123 requirements.

H. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that, when cured and washed, meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

I. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening coating. Provide coating compounded for permanent adhesion to metal in 1/8-inch (3-mm) thickness that does not chip, flake, or blister.

J. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds.

K. Casters: NSF-certified, heavy duty, stainless-steel, swivel stem casters with 5-inch- (125-mm-) diameter wheels, polyurethane tires with 1-inch (25-mm) tread width, and 200-lb (90-kg) load capacity per caster. Provide brakes on 2 casters per unit.

2.02 MATERIALS – CASEWORK/MILLWORK

A. Cabinet Hardware: Provide NSF-certified, stainless-steel hardware for equipment items as indicated. Pulls, Handles and Catches to be included.

B. All wood to be thoroughly seasoned and kiln dried prior to being used for fabrication of custom casework. All wood to be free from knots, pitchy seams, or other imperfections. All exposed wood to be grade A pine.

C. All plywood to be thoroughly seasoned and kiln dried prior to being used. All plywood to be free from knots, pitchy seams, and other imperfections. All plywood to be glued with water resistant resin. Particle board may not be substituted for plywood panels. "W.I. - Custom Grade" marine grade plywood is required on all fixtures to be installed in high humidity environments.

D. All wood to have less than 12% moisture content and be a species listed by the national hardwood association.

E. Plastic laminates shall be 1/16th thick, general purpose grade GP-50 as manufactured by Wilson Art or equal. Patterns, textures, and colors as specified under individual items. Semi ex-posed and cabinet liners shall be CL-20. Countertops, backsplashes and edges shall be grade GP-50 on exposed and grade BK-20 on underside of tops. Exposed vertical surfaces and cabinet liners shall be grade CL-20. Sides and edges of shelving shall be grade 50. Adhesive shall be waterproof and low VOC.

F. Hardware that is furnished and installed shall be of solid material unless specified otherwise. The hardware shall be provided with the necessary mechanisms for locking. All locks shall be furnished with two (2) keys.

G. Solid Surface Material (SSM) shall be Caesarstone, Silestone or approved equal and installed over 3/4" plywood per manufacturer's instructions. Provide air space, trim and /or insulation around any heat or cold producing equipment to guard against discoloration and cracking.

2.03 FABRICATION, GENERAL, METAL

A. Fabricate food service equipment according to NSF (standards 2, 4 & 7) requirements. Factory assemble equipment to the greatest extent possible.

B. STAINLESS-STEEL EQUIPMENT: for all parts of custom tables, tops, benches, sinks, cabinets, etc., as drawn or as specified, shall be AICI type 304 (18-8 Austenitic). All gauges called for shall be U.S. Standard Gauges, “S/S” or “S.S.” as shown in the drawings or specifications, shall indicate stainless steel.
   1. Edges and Backsplashes: Provide equipment edges and backsplashes indicated complying with referenced SMACNA standard, unless otherwise indicated.
   2. Apply sound dampening to underside of metal work surfaces, including sinks and similar units. Provide coating with smooth surface and hold coating 1 inch (25 mm) back from open edges for cleaning.
   3. Tables: Fabricate with reinforced tops, legs, and reinforced undershelves or cross bracing to comply with referenced SMACNA standard, unless otherwise indicated, and as follows:
      a. Tops: Minimum #14 gauge / 0.0781-inch- (1.984-mm-) thick stainless steel, unless otherwise indicated.
      b. Legs: 1-5/8 inch (41.3 mm) OD, minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick stain-less steel with stainless-steel gusset and adjustable insert bullet-type feet with minimum adjustment of 1 inch (25 mm) up or down without exposing threads, unless otherwise indicated.
      c. Undershelves: Minimum #16 gauge / 0.625-inch- (1.588-mm-) thick stainless steel, unless otherwise indicated.
      d. Top and Undershelf Reinforcement: Provide minimum #14 gauge / 0.0781-inch- (1.984-mm-) thick, stainless-steel reinforcing, unless otherwise indicated.
      e. Cross Bracing: 1-1/4 inch (31.75 mm) OD, minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick stainless steel, unless otherwise indicated.
   4. Sinks: Fabricate of minimum #14 gauge / 0.0781-inch- (1.984-mm-) thick stainless steel with fully welded, 1-piece construction. Construct 2 sides and bottom of sink compartment from 1 stainless-steel sheet with ends welded integral and without overlapping joints or open spaces between compartments. Provide double-wall partitions between compartments with 1/2-inch- (13-mm-) radius rounded tops that are welded integral with sink body. Cove horizontal, vertical, and interior corners with 3/4-inch (19-mm) radius. Pitch and crease sinks to waste for drainage without pooling. Seat wastes in die-stamped depressions without solder, rivets, or welding.
      a. Wastes: 2-inch (50-mm), stainless steel ball valve, rotary-handle waste assembly with stainless-steel strainer plate, rough chrome plated body.
      b. Drainboards: Minimum #14 gauge / 0.0781-inch- (1.984-mm-) thick stainless steel, pitched to sink at 1/8 inch/12 inches (3 mm/300 mm) of length. Reinforce drainboards with minimum #14 gauge / 0.0781-inch- (1.984-mm-) thick stainless steel, unless otherwise indicated.
      c. Legs: 1-5/8 inch (41.3 mm) OD, minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick stain-less steel with stainless-steel gusset welded to #12 gauge / 0.1094-inch- (2.779-mm-) thick, stainless-steel support plate. Provide adjustable insert bullet-type feet with minimum adjustment of 1 inch (25 mm) up or down without exposing threads, unless otherwise indicated.
      d. Drainboard Braces: 1 inch (25 mm) OD, minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick stainless steel, unless otherwise indicated.
      e. Cross Bracing: 1-1/4 inch (31.75 mm) OD, minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick stainless steel, unless otherwise indicated.
   5. Wall Shelves and Overshelves: Fabricate to comply with referenced SMACNA standard, unless otherwise indicated, and with minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick, stainless-steel shelf tops.
   6. Drawers: Provide lift-out type, 1-piece, die-stamped drawer pan fabricated from #18 gauge / 0.050-inch- (1.27-mm-) thick stainless steel with inside corners radiused. Support drawer pan with #16 gauge / 0.0625-inch- (1.588-mm-) thick, stainless-steel channel frame welded to drawer front. Provide 1-inch- (25-mm) thick, double-wall front fabricated from #16 gauge / 0.0625-inch- (1.588-mm-) thick stainless steel and with integral

recessed pull. Fill void in drawer front with semi rigid fiberglass sound dampening. Mount drawers on NSF-certified, full-extension, stainless-steel drawer slides that have minimum 100-lb (45-kg) load capacity per pair, ball-bearing rollers, and positive stop. Mount drawer slides for self-closing on drawer housing as indicated.

7. Refrigerated Bases: Unit to be all welded construction and fabricated in accordance with NSF Standard 7.
   a. Top: 18 gauge galvanized sub-top or 14 gauge stainless steel top.
   b. Exterior: Front and Sides to be 18 gauge number 4 finish type 304 stainless steel; bottom and back to be 18 gauge galvanized (unless otherwise noted).
   c. Interior liner: 20 gauge number 4 finish type 304 stainless steel with 3/8" radius corners.
   d. Insulation: Minimum 2" thick polyurethane foam in place insulation (CFC free).
   e. Doors: 18 gauge front and 20 gauge door pan number 4 finish type 304 stainless steel with 2" polyurethane foam in place insulation, long-life press in place gasket.
   f. Drawers: 300 lb. capacity with 14 gauge stainless steel track system, tandem 2" all stainless steel skate wheels, each drawer accommodates two 6" deep, 12" x 20" pans side by side.
   g. Shelving: Each door section shall have stainless steel wire racks.
8. Refrigerated Pan Rails: Unit to be all welded construction and fabricated in accordance with NSF Standard 7.
   a. Top: 16 gauge number 4 finish type 304 stainless steel top and inner liner.
   b. Outer liner: To be 18 gauge type 304 stainless steel; bottom and back to be 18 gauge galvanized (unless otherwise noted).
   c. Insulation: Minimum 2" thick polyurethane foam in place insulation (CFC free).
   d. Drain: Provide with 1" stainless steel drain
   e. Control: Provide with on/off control to be filed installed.

C. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Provide ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
   1. Welded Butt Joints: Provide full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
   2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
   3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and underpressed.
   4. Coat unexposed stainless-steel welded joints with suitable metallic-based paint to prevent corrosion.
   5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPCPaint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780.

D. Fabricate field-assembled equipment prepared for field-joining methods indicated. For metal butt joints, comply with referenced SMACNA standard, unless otherwise indicated.

E. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

F. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

G. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

H. Provide surfaces in food zone, as defined in NSF 2, free from exposed fasteners.

I. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

J. Provide pipe slots on equipment with turned-up edges and sized to accommodate service and utility lines and mechanical connections.

K. Provide enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.

L. Seismic Restraints:
   1. Fabricate to comply with referenced “SMACNA Guidelines for Seismic Restraint of Kitchen Equipment” in any State, province, or jurisdiction that has legislated this requirement as necessary for acceptance. This shall include:
      a. Identifying these items on his submittal drawings, Plans, Elevations, and Sections.
      b. Showing required SMACNA methods of restraint on his submittal drawings.
      c. Referencing the appropriate detail(s).
      d. Obtain regulatory approval for all seismic engineering details

2.04 FABRICATION, MILLWORK/CASEWORK

A. Fabricate food service equipment according to the "Manual of Millwork, current edition" of the Woodwork Institute, including all amended printed revisions, and NSF Standards. All composite wood products shall meet the latest California Air Resources Board (CARB) Composite Wood Products Regulations. Factory assemble equipment to greatest extent possible. All specially fabricated equipment must be by one manufacturer/fabricator per specialty acceptable to Consultant and the Owner.

B. Solid Surface Material (SSM) shall be Caesarstone, Silestone or approved equal and installed over 3/4" plywood per manufacturer's instructions. Provide air space, trim and /or insulation around any heat or cold producing equipment to guard against discoloration and cracking.

2.05 EXHAUST HOOD FABRICATION

A. Definitions:
   1. Listed Hood: A hood, factory fabricated and tested for compliance with UL-710 by a testing agency acceptable to authorities having jurisdiction.
   2. Type I Hood: A hood designated for grease exhaust applications.
   3. Type II Hood: A hood designed for heat and steam removal and for other non-grease applications.
   4. Non-listed Hoods are not acceptable for this project.

B. General: Provide listed hoods with dual wall construction and manufactured from minimum #18 gauge / 0.050-inch- (1.27-mm-) thick type 304 stainless steel, unless otherwise indicated. FSEC shall verify size and location of all connections required before fabrication.
   1. Exhaust hood performance tests shall be in accordance with ASTM F1704-05. Manufacturer, upon request, shall be required to submit validation that full capture and containment of appliance thermal plume and smoke can be accomplished at specified/design air volumes without modifications to duct size, filter velocity or hood/system static pressure.

2. Hoods shall comply with current NFPA 96, NSF, ASHRAE 90.1, ASHRAE 154, CA-Title 24 (CA Based Projects Only), Local Applicable Codes and Manufactures Recommendations.
3. Product/system must meet the design, construction, performance and operational intent of the project. It is the responsibility of the FSEC to verify interface of the system with all associated trades including, but not limited to; electrical, mechanical, sheet metal, plumbing and controls per Division 23.
4. Design exhaust volume shall be based on hood manufacturers heat load based design calculations and not estimated CFM/linear foot or minimum UL-710 listed volume.

C. Grease Removal: Provide removable, stainless-steel, baffle-type grease. Provide minimum #18 gauge / 0.0781-inch- (1.984-mm-) thick, stainless steel filter frame and removable collection basins or troughs. Filters/baffles shall be UL 1046 Classified and tested according to ASTM Standard F 2519-05 “Standard Test Method for Grease Particle Capture Efficiency of Commercial Kitchen Filters and Extractors” by a nationally recognized testing laboratory acceptable to authorities having jurisdiction. The filters/baffles must be single stage and have a minimum extraction rate of 93% at 5 microns and 98% at 15 microns.

D. Sound Level Criteria: Isolated grease filter sound levels shall not exceed an NC rating of 55 at full design exhaust volume.

E. Light Fixtures: Provide NSF, UL, CSA AND CE-certified LED fixtures, vapor-tight sealed lenses, to provide 3500K with 50 foot candles at the cooking surface. Any exposed wiring shall be concealed in stainless-steel.

F. Appliance Interlock: Hoods to be provided with Appliance Interlock Temperature Sensor to comply with IMC 2006 requirement, section 507.2.1.1.

G. Exhaust-Duct Collars: Minimum #16 gauge / 0.0625-inch- (1.588-mm-) thick stainless steel, FSEC shall provide all stainless steel duct collars and make final connections to hood, welded 100% grooved smooth and painted.

H. Fires suppression system: Hoods to be provided with wet chemical fire suppression system, model R102 as manufactured by “Ansul” or equal in compliance with UL300 standards. System shall include factory pre-piping, all permits and test as required by the authority having jurisdiction.
1. Automatic actuation shall be by means of fusible link with no visible conduit.
2. System shall be furnished and installed by an Ansul certified distributor in accordance with manufacturer’s instructions and the authority having jurisdiction.
3. Micro-switches shall be furnished as part of the fire protection system for “tie in” of building alarm and for the make-up air/fire/fuel shut down. Gas valve(s) shall be electric solenoid type and support simultaneous activation.
4. Surface drop exposed piping shall be stainless steel.

2.06 STAINLESS-STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
1. Remove or blend tool and die marks and stretch lines into finish.
2. Grind and polish surfaces to produce uniform, directional textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Concealed Surfaces: No. 2B finish (bright, cold-rolled, unpolished finish).

C. Exposed Surfaces: No. 4 finish (bright, directional polish).

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

2.07 WALK-IN COOLERS/FREEZERS

A. Panel Construction:
   1. Panels shall be pre-fabricated, sectional construction (minimum 4-inches thick for Coolers and Freezers), of tongue and groove design with foamed-in-place gaskets (not glued, stapled, or nailed) on the male side of all interior and exterior panels and rigid urethane frame. Every panel shall be NSF and UL factory approved and bear the certifying labels. Walk-in box height to be 108"; Interior Height, except freezers with pre-fab floor in combination with cooler without floor to be 104" or unless otherwise specified.
   2. Gaskets shall be impervious to stains, greases, oils, and mildew and be resistant to chemical corrosion and ultraviolet radiation. Gasket operating temperature shall be -30 degrees F to 160 degrees F (-34 degrees C to +71 degrees C).
   3. Corner panels shall be 90-degree angles with coved corners; interior partition walls shall utilize `T' panels with coved corners. All panels shall be manufactured in accordance NSF approved standards.
   4. Panels shall be completely filled with rigid 100% foamed-in-place non-CFC urethane between interior and exterior metal `skins' which have been die-formed and gauged for uniformity in size. Rigid polyurethane blowing agents shall comply with current US EPA SNAP program listings. Slab urethane or polystyrene are not acceptable. In addition, wood shall not be acceptable in any panel including doors, walls, floor, and ceiling.
   5. Insulation shall have a 95% closed cell structure with an average in-place density of 2.2 lbs. per cubic foot, and compression strength at yield point of 19 lbs. per square inch. The R-Values of the floor, ceiling and wall panels meet the requirements under the Energy Independence and Security Act of 2009 (EISA).
   6. Floor panels: Floor panels shall be die stamped with 3/8-inch radius NSF coved corners. All plane intersections shall be drawn, not cut and welded. Panels shall be fabricated similar to other panels and designed to readily withstand uniformly distributed loads, point loads for stationary shelving, rolling loads from hand truck and mobile food racks. Where noted, pre-fabricated floors shall withstand rolling loads from either manual pallet jacks or electric pallet jacks.

B. Door Construction: Walk-in coolers and freezers shall have entry and exit door hardware that complies with all of the requirements of CBC Section 11B-404.2.8.1 and maneuvering clearances at the exterior side per CBC Section 11B-404.2.7 & 11B-309.4. Doors shall be flush (in-fitting) type, self-closing, 36-inches by minimum 80-inches high, 20-guage stainless steel interior and exterior.
   1. Doors shall be mounted with three adjustable cam-lift hinges (Kason 1245) and hydraulic adjustable automatic hold-open (rack and pinion) door closers. Door hardware shall be chrome plated Kason model 27C. Mounting height of latching hard-ware shall be 34 to 48 inches above finish floor. All hardware shall meet the requirements of CBC 11B-404.2.7 & 11B-309.4.
   2. Door latches shall lock and have a safety release to prevent entrapment (one quarter turn of the release handle unlocks the door from the inside).
   3. All freezer door will be provided with a Department of Energy approved heater strip, heated sweep gaskets, and a heated pressure relief port.

4. Provide pre-wired light fixtures switch and pilot lights switch on each door section. All door sections to have raised casings. All lights are to be vapor proof LED. Refer to para. 2.7.E.4 for digital controller requirements.
5. The doorjambs, frames, and thresholds shall be made of durable Fiberglass Reinforced Plastic (FRP) or polyvinyl chloride (PVC).

C. Assembly: Panels shall be assembled by Posi-Locs or equal which shall be foamed-in-place and activated by a hex wrench. Floor panels shall utilize post tension construction within the floor panels. Access ports to locking devices shall be covered by snap caps and shall be located in interior of walk-in.

D. Finishes: Refer to the finishes shown and the Foodservice Equipment Schedule paragraph 3.5.
1. Surfaces (walls, ceiling and closure panels):
   a. Exposed exterior 20-gauge Type 304 stainless steel, #4 finish, Rimex Windsor pattern.
   b. Unexposed exterior surfaces to be 20 gauge smooth embossed galvanized steel.
   c. Interior finishes: minimum 26 gauge Antimicrobial finish steel, walls and ceiling.
   d. Interior floor: verify on finish schedule and item specification, paragraph 3.5.

E. Accessories:
1. Provide and install 14 gauge (stainless steel) kickplates to 36-inches high on interior and exterior doors.
2. Provide (s/s) closure panels to interior ceiling and all adjacent walls, finished with 90-degree angles at the box and the ceiling/wall; no raw edges will be accepted.
3. Provide vinyl strip curtains.
4. Refrigerated compartments fabricated and standard, shall be fitted with flush mounted digital temperature controllers. Thermometers on such controllers shall be adjustable and calibrated after installation. All thermometers shall have an accuracy of 2 degrees. Controller shall be Modularm 75 LC, or equal, and include frame mounted door magnets for door ajar alarm, interior panic alarm button and motion detector activated automatic panic alarm. All controllers are to be programmable and have the capability of being connected to remote monitoring systems or building management systems.
5. Per document drawings, provide 14-inches by 24-inches view port - unheated for cooler door, heated for freezer door.
6. Freezer Door Fan Switches (at ambient facing freezer door only)
7. When Anthony doors are specified: include Optimax Pro LED Lighting.

F. Insulated Floor Depressions: The FSEC shall provide styrofoam insulation for cooler and freezer floors. Insulation shall be a minimum of 2 layers 60 high load extruded polystyrene, 2-inch thick, with R-value, 75°F mean temperature, min 5.0/inch°F ft. square h/BTU; Compressive Strength: vertical, 60.0 lbs./inch square; Water Absorption maximum 0.1% by volume.

G. Approvals: Fire hazard classification according to ASTME-84 (UL723) shall be a flame spread rating of 25 or less with a certifying UL label attached to every panel showing the meeting of the fire code. Smoke development rating to be 450 or less; Factory Mutual approved; NSF-listed with an approved toxicity rating.

H. Walk-in coolers and freezers shall have level maneuvering clearances at the exterior side (CBC 118-404.2.4.1) and accessible entry and exit door hardware (CBC 11B-404.2.7, 11B-309.4 & 11B-404.2.8.1).

I. Installation: Equipment identified under this section shall be erected by individuals approved by the manufacturer who qualify as “factory certified” installers.

2.08 REMOTE REFRIGERATION SYSTEMS

A. Furnish and install mechanical refrigeration work as indicated and specified, complete and ready for use. All systems shall comply with the latest edition of Title 24, 2016 Building Efficiency Standards. Principal items of work include:
   1. Mechanical refrigeration systems, including compressor units, condensers, refrigerant piping, evaporator coils, control valves, compressor racks, weather covers and required miscellaneous items. Refrigeration equipment shall consist of two major assemblies. One is the condensing unit assembly with all necessary components, factory installed and wired including single point electrical control panel, circuit breakers and contactors, OSHA approved fan guards, aluminum flexible conduit for internal wiring, suction filter, sight glass, drier, adjustable dual pressure control, flexible pressure hoses, Rotolock compressor adaptors and necessary tubing. The other is the refrigeration coil assembly/heat exchanger with expansion valve, electronic thermostat temperature control with electronic defrost time clock and on/off power switch, completely factory mounted and factory pressure tested with dry nitrogen.
      a. Utilize refrigerant with an ozone depleting potential of 0
      b. R-407A Low to Medium Temperatures
      c. Other refrigerant approved by the Department of Energy for use in remote systems after December 31, 2017.
      d. Glycol – Food Grade
   2. Furnishing of motor starters and walk-in refrigerator/freezer thermostats for installation under Electrical Section.
   3. Sleeves, inserts, hangers, supports and other incidental items necessary to complete the work.
   4. Cutting and patching of non-structural and other incidental items necessary to complete the work on this section.
   5. Testing, charging, adjusting, operational testing and cleaning of equipment. Conduct all tests as required by local inspecting agencies concerned with this project. Each refrigeration items specification is written to provide minimum specifications and scope of work.
   6. Refrigeration equipment shall be designed and installed to maintain the following general temperature unless otherwise specified.
      a. Walk-In Refrigerators 1.7°C / 35°F
      b. Walk-In Freezers -23.2°C / -10°F
      c. Reach-In Refrigerators 1.7°C / 35°F
      d. Reach-In Freezers -23.2°C / -10°F
      e. Undercounter Refrigerators 1.7°C / 35°F
      f. Undercounter Freezers -23.2°C / -10°F
      g. Cold Pan 4°C / 39°F

B. Compressors and Condensing Unit: Factory assembled, scroll compressors with air cooled condensers operating at such speed within recommended range of section and discharge pressures for economical operation and with required BTU rating per hour, sizes and capacities in accordance with specifications. Provide units of same manufacturer and type throughout, new standard cataloged, to operate with refrigerant R-407A. 100 degrees ambient air, capacities selected on 16 hour running time basis for medium temperature fixtures and 18 hour running time basis for low temperature fixtures. For locations where the ambient exceeds 100 degrees Fahrenheit, the system is to be engineered for the maximum recorded ambient temperature. Additionally, all parallel systems shall include a minimum of one digital scroll compressor and be designed with 75% redundancy minimum.

C. Condensing units shall be scroll air cooled condensing unit with rigid structural bases, 20 gauge weather covers, OSHA-approved fan guards and shrouds and waterproof electrical systems. Include internal inherent motor protection, suction line, shut off valves, liquid line shut off valves, oil pressure safety switches when required, adjustable dual pressure control, crank case heaters and oil separators on systems with longer than 100 lin. ft. run from condensing unit to the evaporator coil. Any outdoor installation within 20 miles of the salt air environment shall be provided with coated condenser coils.

D. Medium temperature evaporators shall be equipped with Electronically Commutated Motors (ECM). Coils shall be low profile UL/NSF approved units with inline fans and cross fins staggered. Provide copper tubing, aluminum cased, permanently lubricated motors with thermal overload protection. Unit shall be provided with evaporator controller system capable of providing evaporator fan control, remote monitoring and diagnostics. Control system shall be interconnected to the local area network and be capable of sending alarm alerts via mobile telephone or e-mail. Water proof electrical system pre-wired to a single connection. Coils are designed to operate above 34 degrees Fahrenheit.

E. Low Temperature evaporators shall be equipped with Electronically Commutated Motors (ECM). Coils shall be low profile UL/NSF approved units with inline fans and cross fins staggered. Provide cooper tubing, aluminum cased, permanently lubricated motors with thermal overload protection. Unit shall be equipped with electric demand defrost controller system. Controller system shall provide on-demand defrost, remote monitoring and diagnostics and be interconnected to the local area network with the capability of sending alarm alerts via mobile telephone or e-mail. Water proof electrical system pre-wired to a single connection. Coils are designed to operate in a range from 30 degrees above Fahrenheit to -20 degrees Fahrenheit.

F. Refrigerant lines shall be type “L” ACR copper tubing with wrought copper fittings assembled by silver soldering joints.

G. Coil drains shall be 1” IPS copper. Route and pitch ½” per foot to drain. Provide electrical heaters on freezer drains.

H. Refrigeration lines insulation shall have a minimum ½ “ Armstrong Armaflex AP Pipe insulation sealed with adhesive foam insulation. For glycol systems the minimum insulation shall be ¾”. Tape fittings to be sufficient thickness to prevent condensation. Lines ran externally shall include a hard white PVC cover.

I. Installation of this refrigeration equipment shall be performed by individuals approved by the manufacturer who qualify as “factory certified” installers.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Unless expressly stipulated, and in a timely manner, no additional allowances will be made for Contractors or Manufacturers for errors, omissions or ambiguities not reported at time of bidding. Carefully review and compare the Contract Documents and at once report to Owner and/or Designer any errors, ambiguities, inconsistencies or omissions. Unless expressly stipulated, and in a timely manner, Kitchen Equipment Contractor shall be liable to Owner or Designer for any damage resulting from such errors, inconsistencies or omissions in the Contract Documents. Work shall not be done without approved Drawings, Specifications and/or Modifications and without receiving prior written receiving authorizations from Owner or

Designer. Drawings and equipment specifications are intended to complement each other. Therefore, neither should be considered complete without the others.

B. Examine areas and conditions, with Installer present, for compliance with requirements or installation tolerances, service-utility connections, and other conditions affecting installation and performance of food service equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Examine roughing-in for piping, mechanical, and electrical systems to verify actual locations of connections before installation.

D. Verify all conditions at the building, particularly door openings and passageways for large equipment. Coordinate with General Contractor access to insure delivery of equipment to the required areas. Coordination shall include, but not be limited to, early delivery, hoisting, window removal and/or delay of wall construction. All special equipment, handling charges, window removal, etc. shall be paid for by the Food Service Equipment Contractor.

E. Any and all food service equipment and equipment systems noted as “by owner/operator”, “by purveyor”, or “existing” in the food service construction documents are presented for reference only. These representations must be verified in writing by the food service equipment contractor, owner, operator, and/or general contractor prior to the release of “for construction” documentation. It will be the general contractor’s responsibility to further verify and coordinate all necessary information pertaining to this equipment or systems making up, or relating to, this equipment including, but not limited to, local health department regulations, local sanitation code requirements, mechanical, structural, plumbing and electrical requirements prior to commencement of construction. Consultant or Architect take no responsibility for design, intent, function, performance, utility requirements, or code compliance of non-specified equipment.

3.02 INSTALLATION, GENERAL

A. Install food service equipment level and plumb, according to manufacturer's written instructions, original design, and referenced standards.

B. Complete equipment field assembly, where required, using methods indicated.
   1. Provide closed butt and contact joints that do not require a filler.
   2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "Fabrication, General" Article.

C. Install equipment with access and maintenance clearances according to manufacturer's written instructions and requirements of authorities having jurisdiction.

D. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections. Cut holes and provide sleeves for pipes on equipment, for drains, electrical, plumbing, etc., as required for proper installation. Verify sizes with Owner on the following items before ordering or fabrication: steam pans, sheet pans, trays, glass and cup racks.

E. Except for mobile and adjustable-leg equipment, securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.

F. Install hoods to comply with NFPA 96 requirements and to remain free from vibration when operating.

G. Install seismic restraints according to referenced SMACNA standard.

H. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches (1200 mm) o.c. maximum.

I. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

J. Prohibit cold storage rooms from being used by any other trade for storage or work areas. Repair or cause replacement to any damaged areas on the interior of the cold storage rooms, if the damage was caused due to the cold storage rooms being used for storage or work areas.

3.03 PROTECTING

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure food service equipment is without damage or deterioration at the time of Substantial Completion.

3.04 START-UP, TESTING AND COMMISSIONING

A. Startup Services: Engage factory-authorized service representatives to perform startup services for all equipment.
   1. Coordinate food service equipment startup with service-utility testing, balancing, and adjustments. Do not operate steam lines before they have been cleaned and sanitized. Provide demonstrations for both operations and maintenance personnel.
   2. Remove protective coverings and clean and sanitize equipment, both inside and out, and re-lamp equipment with integral lighting. Where applicable, comply with manufacturer's written cleaning instructions.
   3. Test each equipment item for proper operation. Repair or replace equipment that is defective in operation, including units that operate below required capacity or that operate with excessive noise or vibration.
      a. Start up and testing for ice making equipment to be performed by the Original Equipment Manufacturer’s authorized representative after substantial completion by the FSEC prior to final testing. All issues of installation hook-up and operational conditions are to be addressed. Any conditions not meeting operational needs will be identified and reviewed with the FSEC and/or GC.
      b. Type I grease hoods and fire protection systems are to be reviewed by the Original Equipment Manufacturer’s authorized representative after substantial completion and prior to final testing. This review shall also take place prior to the start-up and demonstration of any cooking equipment under the hood. All issues of installation hook-up and operational conditions will be addressed. Any conditions not meeting operational needs will be identified and reviewed with the FSEC and/or GC. A field inspection report will be provided as part of the Owner’s equipment manual and submitted to the GC and local fire marshal when required by code.
   4. Provide maintenance and proper operations training to both the client maintenance and operations staff.
   5. Provide maintenance manuals, service parts manuals and product schedule in accordance with paragraphs 1.4.K and 1.4.K.1

B. Demonstration and Commissioning: Representatives of authorized service agencies, manufacturer or original equipment supplier shall provide these services with FSEC in attendance.

1. Demonstrate in the presence of the owner, owner's designated representative and owner's maintenance and operations personnel the proper initial start-up, operation clean-up, preventative maintenance safety procedures of each item of equipment.
2. FSEC is to provide a signed log or record of all demonstrations, training and start-ups conducted to the owner with equipment operations manuals.

3.05 FOOD SERVICE EQUIPMENT SCHEDULE

END OF SECTION

SECTION 11 61 43

PRESENTATION PLATFORM CURTAINS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Presentation Platform curtains systems including tracks, hangers, anchors, and accessories as required for complete operational installation including following components.
   1. Front Setting: Valance, front curtain, tormentors, borders and legs.
   2. Intermediate Setting: Valance, intermediate curtains, and intermediate legs.
   3. Rear Curtain.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Include plans, elevations, and detailed sections of curtain layout. Include anchors, hardware, track details, and other components required.

B. Product Data: Manufacturer's specifications, installation instructions, and recommendations for curtain track.

C. Samples: 12-inch-square samples of curtain fabric and color required.

D. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Rose Brand, or equal.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Platform curtain shall include dead-hung fixed valance curtains and two legs.

B. Flame Resistance:
   1. Stage curtains and linings shall be certified to be flame resistant in accordance with NFPA 701, Regulation No. A-358 and Title 19, Section 3.08.
   2. Permanently attach label to curtain indicating that unit is inherently and permanently flame resistant (immersion method) or whether it will require retreatment after dry cleaning.

2.03 CURTAIN MATERIALS

A. Fabric: 100 percent cotton velour napped fabric, 54 inch width minimum, not less than 40 ground ends/inch, 40 pile ends/inch, 32 picks per inch, 640 pile tufts/square inch, and weighting not less than 25 ounces per linear yard with pile height of approximately 100 mils.

B. Lining: Yarn-dyed denim cloth woven in warp-faced twill, 54 inch minimum width.

C. Curtain Fabrication:
   1. Velour curtains shall be made with nap down.
   2. Seams: Seams shall be vertical, material being fed straight to machine, equally lapped and stretched and finished free of wrinkles or sag.
      a. Selvage edges shall be properly clipped, and curtains shall finish square and true.
      b. Cross seams are not acceptable.
   3. Hems:
      a. Hang curtain on track for at least 24 hours before hemming.
      b. Minimum hems shall be 6 inches. Bottom hems shall contain No. 8 jack chain weight in permanently flameproofed canvas tube secured within hem.
   4. Webbing:
      a. 3-1/2-inch 9-pound jute sewn at top, triple stitched at both sides of webbing for length of draper piece.
      b. Finish with 1-1/4-inch binding tape folded in half and lockstitched.

2.04 CURTAIN TRACKS

A. Type: Standard duty, straight, galvanized steel or extruded aluminum, cord tension pulley operated; “Beesteel” 170 Series by Rose Brand, or equal.
   1. Provide with single end pulley, carriers, master carrier, end stop, and overlap clamp.
   2. Provide curtain carriers for track spaced at 12 inches on center.
   3. Finish: Black.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install curtain track in accordance with manufacturer's recommendations. Install level, plumb, and secure.

B. Curtain shall be hung on track for 24 hours before insertion of hems so as to avoid improper stretching.

C. Install track for center-parting curtains with not less than 2'-0" overlap of track sections at center, supported by special lap clamps.

D. Secure curtains to track carriers with track manufacturer's special heavy-duty "S" hooks or snap hooks.

END OF SECTION

SECTION 12 24 00

WINDOW SHADES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Manually operated window shades, single light filtering fabric.
   2. Electrically operated dual shade system with light filtering and room darkening fabrics.

1.02 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit for each mounting condition and each location, showing brackets, anchorage to substrate, and relationship to adjacent materials. Manufacturer's standard details, if representative of actual field conditions, are acceptable.
   2. Submit detailed wiring diagrams for motorized shades. Include each component of the system with a detailed list of the components, wiring schematics, and operational characteristics for every level of operation.

B. Product Data: Manufacturer's descriptive literature of controls, accessories, attachment brackets, and installation instructions. Include test reports from a qualified testing agency for each shade cloth verifying compliance with specified performance criteria.

C. Samples: 12-inch square of each shade material.

D. Shades Schedule:
   1. Use same designations for openings or Room as indicated on Drawings.
   2. Show field-measured dimensions of openings scheduled to receive shades.

E. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Installer qualifications.

1.04 CLOSEOUT SUBMITTALS

A. Manufacturer's recommended maintenance procedures for each type of shade, control, and two sets of any special tools that are required for inclusion in District's Operations and Maintenance Manual.

B. Extended warranties.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: Employee of shade manufacturer or certified in writing by manufacturer as an acceptable installer of shade system.
   2. Manufacturer: Continuously engaged in manufacturing commercial window shades of the types required for not less than 10 years prior to date of this Contract.

B. Mockup: Install window shade mockup at one location for each type of shade configuration to show full operation and appearance review by District's Design Consultant.

1.06 WARRANTY

A. Manufacturer: Furnish District with the following manufacturer warranties.
   1. Tracks, Gear-and-Sprocket Mechanism, and Accessories: 5 years against defects in materials and workmanship which inhibit proper and intended functioning of products.
   2. Shadecloth: 10 years with the provision that it will not deteriorate, sag or warp and will remain fit for use for the full warranty period.
   3. Motors: 4 years against defects in manufacture.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE REQUIREMENTS

A. Each shade shall extend the full height and width of the window opening where it occurs.

B. Drive Assembly:
   1. Shall be factory set for size and travel of shades.
   2. Shall be adjustable from exterior of shade unit without disassembly of hardware.
   3. Shall have a built-in shock absorber system to prevent chain breakage under normal usage conditions.

C. Removal of shade shall not require disassembly of shade unit.

D. Shade Cloth:
   1. Shade cloth shall hang flat, without buckling or distortion.
   2. Edge, when trimmed, shall hang straight without raveling.
   3. An unguided roller shade cloth shall hang true and straight, without shifting sideways more than 1/8 inch in either direction due to warp distortion or weave design.
   4. Flame Retardance: Shade fabric shall be certified by an independent testing laboratory to pass NFPA 701 and applicable code requirements.
   5. Each type of shadecloth shall be woven of the same yarns, have similar weaves, and shall be color matched by dye lot.
   6. Furnish shadecloth of the same dye lot for each area.
   7. Shades shall have no seams, except where approved in advance in writing by District's Design Consultant.

E. Conduit as required for window shade electrical wiring shall be concealed.

F. Above-ceiling and concealed wiring shall be plenum-rated or installed in conduit.

G. Provide a system which has been designed, developed, and manufactured as a totally integrated unit. The system shall be furnished by a single-source supplier with a certification

that all components including motor, shade fabrics, electrical controls, and override controls have been designed and tested as a compatible system and will be available in the future for either replacement or add-on requirements.

2.02 SHADES

A. Manufacturers: MechoShades Systems Inc., Hunter Douglas Architectural, or equal.

B. Types: Hand chain and motorized.

C. Configurations:
   1. Dual shade system, top down.
   2. Single shade system, top down.

D. Where more than one shade occurs in a pocket, locate chains for shades on same side of pocket.

2.03 MATERIALS AND COMPONENTS

A. Shade Materials:
   1. Fabric: To be selected by Architect.
   2. Transparency: 3 to 5 percent open.
      1. Colors: Custom and different interior and exterior side, to be selected by Architect.

B. Blackout Shade: 75 percent vinyl (coating), 25 percent fiberglass (yarn): “Classic Blackout” 0700 Series.

C. Fascia: Extruded aluminum with specified custom paint finish. Secure without exposed fasteners.

D. Hembar: Concealed (sealed) hemtube at bottom.

E. Drive Assembly at Manual Shades: Factory set for size and travel of shades.
   1. Capable of field adjustment from the exterior of the shade unit without disassembling the hardware.
   2. Provided with a built-in shock absorber system to prevent chain breakage under normal use conditions.

F. Chain at Manual Shades: No. 10 stainless steel bead chain formed in a continuous loop. Chain shall have a 90 pound test.

G. Miscellaneous Brackets, Fastenings, and Accessories: As detailed, or if not detailed, as recommended by shade manufacturer for conditions indicated on the Drawings or encountered.

H. Factory Finish on Exposed Aluminum: Polyvinylidene fluoride paint system using PVDF resin.
   1. Color: Color matching requirements to be finalized.

2.04 POWER OPERATOR

A. Motor: Fractional horsepower asynchronous motor with reversible capacitor designed for intermittent operation.
   1. Power: 95-125V AC, 60 HZ, single phase.
   2. Thermally protected, temperature Class A, totally enclosed.

3. Solenoid activated disk brake mechanism to stop and hold shade in any position, and externally adjustable internal limit switches. Brake shall automatically disengage when motor is operating.
4. Electrical Components: CSA and UL listed.
5. Motor shall be concealed within the shade tube and shall be maintenance free.
6. Controller: Manufacturer's "Smart Operating System" group controller.

B. Switching: To be coordinated with District's Design Consultant.

C. Controls: Provide 3-position rocker-type wall switch where indicated on the Drawings; switch and switch plate to match other switches provided under Division 26.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install shades in accordance with manufacturer's installation instructions.

B. Verify operation. Adjust clearances to ensure free operation.

END OF SECTION

SECTION 12 36 61

SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Solid quartz and polymer countertops, with matching splashes.

1.02 ACTION SUBMITTALS

A. Shop Drawings:
   1. Dimensioned, to-scale plans and elevations showing details of fabrication, seam locations, edging, lavatory or sink installation, fastener types and locations, and method of attachment.
   2. Identify color and pattern of solid surfacing for each location.
   3. Coordinate preparation of shop drawings with casework interfacing with solid surfacing countertops.

B. Product Data: Manufacturer’s descriptive literature and test reports substantiating that solid surfacing meets specified requirements.

C. Samples:
   1. Minimum 6-inch-square piece of each pattern and color.
   2. Counter edge, 6-inches long, in required profile.

1.03 INFORMATIONAL SUBMITTALS

A. Evidence of certification of installer by manufacturer.

1.04 CLOSEOUT SUBMITTALS

A. Extended warranty.

B. Manufacturer's recommended care and maintenance recommendations including recommended repair and cleaning instructions.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Certified by manufacturer of solid surfacing as an acceptable fabricator and installer.

1.06 WARRANTY

A. Manufacturer: Furnish District with manufacturer's extended 10-year warranty against defects in materials, fabrication, and installation. Warranty shall provide material and labor to repair or replace defective materials.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Flammability: Provide solid surfacing with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Flame Spread Index: 25 or less.
   2. Smoke Developed Index: 450 or less.

B. Solid surfacing shall comply with the following industry standards:
   1. American National Standards Institute (ANSI) and International Cast Polymer Association (ICPA):
      a. ANSI/ICPA SS-1, "Performance Standard for Solid Surface Materials."
   2. International Solid Surfacing Fabricators Association (ISSFA):
      a. ISSFA-2, "Classification & Standards Publication of Solid Surfacing Material."

2.02 MATERIALS

A. Solid Surfacing: H Homogeneous, thermoset, quartz and polymer alloy sheet; “CaesarStone” as distributed by Caesarstone U.S.A., Inc., or equal meeting the appearance of the basis of design product selected by the District’s Design Consultant.
   1. Nominal Thickness: 3/4 inch (20 mm).
   2. Slabs shall be sized to minimize number of joints in installation.

2.03 ACCESSORIES

A. Mounting Adhesive: Structural-grade silicone or epoxy of type recommended by manufacturer for application and conditions of use.

B. Panel Joint Adhesive: Manufacturer's standard two-part epoxy or polyester to create flush, inconspicuous, monolithic, non-porous joints with a chemical bond.

C. Perimeter Sealant: Silicone; type as recommended by solid surfacing manufacturer.

D. Mounting Hardware:
   1. Fixtures: Manufacturer's approved bowl clips, brass inserts, and fasteners.
   2. Surfacing: Type and size as required and recommended by surfacing manufacturer.

2.04 FABRICATION

A. Comply with applicable requirements of ISSFA-2 and printed instructions of manufacturer including those for treating cut edges, sanding, polishing, seaming and layering.

B. Use a single piece wherever possible.
   1. Provide joints only were maximum available lengths or countertop configuration requires a joint.
   2. Where multiple sheets are required, use sheets in consecutive order as numbered by manufacturer.

C. Precut openings for applied fixtures and fittings, where possible. Cutouts shall be smooth and uniform without saw marks.

D. Predrill mountings for applied hardware, where possible.

E. Conceal all fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install countertops conforming to manufacture's recommended installation procedures.

B. If field joints are required, make them in same manner as shop joints. Finished joints shall be flush, monolithic, uniform, and nearly invisible.

C. Scribe and cut to fit adjoining work.

D. Install work plumb, level, true, and straight, with no distortions. Install with no variation in flushness of adjoining surfaces.

E. Sealant:
   1. Use silicone sealant to attach back and end splashes, and to seal joints around plumbing fixtures.
   2. Use sealant to close any small unavoidable gaps between counter and abutting surfaces. Sealant shall not be used to correct excessive joint size or scribing errors.

END OF SECTION

SECTION 12 48 13

ENTRANCE GRATES AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Recessed entrance gratings and frames.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Show plan and details of grating installation.

B. Product Data: Manufacturer's descriptive literature for grating and frame.

C. Samples: Frame and grating, not less than 12 inches by 12 inches.

D. Sustainable Design (LEED):
1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
2. LEED design submittals shall be in addition to other submittals.

1.03 INFORMATIONAL SUBMITTALS

A. Certified test reports showing compliance with specified performance characteristics and physical properties of grating.

1.04 CLOSEOUT SUBMITTALS

A. Cleaning and maintenance data. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

B. Extended warranty.

1.05 WARRANTY

A. Manufacturer: Furnish District with manufacturers' a written 5-year warranty for gratings and frames against all defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Structural Performance: Provide foot grilles and frames capable of withstanding the following loads and stresses:
1. Uniform floor load of 300 lbf/sq. ft.
2. Wheel load of 350 lb per wheel.

B. Coefficient of Friction: 0.60 minimum per ASTM D2047.

C. Gratings shall comply with accessibility requirements CBC Chapter 11B and ADA “Standards for Accessible Design,” whichever is more stringent.

2.02 MATERIALS

A. Manufacturer and Product: Am Basis-of-Design Product: Subject to compliance with requirements, provide ARDEN Architectural Specialties, Inc. "eleGril" Model SS-38G or a comparable product by one of the following:
   1. Balco, Inc.
   2. Cactus Mat Mfg. Co.
   3. Crowder, K. N. Manufacturing, Inc.
   4. C/S Group.
   5. J. L. Industries, Inc.
   6. Kadee Industries, Inc.
   7. Mats, Inc.
   8. Pawling Corporation; Architectural Products Division.
   9. Reese Enterprises, Inc.
   10. Or equal.

B. Grating: Stainless steel, Type 304.
   1. Stainless Steel: Type 304 with satin finish.
   2. Wire Spacing: 3/16 inch on center
   3. Grid Depth: 3/8 inches.
   4. Grating Lockdown: Manufacturers’ hidden lockdown system.

C. Recessed Frame: Bent 1/4 thick stainless steel angle, Type 304.
   1. Frame Depth: 3/4 inches.
   2. Frame shall be precut with mitered corners and supplied with manufacturer's anchors.

D. Fasteners: As recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set recessed frames prior to placement of concrete slabs or provide blockouts in concrete and install frames with drilled in anchors. Set top of frame flush with top of adjacent floor.

B. Install grating in accordance with manufacturer's written instructions just prior to final acceptance of the work and secure with hidden lock down assembly.

END OF SECTION

SECTION 21 05 00

BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Fire Protection Sections specified herein.

1.02 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:
   1. Compliance with all codes and standards applicable to this jurisdiction.
   2. Shop Drawings for Equipment
   3. Coordination Documents
   4. Record Drawings
   5. Start-up Service and Building Commissioning
   6. Instruction, Maintenance, and O & M Manuals
   7. Work associated with Delivery, Storage, and Handling of products
   8. Work associated with provision of Temporary Facilities
   9. Preparation of Posted Operating Instructions
   10. Meeting Project Safety and Indemnity requirements
   11. Proper Cleaning and Closing
   12. Supplying proper Warranty information
   13. Supply specified Guarantee documentation
   14. Design and provision of Supports and Anchors
   15. Pipe Portals
   16. Access Panels and Doors
   17. Identification Markers
   18. Coordination of Electrical requirements for equipment provided

1.03 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to provide all material and labor to install complete fire protection systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and he shall coordinate his work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the equipment, and risers and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

D. Where project involves interface with existing building and site systems, effort has been made to note existing utilities and services. However, the Contractor should thoroughly familiarize

themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

1.04 DESCRIPTION OF BID DOCUMENTS

A. Specifications in general, describe quality and character of materials and equipment.

1.05 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

C. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

D. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

E. "Connect": Complete hook-up of item with required service.

F. "Exposed": Not installed underground or "concealed."

G. "Furnish": To supply equipment and products as specified.

H. "Indicated," "Shown" or " "Noted": As indicated, shown or noted on Drawings or Specifications.

I. "Install": To erect, mount and connect complete with related accessories.

J. "Motor Controllers": Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

K. "Must": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

L. “NRTL”: Nationally Recognized Testing Laboratory, including UL and/or ETL.

M. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

N. "Provide": To supply, install and connect as specified for a complete, safe and operationally ready system.

O. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner.

P. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

Q. "Shall": An exhortation or command to complete the specified task.

R. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

S. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

T. “Typical” or “Typ”: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

U. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

V. "Wiring": Raceway, fittings, wire, boxes and related items.

W. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.06 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 21 Fire Suppression sections included herein.

B. Division 02: Existing Conditions.
   1. Coordination of excavation of trenches and the installation of piping on site.

C. Division 03: Concrete.
   1. All concrete work for Fire Suppression Division shall be included in Division 21 under the appropriate Sections and shall include:
      a. Concrete curbs and housekeeping pads for the equipment.
      b. Thrust blocks for piping.

D. Division 07: Thermal and Moisture Protection.
   1. Sealants and caulking.
   2. Firestopping.

E. Division 09: Finishes:
   1. Division 21 installers shall perform all painting, except where specifically stated otherwise in Division 09.

F. Division 26: Electrical is related to work of:
   1. Fire protection alarms and relays.
   2. Detectors and monitoring.
   3. Power connections to all equipment.
   4. Life safety provisions.

1.07 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 21 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

E. Provide in accordance with rules and regulations of the following:
   1. NFPA Standards:
      a. NFPA 13: Standard for Installation of Sprinkler Systems (latest adopted version)
      b. NFPA 14: Standard for the Installation of Standpipe and Hose Systems (latest adopted version)
      c. NFPA 17: Standard for Dry Chemical Extinguishing Systems (latest adopted version)
      d. NFPA 17A: Standard for Wet Chemical Extinguishing Systems (latest adopted version)
      e. NFPA 20: Standard for the Installation of Stationary Pumps for Fire Protection (latest adopted version)
      f. NFPA 22: Standard for Water Tanks for Private Fire Protection (latest adopted version)
      g. NFPA 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances (latest adopted version)
      h. NFPA 25: Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (latest adopted version)
      i. NFPA 70: National Electrical Code (latest adopted version)
      j. NFPA 72: National Fire Alarm and Signaling Code (latest adopted version)
      k. NFPA 80: Standard for Fire Doors and Other Opening Protectives (latest adopted version)
      l. NFPA 101: Life Safety Code (latest adopted version)
      m. NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems (latest adopted version)
   2. Factory Mutual Global insurance company if declared by building Owner, including, but not limited to the following Data Sheets:
      a. Data Sheet 3-26: Fire Protection Water Demand for Nonstorage Sprinklered Properties.
      b. Data Sheet 2-0: Installation Guidelines for Automatic Sprinklers
      c. Data Sheet 2-8: Earthquake Protection for Water-Based Fire Protection Systems
      d. Data Sheet 8-9: Storage of Class 1, 2, 3, 4 and Plastic Commodities
      e. Data Sheet 2-10R: Dry-Pipe, Deluge, Preaction Valves & Accessories
      f. Data Sheet 3-0: Hydraulics of Fire Protection Systems
      g. Data Sheet 4-4N: Standpipe and Hose Systems
   3. Building Codes enforced by the Authority Having Jurisdiction in California:
      a. 2016 Building Standards Administrative Code, Part 1, Title 24 CCR.
      b. 2016 California Building Code (CBC), Part 2, Title 24 CCR (2015 International Building Code with California Amendments)
      c. 2016 California Electrical Code (CEC), Part 3, Title 24 CCR (2014 National Electrical Code with California Amendments)
      d. 2016 California Mechanical Code (CMC) Part 4, Title 24 CCR (2015 Uniform Mechanical Code with California Amendments)

e. 2016 California Plumbing Code (CPC), Part 5, Title 24 CCR (2015 Uniform Plumbing Code with California Amendments)
f. 2016 California Nonresidential Energy Code (CEC), Part 6, Title 24 CCR
g. 2016 California Fire Code, Part 9, Title 24 CCR (2015 International Fire Code with California Amendments
h. 2016 California Green Building Standards Code (CALGreen), Part 11, Title 24 CCR.
i. 2016 California Referenced Standards, Part 12, Title 24 CCR.
j. Title 19 CCR Public Safety, State Fire Marshal Regulations.
k. 2014 National Electric Code (NEC) with State Amendments
l. 2015 International Energy Conservation Code (IECC) with Amendments

4. Local, city, county and state codes and ordinances
5. Local and State Fire Prevention Districts.
6. Other applicable standards and references:
   a. UL and FM Compliance: Provide products, which are UL listed and FM approved.
   b. ASCE/SEI 7-10: Minimum Design Loads for Buildings and Other Structures.
   c. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).
   d. SMACNA: Seismic Restraint Manual-Guidelines for Mechanical Systems.
   e. Factory Mutual Approval Guide (Product listing, only).
   f. Factory Mutual Approval Guide and FM Pamphlet #20 “Rules for Installing Sprinklers” (Product listing and project review).
   g. Underwriters Laboratories, Inc.
   h. Industrial Risk Insurance Underwriters.
   i. Owner’s insurance agency.

F. Provide in accordance with appropriate referenced standards of the following:
1. NFPA - National Fire Protection Association.
2. CSA - Canadian Standards Association.
3. ANSI - American National Standards Institute.
4. ASME - American Society of Mechanical Engineers.
5. ASTM - American Society for Testing Materials.
6. AWS - American Welding Society.
7. AWWA - American Water Works Association.
8. FM - Factory Mutual.
9. MSS - Manufacturer's Standardization Society.
10. NEMA - National Electrical Manufacturer's Association.
11. UL - Underwriter's Laboratories.
12. ADA - Americans with Disabilities Act.
13. ETL - Electrical Testing Laboratories.
14. IAPMO - International Association of Plumbing and Mechanical Officials.

1.08 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Owner’s Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to the Owner's Representative for a decision before proceeding.

1.09 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminum or Type 304 stainless steel sheet, not less than 20 USG (0.0375"), riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

B. Current Models. All work shall be as follows:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 21, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

D. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.
1. All pipe, pipe fittings and valves shall be manufactured in North America. Alternatives may be acceptable, but must be submitted and approved by the Owner's Representative prior to bidding.

OR

2. Upon request, the Owner's Representative shall be furnished certification by the manufacturer, stating samples representing each lot have been tested and inspected as indicated in governing ASTM specifications have been met. Certification shall be accompanied by test reports as prepared in accordance with relevant ASTM sections governing Test Methods and Inspection. Tension Tests reports shall include breaking load, machined diameter of the test bars, and calculated tensile strength. Certification shall include the legal name and address of the manufacturer.

E. Each product and/or equipment type shall be provided by one manufacturer. Mixtures of manufacturers for each product and/or equipment type are not acceptable. Example – all wet system sprinkler piping shall be supplied by one manufacturer while different piping systems may be provided by other manufacturers.

F. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

1.010 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

E. Coordinate equipment and materials installation with other building components.

F. Verify all dimensions by field measurements.

G. Arrange for chases, slots, and openings in other building components to allow for installations.

H. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

I. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work.

J. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted.

K. Install fire protection services and overhead equipment to provide the maximum headroom possible.

L. Install equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

M. Coordinate the installation of materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, and other installations.

N. Coordinate connection of systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

O. Coordinate with Owner's Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

P. All materials (such as insulation, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

Q. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed

as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

1.011 MINOR DEVIATIONS

A. The Contractor shall review the structural and architectural conditions and drawings affecting his work. It is the specific intention of this section that the contractor's scope of work shall include

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications

B. The Contractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work." Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

C. Advice the Owner’s Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner’s Representative of conflict.

1.012 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:

1. The proposed substitution does not affect dimensions shown on drawings.
2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.
3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
4. Maintenance and service parts available locally are readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution.

1.013 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner’s Representative for approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final

coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings:

1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per Division. Multiple submissions will not be accepted without prior approval of the Owner's Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.
2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.
3. Paper submittals will only be acceptable if specifically required by Division 01.
4. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.

1.014 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.

1. The shop drawings shall serve to record the coordination of the installation and location of all fire sprinkler heads, piping, HVAC equipment, ductwork, grilles, diffusers, lights, audio/video systems, electrical services and all system appurtenances.
2. The Drawings shall include all mechanical rooms and floor plans.
3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.
4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:
1. Two dimensional AutoCAD / Revit based documents:
   a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.
   b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the HVAC work.
   c. Fire protection drawings shall indicate locations of all sprinkler heads and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.

e. Drawings shall incorporate all addenda items and change orders.
f. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

2. Three dimensional Revit / BIM based documents (if required for project):
   a. Provide three dimensional Revit model and BIM input information locating all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   b. Contractor shall obtain Revit model and BIM input from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
   c. Model shall indicate locations of all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
   e. Model shall incorporate all addenda items and change orders.
   f. Distribute Revit model and BIM input information to all other trades and provide additional coordination as needed to assure adequate space for equipment and piping and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner's Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner's Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

1.015 REQUESTS FOR INFORMATION (RFIS).

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).

   1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
   2. RFIs shall address single questions and related issues only.
   3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner's Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.

3. Date.
4. Name of Contractor.
5. Name of Architect and Construction Manager.
6. RFI number, numbered sequentially and unique.
7. RFI subject.
8. Specification section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the contract time or the contract sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, product data, shop drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Incomplete RFIs or inaccurately prepared RFIs.
      b. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.
      c. RFIs addressing multiple unrelated issues.
      d. Requests for approval of submittals.
      e. Requests for approval of substitutions.
      f. Requests for approval of Contractor's means and methods.
      g. Requests for information already indicated in the Contract Documents.
      h. Requests for adjustments in the Contract Time or the Contract Sum.
      i. Requests for interpretation of Engineer's actions on submittals.
   2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.016 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked “Record Set” at the job site at all times, and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall indicate revisions to piping, size and location both exterior and interior; including control devices, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance.

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record

Documents and electronic media (DVD disks) labeled with all drawings and specifications and other supporting documentation.

E. Refer also to Division 01 for full scope of requirements.

1.017 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of pumps, and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Refer to other Division 21 Sections for additional requirements.

1.018 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, the Contractor shall submit to the Owner's Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. The Contractor shall be responsible for proper instruction of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 21 to be no less than 2 hours for each piece of equipment.

1.019 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment showing signs of rust shall be removed from site and replaced with new.

1.020 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.021 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.022 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner’s Representative.

1.023 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, or longer, as defined in each subsequent specification section. Warranty shall include all parts, material, labor and travel.

D. Warranty Start Date: The start date for all warranty periods shall be defined as starting from the date of Substantial Completion which shall include the Certificate of Occupancy from the Authority Having Jurisdiction.

E. Refer to individual Specification sections for additional extended warranty requirements.

F. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

G. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

H. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

2.02 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.
2. Manufacturers: Hilti Inc., B-Line, Anvil International, Tolco, Kin-Line, Simpson, Erico or Superstrut.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.
1. Adjustable Steel Clevis Hangers: MSS Type 1.
2. Adjustable Steel Swivel Band Hangers: MSS Type 10.
3. U-Bolts: MSS Type 24.
4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
   a. Plate: Unguided type.
   b. Plate: Guided type.
   c. Plate: Hold-down clamp type.
5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.
6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.
7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.
8. Single Pipe Roller with Malleable Sockets: MSS Type 41.
9. Adjustable Roller Hangers: MSS Type 43.
10. Pipe Roll Stands: MSS Type 44.

11. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.
1. Steel Turnbuckles: MSS Type 13.
2. Steel Clevises: MSS Type 14.
3. Swivel Turnbuckles: MSS Type 15.
4. Malleable Iron Eye Sockets: MSS Type 16.
5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments of one of the following types listed.
1. Concrete Inserts: HCI-MD (for metal deck) or HCI-WF (for wood forms) cast-in anchors by Hilti Inc. or MSS Type 18 or Blue Banger Hanger by Simpson
2. Steel Brackets: One of the following for indicated loading:
   a. Light Duty: MSS Type 31.
   b. Medium Duty: MSS Type 32.
   c. Heavy Duty: MSS Type 33.
3. Horizontal Travelers: MSS Type 58.
4. Concrete Screw Anchors: Hilti Kwik HUS EZ or equal.
5. Torque-Controlled Expansion Anchor: Hilti Kwik Bolt TZ or equal.

G. Saddles and Shields (for heat traced pipe): Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
2. Insulation Protection Shields: MSS Type 40, 18” minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.
3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert.
4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:
1. Metal Framing: Provide products complying with NEMA STD ML1.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.
3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0

parts sand by volume, with minimum amount of water required for placement and hydration.

4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.
5. Pipe Brackets: "HoldRite" copper plated brackets. Insulate brackets attached to metal studs with felt.

2.03 SEISMIC RESTRAINT AND VIBRATION ISOLATION REQUIREMENTS

A. Equipment, piping, and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest code editions with State Amendments, applicable local codes, and applicable Importance Factors and Soil Factors. Refer to Section 21 05 48 Vibration Isolation for Fire Protection Equipment or Section 21 05 49 Seismic Restraint for Fire Protection Piping and Equipment, as applicable.

2.04 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20-gauge steel, 1” flange width, continuous piano hinge, key operated, prime coated. Refer to Architectural Specifications for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels are not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each concealed valve. Use no panel smaller than 12" x 12” for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Owner’s Representative. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Acceptable Manufacturers: Milcor, Karp, Nystrom, Elmdor/Stoneman, or equal.

D. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Owner’s Representative.

2.05 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 21 Sections. Where more than a single type is specified for application, selection is at installer's option, but provide single selection for each product category. Stencils are not acceptable.

B. Plastic Pipe Markers:
   1. Snap-On Type: Provide pre-printed, semi-rigid snap-on, color coded pipe markers, complying with ANSI A13.1.
   2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape.

3. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

C. Underground-Type Plastic Line Markers: Provide 6” wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

D. Valve Tags:
1. Brass Valve Tags: Provide 1-1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4” high letters and sequenced valve numbers 1/2” high, and with 5/32” hole for fastener. Fill tag engraving with black enamel.
2. Plastic Laminate Valve Tags: Provide 3/32” thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32” hole for fasteners.
3. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
4. Access Panel Markers: Provide 1/16” thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8” center hole to allow attachment.

E. Plastic Equipment Signs:
1. Provide 4-1/2” x 6” plastic laminate sign, ANSI A.13 color coded with engraved white core lettering.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters, such as pressure, rpm, etc.

F. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., Brimar or equal.

2.06 ELECTRICAL

A. General:
1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
2. Provide all motors for equipment specified herein. Provide motor starters, controllers, transfer switches, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.
3. Set and align all motors and drives in equipment specified herein.
4. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.
5. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.
6. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

B. Quality Assurance:
   1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Low Voltage Control Wiring:
   1. General: 14-gauge, Type THHN, color coded, installed in conduit.
   2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., Southwire Co, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Workmanship shall be performed by licensed journeymen or master fitter and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work, unless so indicated on Drawings or approved by Owner's Representative.

3.02 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.03 INSTALLATION

A. Coordinate the work between the various Fire Protection Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Owner's Representative and at the Contractor's cost. Coordinate wall and ceiling work with the General Contractor, and his subcontractors in locating ceiling air outlets, wall registers, etc.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

3.04 SUPPORTS AND HANGERS

A. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed. Fasten insert securely to forms.

B. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

C. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

D. Install hangers within 12 inches of every change in piping direction, end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

F. Support sprinkler piping independently of other piping.

G. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

H. Hanger Spacing in accordance with following minimum schedules (other pipe/rod sizes and hanger spacings may be used in accordance with NFPA-13):
   1. Steel Pipe:

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 1"	7 feet	3/8"
1-1/4" to 2"	10 feet	3/8"
2-1/2" to 3"	12 feet	3/8"
4" to 8”	15 feet	1/2"

   2. Plastic Pipe:

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 2"	4 feet	3/8"
2-1/2" and larger	6 feet	1/2"

I. Sloping, Air Venting, and Draining:

   1. Slope all piping as specified and as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in the direction of flow as follows:

Service	Slope
Wet	Not required
Dry/Preaction Mains	1/4"/10'

Dry/Preaction Branches 1/2"/10'

J. Provisions for Movement:
   1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
   2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.

K. Installation of Anchors:
   1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.
   2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.
   3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
   4. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

L. Equipment Supports:
   1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.
   2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

M. Adjusting:
   1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
   2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
   3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades they are installed when roofing is being installed.

3.06 VIBRATION CONTROL ISOLATORS

A. Comply with manufacturer's recommendations for selection and application of vibration isolation materials and units except as otherwise indicated. Comply with minimum static deflections recommended by ASHRAE, of vibration isolation materials and units where not otherwise indicated.

B. Comply with manufacturer's instructions for installation and load application to vibration control materials and units except as otherwise indicated. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or

bearing points. Remove space blocks and similar devices intended for temporary support during installation.

C. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

D. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

E. Flexible Pipe Connectors: Install on equipment side of shutoff valves.

F. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

3.07 ELECTRICAL COORDINATION

A. Division 21 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

C. Division 21 has responsibilities for electrically powered fire protection equipment which is specified in Division 21 Specifications or scheduled on Division 21 Drawings as follows:
   1. Motors: Furnish and install all motors necessary for mechanical equipment.
   2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 21 equipment, also furnish and install the power wiring between starter and motor.
   3. Variable Frequency Drives: Provide all VFD's associated with fire protection equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.
   4. Disconnects: Provide the disconnects which are part of factory wired Division 21 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.
   5. Controls: Division 21 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:
      a. Control relays necessary for controlling Division 21 equipment.
      b. Control transformers necessary for providing power to controls for Division 21 equipment.
      c. Low or non-load voltage control components.
      d. Non-life safety related valve or damper actuators.
      e. Float switches.
      f. Solenoid valves, EP and PE switches.
      g. Communications wiring and conduit between control devices and fire protection equipment.

h. Raceway to support control cabling.

D. Division 26 Electrical Responsibilities:
1. Motors: Provide the power wiring for the motors from servicing panel to motor controller.
2. Magnetic Starters: Except where magnetic starters are factory installed on Division 21 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 21 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring from source panel/disconnect to the starter.
3. Variable Frequency Drives: Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 21.
4. Disconnects: Provide all disconnects necessary for Division 21 fire protection equipment which are not provided as part of factory wired Division 21 equipment. Provide power wiring to all disconnects. In addition, provide power wiring between motor and disconnect when the disconnect is not factory installed.
5. Controls: Division 26 is responsible for providing power to control panels and provide final power connection to Division 21 provided control transformers.
6. Fire Sprinkler System: Division 26 is responsible for providing power wiring to fire protection controls including flow switches and alarm bells.
7. Specialized fire suppression systems: Division 26 is responsible for providing power wiring to suppression system and its controls.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.08 IDENTIFICATION MARKERS

A. General: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Piping System Identification:
1. Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.
2. Locate pipe markers as follows:
a. Near each valve and control device.
b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
d. At access doors, manholes, and similar access points which permit view of concealed piping.
e. Near major equipment items and other points of origination and termination.
f. Spaced horizontally at maximum spacing of 20' along each piping run, with minimum of one in each room. Vertically spaced at each story traversed.

C. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over

buried line at 6” to 8” below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16”, install single line marker.

D. Equipment Identification: Locate engraved plastic laminate signs on or near each major item of mechanical equipment and each operational device. Provide signs for the following:
   1. Main control and operating valves, including safety devices.
   2. Meters, gauges and similar units.
   3. Pumps, compressors, and similar motor-driven units.
   4. Tanks and pressure vessels.
   5. Sprinkler and standpipe equipment.

E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.

3.09 VIBRATION AND DYNAMIC BALANCING

A. Vibration tolerances shall be as specified by the "International Research and Development Corporation", Worthington, Ohio, measured by the displacement, peak to peak, as follows:
   1. Pump and Electric Motors: Below severity chart labeled "SLIGHTLY ROUGH", maximum vibration velocity of 0.157 in/sec, peak.
   2. Compressors: Same as pumps.

B. Correction shall be made to all equipment which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

3.010 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner’s Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

END OF SECTION

SECTION 21 05 49

SEISMIC RESTRAINT FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 21 05 00 - Basic Fire Protection Materials and Methods, and other Sections in Division 21 specified herein.

1.02 SUMMARY

A. This Section includes the following:
   1. Seismic restraint and support of piping and fire protection equipment as required by code and as designed by project registered professional Structural Engineer.
   2. Mechanical component supports and the means by which they are attached to the fire protection component shall be designed for the forces and displacements determined in ASCI 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.
   3. Support and seismic bracing for sprinkler piping shall comply with requirements of NFPA 13 – Standard for Installation of Sprinkler Systems.

1.03 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. ASCE: American Society of Civil Engineers

C. Building Seismic Design Category: The directions of application of seismic forces used in the design shall be those which will produce the most critical load effects. Seismic Design Categories are classified as A, B, C, D, E or F. Refer to Architectural and Structural Designs for project specific classification.

D. Fire Protection Attachments: Means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

E. Fire Protection Components: Elements, including, but not limited to, pumps, pipes and risers.

F. Fire Protection Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

G. IBC: International Building Code with AHJ Amendments.

H. ICC-ES: ICC-Evaluation Service

I. NFPA: National Fire Protection Association

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 21 05 00: Basic Fire Protection Materials and Methods

B. Section 21 05 48: Vibration Isolation for Fire Protection Piping and Equipment

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Structural Performance: Restraint devices and systems shall withstand the effects of locally defined gravity loads, seismic loads, dead loads, live loads, winds loads and stresses within limits and under conditions indicated according to the Building Code and ASCE 7. Coordinate all support structures and restraint systems with project registered professional Structural Engineer.

C. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

D. Codes and Standards: Provide components conforming to the seismic load requirements of the latest addition of the local building code and the following:
   1. International Building Code with State Amendments
   2. NFPA-13: Standard for the Installation of Sprinkler Systems
   3. ASCE 7-10 (Latest Edition) - Minimum Design Loads for Buildings and Other Structures (Latest Edition)
   4. Cooper B-Line/Tolco: Supports and Attachments of Non-Structural Fire Protection Systems
   5. Erico International: Seismic Sway Bracing for Fire Sprinkler Systems

1.06 APPLICABILITY

A. Provide seismic bracing at the following locations per NFPA-13:
   1. Transverse bracing shall be provided at 40 feet (12.2 m) maximum intervals on center except where a lesser spacing is indicated in the NFPA-13 tables.
   2. Longitudinal bracing shall be provided at 80 feet (24.4 m) maximum intervals on center except where a lesser spacing is indicated in the NFPA-13 tables. This includes feed and cross mains.
   3. Brace a change of direction longer than 12 feet (3.7m).

B. Seismically restrained systems shall not move more than 2" when pushed at any location and shall not impact other nonstructural components or building structure.

1.07 PERFORMANCE REQUIREMENTS

A. Component Importance Factor:
   1. Ip=1.5

1.08 SUBMITTALS

A. Product Data:
   1. Include rated load, rated deflection, and overload capacity for each device or system.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Submit seismic brace product details detailing compliance with the specifications.
   4. Where products from pre-approved manufacturers cannot be used, special details must be submitted for approval.

B. Seismic Restraint Calculations
   1. Seismic restraint calculations must be provided for all connections to the structure.
   2. Calculations must be stamped by a registered professional Structural Engineer.

1.09 ENGINEERED PIPING SYSTEMS

A. Where the piping system design indicated on the plans utilizes pre-approved seismic restraint components and flexible connectors the following requirements apply:
   1. Pre-approved products must be installed as shown.
   2. If product substitutions or design changes are made the contractor must provide certified design of the piping system and meet the following conditions:
      a. Certification must be provided by a registered professional Structural Engineer.
      b. Certification shall include a statement that all systems have been checked for loads and stresses and that no excessive loads or stresses exist.
      c. Forces on all anchors, guides, supports, and restraints must not exceed those shown in the original design unless the structure is checked for the larger loads at no cost to the owner.

B. Where the piping system design is not indicated on the drawings the design is delegated to the contractor with the following requirements for piping certification and analysis:
   1. The supports, anchors, seismic braces for fire protection systems.
   2. The results of the analysis shall include reactions at restraints and anchors, maximum pipe displacements and a code compliant report indicating maximum pipe stresses.
   3. Where required, seismic restraint components, anchors, expansion compensators and flexible connectors shall be incorporated into the design of the systems.
   4. The analysis and design must be performed by a Structural Engineer with 5 years of experience in this field.

1.010 MANUFACTURER AND CONTRACTOR RESPONSIBILITIES

A. All seismic restraints shall be designed by a registered professional Structural Engineer.

B. Seismic restraint layouts for piping shall be added to the contractor’s shop drawings and shall include:
   1. The number, size and location of seismic braces.
   2. Maximum support loads and seismic loads at the seismic brace locations.

C. Installations not addressed by the states pre-approval process must be designed, detailed and submitted along with the shop drawings.

D. Submit seismic restraint layout drawings and special details for approval of the project registered professional Structural Engineer.

E. Seismic restraint layout drawings shall bear the stamp and signature of the registered professional Structural Engineer who designed the layout of the braces.

1.011 LOADS ON STRUCTURE

A. The responsibility of determining allowable loads on the structure is the sole responsibility of the project registered professional Structural Engineer.

B. Maximum support loads and seismic brace loads on the structure must be less than the maximum allowable loads defined by the project registered professional Structural Engineer, as shown on the plans.

C. Where maximum loads are not listed on the plans or the maximum allowable loads cannot be met, any additional support steel required to reduce support and seismic bracing loads on the structure shall be designed by the project registered professional Structural Engineer.

D. Mechanical component supports and the means by which that are attached to the component shall be designed for the forces and displacements determined in ASCI 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the fire protection component.

E. Mechanical supports are those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Mechanical attachments are the means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

1.012 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 INTENT

A. All seismic restraints described in this section shall be the product of a single manufacturer.

B. Eaton B-Line/Tolco and Erico products are the basis of these specifications; products of other manufacturers may be submitted for review provided their systems strictly comply with the specifications.

2.02 SEISMIC SWAY BRACING

A. Seismic sway braces shall consist of galvanized steel aircraft cables, steel angles or steel struts.

B. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads. Brace end connections shall be steel assemblies that swivel to the final installation angle.

C. Cable brace assemblies shall have published strength and stiffness ratings based on testing per FM-1950 standards.

D. Angle or strut bracket assemblies shall be FM Approved except as noted below.

E. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps.

F. Cable brace bracket assemblies shall be Type SCB or SCBH. Solid brace bracket assemblies shall be Type SSB-FM, SSBS-FM or SHB-FM. All bracket assemblies shall have published strength and stiffness values based on testing per FM-1950.

G. Rod clamps shall be Type SRC or UCC.

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor's Statement of Responsibility: Each contractor responsible for installing a Designated Seismic System or any seismic resisting component must submit a statement of responsibility prior to the commencement of work to include acknowledgment of awareness of the need for Special Inspections.

B. All seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

C. No connections between the piping and the building structure shall be made that degrades the seismic restraint system herein specified.

D. Any conflicts with other trades due to inadequate space or other unforeseen conditions should be brought to the attention of the Owner's Representative prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

E. Installation of seismic restraints must not cause any change of position of equipment or piping resulting in stresses or misalignment.

F. Install seismic-restraint devices using methods approved by an evaluation service or agency acceptable to the authorities having jurisdiction, providing required submittals for component.

3.02 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

END OF SECTION

SECTION 21 10 00

FIRE PROTECTION PIPING, HEADS AND SPECIALTIES

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 21 05 00 - Basic Fire Protection Materials and Methods, and other Sections in Division 21 specified herein.

1.02 DEFINITIONS

A. Pipe sizes used in this Section are nominal pipe size (NPS) specified in inches.

B. Working plans as used in this Section refer to documents (including drawings and calculations) prepared pursuant to requirements in NFPA-13 for obtaining approval of AHJ (Authority Having Jurisdiction).

C. NICET - National Institute for Certification in Engineering Technologies.

D. Other definitions for fire protection systems are included in referenced NFPA Standards.

E. FM – Factory Mutual Global insurance company.

1.03 DESCRIPTION OF WORK

A. The work includes designing, providing and installing a complete and fully operable automatic sprinkler system as described in this Section of the Specification and as shown on the contract construction drawings and shall be in accordance with rules, regulations and standards as required by the authorities having jurisdiction.
   1. State.
   2. City.
   3. Building Department.
   4. Fire Prevention Division, Fire Marshal’s Office.
   5. Factory Mutual Global insurance if declared by Owner.

B. Work includes but is not limited to the following:
   1. Automatic Wet Type Sprinkler System.
   2. Piping
   3. Sprinkler heads.
   4. Remodeling of existing systems.
   5. All cutting and patching.
   6. Provide all pipe, fittings, sprinklers, valves, signs, flow switches, tamper switches, protective painting, test connections, drains and tests necessary to make the entire system complete and operative.
   7. Coordinate with plumbing contractor for capacity of all sprinkler main, test, and auxiliary drain connections.
   8. Valve tags and instruction plates shall be mounted and/or hung per local fire department requirements.

9. All required fire extinguishers.
10. All sleeves and inserts.
11. Provide hose valve with cap downstream of sprinkler system pressure reducing valves for the purpose of testing. Hose valve shall be sized to provide full flow through pressure reducing valve.
12. All trenching and backfilling, including culverts under rails and guard posts where required.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 21 05 00: Basic Materials and Methods

B. Section 21 05 49: Seismic Restraint for Fire Protection Piping and Equipment

C. Division 26: Electrical. Coordinate for electrical wiring of detectors, flow alarm switches, tamper switches, connection to VESDA system, fire alarm bell, All electrical devices used for this system shall be compatible with the fire alarm system.

D. Division 09: Finishes of exposed materials.

E. Division 22: Coordination with Plumbing for drainage piping.

1.05 DESIGN DESCRIPTION

A. This section of the specification combined with any of the contract drawings are intended as a guide to establish a basis of design for the systems required.

B. Contractor shall examine the existing conditions, the Architectural, Interior Design, Structural, Mechanical, Plumbing, and Electrical drawings, layout and install a complete hydraulically sized sprinkler system for all areas. Access and maintenance space shall be provided for all valves and equipment to be used.
   1. System shall start 5'-0" from perimeter wall and extend throughout the building. Fire main beyond 5'-0" perimeter is provided under Division 02 work. System shall start at connection to utility main, with double detector check backflow prevention assembly, and extend throughout the building.
   2. Contractor shall contact Owner’s insurance agency to incorporate insurer’s design requirements in this layout document. Factory Mutual may review layout drawings and calculations. Incorporate all of their design criteria into documents.

C. Office Areas: The main building shall be served with a wet type sprinkler system. A main riser shall be located in the mechanical room.

D. All areas shall be sprinklered as the construction progresses, including accessible pipe chases, etc. Comply with NFPA 13 and Building Code.

E. Base Building construction shall include upright heads with tees with 1” outlets for future drop in areas with no ceiling. Areas with ceilings, including finished core areas, lobbies, corridors or as noted herein shall have concealed or recessed pendant heads installed as part of the base building construction. Unfinished areas shall be provided with upright type heads. Heads will be relocated to the finished ceiling tile under the tenant improvement contract.

F. Pressure restricting devices shall be installed on any branch outlet exceeding 100 psi.

G. All electrical devices used for this system shall be compatible with the fire alarm system as referred in Division 26 work.

1.06 HYDRAULIC DESIGN

A. System shall be a straight line or gridded system per NFPA-13 with the following exceptions:
   1. For all systems the design area shall be the hydraulically most demanding rectangular area.
   2. Minimum pressure for any sprinkler head shall not be less than 7 psi.

B. Total Combined Inside & Outside Hose Allowances: Hydraulic calculations shall include an allowance for hose streams, added at the point of connection to the water supply.

C. Safety Factor: 10 psi, or 10 percent of static and residual pressure, whichever is greater.

D. Sprinkler system Occupancy Hazard Classifications shall be approved by authorities having jurisdiction:
   1. Air Distribution Plenums: Light Hazard (FM HC-1)
   2. Automobile Parking Areas: Ordinary Hazard, Group 1 (FM HC-2)
   3. Building Service Areas: Ordinary Hazard, Group 1 (FM HC-2)
   4. Churches: Light Hazard (FM HC-1)
   5. Corridors: Light Hazard (FM HC-1)
   6. Dry Cleaners: Ordinary Hazard, Group 2 (FM HC-2)
   7. Electrical Equipment Rooms: Ordinary Hazard, Group 1 (FM HC-2)
   8. Fire Riser Room: Ordinary Hazard, Group 1 (FM HC-2)
   9. General Storage Areas: Ordinary Hazard, Group 1 (FM HC-2)
   10. Healthcare: Light Hazard (FM HC-1)
   11. Kitchens: Light Hazard (FM HC-1)
   12. Laundries: Ordinary Hazard, Group 1 (FM HC-2)
   13. Libraries except Stack Areas: Light Hazard (FM HC-1)
   14. Library Stack Areas: Ordinary Hazard, Group 2 (FM HC-2)
   15. Loading Docks with Tractor Trailers: Ordinary Hazard, Group 2 (FM HC-3)
   16. Machine Shops: Ordinary Hazard, Group 2 (FM HC-2
   17. MDF/IDF/Electronic Data Hall: Ordinary Hazard, Group 1 (FM HC-2)
   18. Mechanical Equipment Rooms: Ordinary Hazard, Group 1 (FM HC-2)
   19. Office and Public Areas: Light Hazard (FM HC-1)
   20. Pump Room: Ordinary Hazard, Group 1 (FM HC-2)
   21. Repair Garages: Ordinary Hazard, Group 2 (FM HC-3)
   22. Residential Living Areas: Light Hazard (FM HC-1)
   23. Restaurant Service Areas: Ordinary Hazard, Group 1 (FM HC-2)

E. Minimum Density for Automatic-Sprinkler Piping Design shall comply with the following:
   1. Light Hazard Areas: Water density of 0.10 GPM per square foot calculated for an area of 1500 square feet in the most remote location.
   2. Ordinary Group I Hazard Areas: Water density of 0.15 GPM per square foot calculated for an area of 1500 square feet in the most remote locations.
   3. Ordinary Group II Hazard Areas: Water density of 0.20 GPM per square foot calculated for an area of 1500 square feet in the most remote locations.
   4. Extra Group I Hazard Areas: Water density of 0.30 GPM per square foot calculated for an area of 2500 square feet in the most remote locations.
   5. Extra Group II Hazard Areas: Water density of 0.40 GPM per square foot calculated for an area of 2500 square feet in the most remote locations.

F. Head spacing shall not exceed the limits described in NFPA-13.
   1. Light Hazard: 225 sq.ft. (for smooth ceiling).
   2. Ordinary Hazard: 130 sq.ft.
   3. Extra Hazard: 100 sq.ft.

G. Maximum floor areas protected by any one sprinkler system riser:
   1. Light Hazard: 52,000 sq.ft.
   2. Ordinary Hazard: 52,000 sq.ft.
   3. Extra Hazard: 40,000 sq.ft.

H. Flow Data: Contractor is to verify flow data (static pressure, residual pressure and GPM flowing) available at site and provide design for available pressure and flow.

1.07 QUALITY ASSURANCE

A. The Contractor for the fire protection installation shall be duly qualified Fire Protection Contractor, experienced and regularly engaged in the installation of fire protection systems with a license classification of C-16. Where local authorities require additional licensing of the Fire Protection Contractor, and/or workmen, such a license shall be mandatory for a prospective Contractor.
   1. Contractor is to verify flow data (static pressure, residual pressure and GPM flowing) available at site and provide design for available pressure and flow.
   2. The Fire Protection contractor shall be the Engineer of Record for the automatic sprinkler and standpipe system.
   3. Permits - The Fire Protection Contractor shall obtain permits for the installation or construction as required for approval and installation of the fire protection system. The Fire Protection Contractor shall submit working plans to the authorities having jurisdiction to obtain approval.

B. Welding Qualifications:
   1. Steel Support Welding: Qualify procedures and personnel according to American Welding Society AWS B2.1, “Specification for Welding Procedure and Performance Qualification”.
   2. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.”
   3. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation per pressure and temperature operating class.
   4. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.08 SUBMITTALS

A. Product Data: Submit six copies of manufacturer’s technical data and installation instructions for fire protection materials and products.
   1. Thirty days after the awarding of contract, contractor shall submit list of manufacturer’s names and model numbers for review and comment to Owner’s Representative. This list shall identify any prior approved substituted items contractor wishes to use. Do not submit technical data until list has been approved.
   2. Prior to construction submit for review and comment items including but not be limited to the following:
      a. Coordinated layout drawings. Lettering shall be minimum 1/8" high.
      b. Sprinklers and escutcheons - designating area of use.

c. Valves, valve boxes, flow switches, and tamper switches.
d. Provide Fire Marshal approval numbers for flow switches and tamper switches.
e. Pipe, fittings, sway bracing, inserts, anchors and hangers.
f. Inspector's test and drain station.
g. Fire department connections.
h. Hose valves, pressure relief valves, and pressure reducing valves.

3. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

B. Working Plans: Prepare scaled working plans for fire protection pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, and elevations and slopes of horizontal runs, wall and floor penetrations, and connections. Indicate interface between and spatial relationship to piping and adjacent equipment. Lettering shall be minimum 1/8" high.
1. Spacing of fire sprinklers shall be coordinated with lights, air conditioning outlets, sound speakers, architectural reflected ceiling plan; obstruction from light fixtures and other architectural features; and sprinkler piping shall be coordinated with HVAC ductwork & piping, plumbing, electrical conduit, cable trays and structure prior to the installation. Drawings shall be composite type including mechanical, plumbing and lighting equipment with sprinkler and sprinkler drain piping.

C. Submittal Drawings: Submit shop drawings to Agency having jurisdiction for approval bearing engineer of record stamp bearing preparer's NICET stamp. Submit six approved copies, bearing stamp and/or signature of Authority Having Jurisdiction to the Owner's Representative for review and comment.

1. Contractor shall submit sprinkler head locations to architect for approval.
2. Each calculation shall include legible schematic of system showing all hydraulic reference points.

D. Hydraulic Calculations: Prepare hydraulic calculations of fire protection systems. Submit to Authority Having Jurisdiction for approval. Submit six approved copies, bearing stamp, and/or signature of Agency having jurisdiction to Owner's Representative for review and comment.
1. Contractor shall submit published piping friction loss data from manufacturer with hydraulic calculations.

E. Certificate of Installation: Submit certificate upon completion of fire protection piping work, which indicates that work has been tested in accordance with NFPA-13, and also that system is operational, complete, and has no defects.

F. Maintenance Data: Submit maintenance data and parts lists for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approval calculation, certificate of installation, and record drawings in maintenance manual; in accordance with requirements of the General Conditions and of Division 01.

G. Operating and Maintenance Instructions: Provide the Owner with three sets of operating and maintenance instructions covering completely the operation and maintenance of sprinkler equipment and controls. Manual shall be assembled in a 3-ring binder and arranged in following sections:
1. Site Utilities: Drawings showing location, size, depth of all connections, valve boxes, manholes, etc., as installed.
2. A chart tabulating all types of pipe fittings, valves, and piping specialties installed in each system.

3. A chart tabulating all pressures, valve settings for fire department and sprinkler pressure reducing valves. Provide pressure reducing valve flow test documentation.
4. Manufacturer's brochures of all sprinkler heads.
5. Tamper switches and flow switches.
6. Fire Department connections.
7. Reproducible copies of approved working drawings prepared to facilitate the actual installation of ductwork and piping. Drawings shall indicate location of all concealed valves, and other apparatus.
8. Copy of NFPA-25 "Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems."
9. Approval Calculations.
10. Certificate of Installation.
11. Guarantees.
12. The Contractor is responsible for proper instruction of Owner's personnel for operation and maintenance of all material, equipment and apparatus provided.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Handle components carefully to prevent damage, denting, and scoring. Do not install damaged components. Damaged components shall be replaced with new components.

B. Store/protect products under provisions of Division 01. Store components in clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

1.010 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 21 05 00 for additional warranty and Substantial Completion requirements.

C. Contractor and Manufacturer warrant that, for a period of ten (10) years from the date of Substantial Completion, the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All products to be commercial grade, new and of the manufacturer's latest design model. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.
   1. All pipe, pipe fittings and valves shall be manufactured in North America, or may be import products where manufacturers are specifically identified below. Alternatives may be acceptable, but must be submitted and approved by the Owner’s Representative prior to bidding.

OR

   2. Upon request, the Owner’s Representative shall be furnished certification by the manufacturer, stating samples representing each lot have been tested and inspected as

indicated in governing ASTM specifications have been met. Certification shall be accompanied by test reports as prepared in accordance with relevant ASTM sections governing Test Methods and Inspection. Tension Tests reports shall include breaking load, machined diameter of the test bars, and calculated tensile strength. Certification shall include the legal name and address of the manufacturer.

B. All products to be UL listed and/or FM approved, except for items, which are not required to be listed by code.

C. All products shall be delivered and stored in original containers. Containers shall be clearly marked or stamped with manufacturer's name and rating.

D. The following items to be included but specified under Section 21 05 00: Basic Fire Protection Materials and Methods.
   1. Hangers and supports.
   2. Escutcheons plates, flashings and sleeves.
   3. Access panel and doors.
   4. Identification markers and signs.
   5. Expansion compensators and flexible connectors.
   6. Anchors, and seismic restraints.
   7. Excavation and backfill.

2.02 SPRINKLER HEADS - GENERAL

A. Sprinkler heads shall be regular automatic closed-type heads of ordinary degree temperature rating except that sprinkler heads installed in the vicinity of heating equipment or in special occupancy areas shall be of the temperature rating as described in NFPA-13.

B. Provide quick response heads in all new light hazard occupancies.

C. Provide corrosion-resistant sprinkler heads where they are exposed to weather, moisture or corrosive vapors.

D. The Contractor shall furnish spare heads. The heads shall be packed in a suitable container and shall be representative of, and in proportion to, the number of each type and temperature rating head installed. In addition to the spare heads, the contractor shall furnish not less than two special sprinkler head wrenches. Refer to NFPA-13 section; "Stock of Spare Heads".

E. Provide escutcheon and minimum 1/4” clearance around penetrations through suspended ceilings per ASCE requirements.

F. Sprinkler heads installed shall be upright or pendent, as conditions require, and shall be of the following type and finish for the areas designated. Unless otherwise specified, sprinklers shall be small frame type, center bulb capsule for finished areas, fusible link for unfinished areas, and 1/2" orifice. Extended coverage heads not allowed in unfinished areas except garages.

G. Sprinkler heads shall have a standard or large orifice K-Factor of 5.6 or 8.0. Sprinkler heads shall be UL Listed and FM Approved.

H. Manufacturers: Viking, Tyco, Reliable, Globe, Victaulic, Venus or equal. Viking models shown as basis of design.

I. Sprinkler head requirements for each area as follows:

BUILDING AREA	SPRINKLER HEAD STYLE	SPRINKLER HEAD FINISH	ESCUTCHEON FINISH	TEMPERATURE RATING (°F)
Unfinished Space, Exposed Ceiling, Exposed Ceiling Office, Mechanical Rooms	Upright/Pendant	Brass	None	155°F
Electrical, Telephone & Switchgear Rooms	Upright	Brass	None	286°F
Finished Ceilings	Semi-recessed Pendant	White	White	155°F
Finished Ceilings in Conference Rooms and Lobbies	Concealed Pendant	Brass	White Cover Plate	155°F
Soffit & Sidewall	Flush Sidewall	White	White	155°F
Exterior Balconies & Overhangs	Dry Sidewall	Brass	Chrome	175°F

J. Quick response sprinkler heads for dry systems, and areas subject to freezing:
   1. Upright in exposed areas: Viking #VK184 (K Factor: 5.6)
   2. Pendent in exposed areas with no ceilings. Viking #VK186 (K Factor: 5.6)
   3. Pendent in exposed areas with ceilings. Viking #VK196 (K Factor: 5.6)
   4. Sidewall: Viking #VK188 (K Factor: 5.6), #VK284 or #VK288 or #VK292 (K Factor: 8.0)

2.03 PIPE AND FITTINGS - ABOVE GROUND

A. General: The piping products listed below by manufacturer's name and model numbers are the only acceptable materials listed for this project. Substitutions of pipe must be submitted and approved in writing by the Owner's Representative prior to bid. No copper pipe shall be allowed in the wet fire sprinkler system.

B. Piping and fittings shall be new and clean prior to installation. Piping or fittings that show substantial rust or breaks in coating will be removed and replaced.

C. Steel Pipe and Fittings for wet systems:
   1. All pipe material shall be corrosion-resistant with a black enamel coating or other corrosion-resistant coating with a corrosion resistance ratio (CRR) of 1 or more.
   2. Schedule 40, Standard Weight, Black-Steel Pipe: ASTM A53/A53M. Pipe ends may be factory or field formed to match joining method.
   3. Schedule 30, Black-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30. Pipe ends may be factory or field formed to match joining method.
   4. Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
   5. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA-13 specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

6. Stainless Steel Pipe, Schedule 10S or 40S: Manufactured and installed per ASTM A312/312M.
7. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
8. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.
9. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
10. Malleable- or Ductile-Iron Unions: UL 860.
11. Cast-Iron Flanges: ASME 16.1, Class 125.
12. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
    a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
    b. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    c. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
    d. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
13. Steel Welded Fittings: Comply with ASTM A234/A234M, ASME B16.9, ASME B16.25, and ASME B16.11.
    a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
    b. Shop fabricated Bonney Forge “Weldolet” or “Thredolet” type fittings may be used in lieu of tee fittings, but field (site) welding will not be permitted.
14. Grooved-Joint, Steel-Pipe Appurtenances:
    a. Pressure Rating: 175-psig (1200-kPA) minimum, and as required by the design.
    b. Painted or Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
    c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
    d. Grooved joint couplings shall consist of two ASTM A 536 ductile iron housings, pressure-responsive, synthetic rubber gasket, and plated steel bolts and nuts.
        1) Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer’s latest recommendations.
    e. Mechanical Couplings: Victaulic grooved couplings style 07, 75 or 77, or equal by Gruvlok.
    f. Mechanical Tees: Victaulic style 920, Gruvlok. U-bolt mechanical tees are not acceptable.
    g. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
    h. Use rigid couplings where flexibility is not required or provide necessary sway bracing.

D. Flexible sprinkler connector for ductwork sprinkler application: Factory Mutual approved system. Manufacturer: Flexhead or equal.

E. Piping and Fittings – Not Allowed:
    1. Galvanized steel piping is not allowed due to corrosion potential.
    2. Pipe that is lighter gauge than Schedule 30 steel with threaded fittings is not allowed.
    3. Schedule 5 piping and fittings are not allowed.

4. Threadable lightwall pipe is not allowed.
5. Mechanical “gripping teeth” type fittings are not allowed.
6. Mechanical “clamping” type tee fittings are not allowed.
7. Quick disconnect, boltless, snap-joint, field drilling or welding of any main or branch lines, and any device specifically prohibited by the local authority having jurisdiction is not allowed.
8. Unions are not allowed for any size pipe.
9. Plain end fittings are not allowed.

2.04 PIPE AND FITTINGS - UNDERGROUND

A. Class 52 ductile iron pipe and fittings, white, cement lined, mechanical or Tyton joint fittings. Piping to be factory encased with 8 mil polyethylene tube or sheet. Fittings to be double field wrapped with 2" wide, 20 mil vinyl tape, 50% overlap.

B. Manufacturer: United States Pipe and Foundry, Griffin or Pacific States, only.

C. All underground piping for fire mains shall be installed, clamped, anchored, flushed and hydrostatically pressure tested according to the requirements of the authorities and/or Agencies Having Jurisdiction, and NFPA-13, NFPA-24 and Factory Mutual Handbook of Industrial Loss Prevention.

D. Anchor underground riser stub to nearest underground connection by means of rodding. Retaining glands with setscrews above grade are not allowed.

2.05 UNDERGROUND PIPE COATING:

A. All underground ferrous piping shall be covered with:
   1. Either two coats of 10 Mill Scotch Wrap No. 51, or with;
   2. "XTRU-COAT" prefabricated extruded cover with joints sealed with two coats of 10 Mill Scotch Wrap #51.
   3. Or approved equal

2.06 THRUST BLOCKS

A. Provide thrust blocks at changes in pipe direction, changes in pipe sizes, dead-end stops and at valves.

B. Calculate area of undisturbed earth of thrust block based on actual soil conditions and water test pressure of 200 psi.

C. Concrete and reinforcing steel shall be as specified in Division 03 and 05. All concrete shall be Class A, unless specified otherwise.

D. Miscellaneous nuts and bolts shall be stainless steel.

2.07 RODS AND CLAMPS

A. Socket clamps shall be stainless steel; four bolt type, equipped with stainless steel socket clamp washers and nuts Grinnell Fig. 595 and 594, Elcen Fig. 37 and 37X, or equal.

B. Rods shall be stainless steel, 3/4" diameter.

2.08 VALVING

A. 2" or Smaller:
   1. Control Valve: OS&Y rising stem type gate or globe valve, bronze body, bonnet and disc, copper alloy stem, threaded ends, 175 psig WOG min. Provide with tamper switch.
   2. Check Valve: Swing check type with bronze body, cap and disc, threaded ends, 175 psig WOG min.
   3. Drip Valve: 3/4", cast brass automatic ball drip type, threaded ends, 175 psig WOG min.
   4. Testing Valve: 1-1/4", test and drain, sight glass, 1/2" test orifice, lever operated, 300 psi WOG. Drain to mop sink or drain riser.
   5. Main Drain Valve: 2", angle gate valve, bronze body, copper alloy stem, threaded ends, 175 psi WOG. Drain to mop sink or drain riser.
   6. Manufacturer: Grinnell, Victaulic, Stockham, Milwaukee, Mueller, Nibco, United Brass Works, Kennedy, Elkart or AGF.

B. 2-1/2" or Larger:
   1. Control Valve: Grooved butterfly valve with tamper switch, ductile iron body, aluminum bronze disc, stainless steel stem and EPDM Liner, 200 psig WOG min, Victaulic 700.
   2. Control Valve: OS&Y rising stem type gate valve, cast iron body and bonnet, bronze stem, seat and disc, flanged ends, 175 psig WOG min. Provide with tamper switch.
   3. Check Valve: Swing check type with cast iron body, bolted cap and disc, flanged or grooved ends, 175 psig WOG min.
   4. Manufacturer: Grinnell, Victaulic, Stockham, Milwaukee, Mueller, Nibco, Kennedy, Elkart or AGF.

2.09 WET SPRINKLER ALARM CHECK VALVE

A. Contractor shall provide, where required, a completely engineered horizontal wet alarm check valve, retarding chamber, and trim assembly. Viking #H-2, Star or Reliable.

2.010 UNDERGROUND WATER VALVE

A. Resilient seated gate, valve, non-rising stem, 2" square valve nut, ductile iron construction with epoxy coated surfaces, both interior and exterior, 250 psi, mechanical joint ends. Provide yard box and cover.

B. Manufacture: American Darling, Clow, Dresser, or U.S. Pipe.

2.011 VALVE BOXES

A. Cast iron valve boxes for shutoff valves buried in ground shall be complete with bellbottoms, extension piece, top and cover. Boxes shall be suitable for the types of valves with which they are used. All valve boxes shall have a concrete collar flush with grade.

B. Lids shall have the applicable letters embossed upon the top surface. Tagging shall match existing lids.

C. Manufacturer: Tyler, ITT Grinnell, or equal.

2.012 PRESSURE REDUCING VALVES

A. Sprinkler System: Rough bronze body with red enameled hand wheel with integral check valve of the pressure reducing type. Outlet pressure shall not exceed 165 psig at maximum system pressures. Pressure settings to be field adjustable.
   1. Manufacturer: Zurn #Z-3004

B. Fire Service: 150 class pressure rating, cast iron body with brass main valve trim, control system cast bronze with stainless steel trim
   1. Manufacturer: Cla-Val #90-21UL.

2.013 PRESSURE RELIEF VALVE

A. Provide 3/4" pressure relief valve on discharge side of Sprinkler system pressure reducing valve. Set to a maximum of 175 psi.
   1. Manufacturer: Zurn #P1000A.

2.014 BACKFLOW PREVENTER

A. Provide listed backflow prevention device as required by local codes and ordinances. Backflow prevention devices installed in the vertical position shall be approved for that orientation.

B. Double check detector check valve assembly: Epoxy coated, ductile iron construction, 175 psig working pressure, complete with two spring loaded "Y" type check valves, "Y" strainer with hose bibb on suction side of assembly, two OS&Y gate valves, test cocks, bypass water meter and bypass doublecheck. Ames Model 3001SS, Febco #856-DCDA, Watts #709-DCDA-OSY, Wilkins #950DA or approved equal

C. Reduced pressure backflow preventer: Ductile iron construction, 150 psig working pressure, complete with two spring loaded "Y" type check valves, "Y" strainer with hose bibb on suction side of assembly, one differential relief valve, two OS&Y gate valves and test cocks. Unit shall be tapped on both sides to accommodate installation of test cocks. Febco #860 RPA, Wilkins #975DA, Watts #909-RPDA or approved equal.

D. Detector check valve assemblies: Ductile iron construction, 150 psig working pressure, complete with spring loaded check valve, two OS&Y gate valves and four test cocks. Febco #800 or approved equal.

2.015 INTEGRAL INSPECTORS ALARM TEST AND SYSTEM DRAIN

A. Combination system drain and visible orifice insert/sight glass for testing system alarm; with screwed or grooved inlet and outlet connections, Malleable iron hand wheel, EPDM valve seats, maximum working pressure 300 psi, 1/2" orifice insert, Bronze housing with 1/2" pressure relief valve, Watts Regulator Model FP 53L, 175 psi, UL listed and FM Approved. Victaulic TestMaster II style 720, or approved equal.

B. Water pressure gauge, range 0-300, in 5 psig increments, brass case - 3-1/2" diameter, 1/4" NPT male pipe connection, UL listed. Locate pressure gage on riser per code. Star Sprinkler, Ashcroft or approved equal.

C. Pressure gauge test valve, brass 1/4" screwed ends, 300 psig WOG. United or approved equal.

D. All relief, main, auxiliary and equipment drains shall be routed separately to floor drain or air gap fitting (by plumbing).

2.016 TAMPER SWITCHES

A. Switch shall be mounted so as not to interfere with normal operation of the valve and be adjusted to operate when handle of valve has traveled more than one-fifth the distance of its normal operating position. Electrical Contractor shall provide conduit from switch to fire alarm panel.

B. Housing shall be of aluminum, acid-treated, primed and finished in baked red enamel. Removal of housing shall cause switch to operate. Inside shall be single pole, double throw micro switch with connection for electrical conduit.

C. Install on all control valves.

D. Manufacturer: Potter-Electric, Notifier, Ellenco, or Simplex.

2.017 WATER FLOW ALARM - VANE TYPE

A. Indicator shall be for either vertical or horizontal installation. Indicator shall not be installed in a fitting that changes direction of water flow and shall have a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head. Provide retarding device to prevent false alarms from line surges.

B. Whenever a water flow alarm is installed in the piping system, an approved floor control valve shall be provided upstream of the alarm indicator. In addition, a drain is required downstream of the alarm indicator.

C. Each water flow alarm shall be wired to a Fire System. All wiring and conduits as required will be provided under Division 26. An alarm will automatically activate the local fire alarm system.

D. Manufacturer: Potter Electric Signal Company, Notifier, Simplex, or equal.

2.018 AUTOMATIC MAIN LINE AIR VENT

A. Automatic in-line air vent with enlarged air collection chamber. A single automatic in-line air vent shall be located near a high point in the system to allow air to be removed automatically from the metallic pipe system. Install per requirements of NFPA-13 and as required by local AHJ.

B. Pressure Rating: 300 psig (2070 kPa) minimum.

C. Separation Chamber:
1. Carbon steel body with threaded fitting for cast bronze air scoop attachment.
2. Powder coated safety red color.
3. Inlet and outlet size to match sprinkler pipe line sizes with grooved ends.

D. Automatic Air Vent Valve:

1. Body Material: Forged brass body.
2. Components: Integrated ball valve, stainless steel strainer, purge valve with hose connection, threaded cap with lanyard, automatic air vent.

3. Inlet Size: 1 inch NPT.
4. Outlet Size: 3/4 inch NPT.
5. Drainage Piping: Field provided 3/4-inch copper tubing. Provide on the discharge of the automatic air vent valve and route to approved plumbing receptacle or to the exterior landscaping.

E. Manufacturer: AGF Manufacturing PURGEnVENT #7950ILV or equal.

2.019 MANUAL BRANCH LINE AIR VENT

A. Manual in-line air vent to be located at the end of each branch line, at the highest and furthest points of the system, and at the top of the supply risers to eliminate as much air as possible to minimize internal pipe corrosion. Install per requirements of NFPA-13 and as required by local AHJ.

B. Pressure Rating: 300 psig (2070 kPa) minimum.

C. Manual Air Vent Valve:
1. Body Material: Forged brass body.
2. Components: Integrated ball valve, stainless steel strainer, threaded cap with lanyard, polypropylene float.
3. Inlet Size: 1/2 inch NPT.
4. Outlet Size: 1/2 inch NPT.

D. Manufacturer: AGF Manufacturing PURGEnVENT #7910MAV or equal.

2.020 EXTERIOR ALARM

A. Electric bell, 10" diameter, UL listed, weather-proof back box housing, 120 VAC, 99 dB at 10 feet. Manufacturer: Potter Electric Signal Company #PBA12010, Notifier, Simplex, or equal.

B. Electric Horn: Weatherproof with backbox, indoor or outdoor use, horn and strobe, 120 VAC. Manufacturer: Potter Electric Signal Company, Notifier, Simplex, or equal.

2.021 FIRE HOSE CABINETS

A. Refer to Architectural and Mechanical Drawings for exact location and elevations.

B. Cabinets shall be recessed / semi-recessed / surface mounted, 20-gauge steel construction, 28" wide by 39" high by 8" deep overall dimensions with full glass door panel, identifying decal, and gray enamel factory prime finish. All components shall have a rough chrome finish. Provide with the following:
1. 1-1/2" stamped valve escutcheon.
2. 2-1/2" angle valve.
3. Baked enamel steel hose rack.
4. 1-1/2" brass rack nipple.
5. 1-1/2" x 100'-0" of single jacket polyethylene lined hose.
6. Cast brass couplings.
7. Fog nozzle.

C. Manufacturer: Croker, Larsen’s J & L or Potter-Roemer.

2.022 FIRE DEPARTMENT VALVE CABINETS

A. Refer to Architectural and Mechanical drawings for exact location and elevation of each cabinet.

B. Cabinets shall be 18" x 18" inside box dimensions, recessed, 20-gauge steel with full glass door and 2-1/2" fire department valve with rough chrome finish. Cabinets shall have a factory prime finish.

C. Manufacturer: Crocker, Larsen's J & L or Potter-Roemer.

2.023 FIRE DEPARTMENT CONNECTIONS

A. Flush wall mounted unit or freestanding unit with individual clapper valves, plugs and chains, locations as indicated on drawings. Escutcheon plate to be lettered as follows; "AUTO SPRINKLER", "DRY STANDPIPE" or "AUTO SPRINKLER AND STANDPIPE". Unit shall be polished chrome or brass finish, mounted 36" above finished grade. Number of inlets required shall be in accordance with regulations of the Fire Marshal or local fire department.

2.024 FIRE DEPARTMENT HOSE VALVES

A. Fire Department Valves: 2-1/2" <<with 3" outlets>> brass construction female to male angle valve with cap and chain, rough chrome finish and mounted 48" above finished floor.

B. Pressure Reducing Fire Department Valves: 2-1/2" <<with 3" outlets>> tamper proof, automatic pressure reducing, all brass male to female angle, rated at 400 psig rough brass finish, mounted 48" above finished floor.

C. Manufacturer: Croker, Elkhart, Powhattan Brass, Potter-Roemer or Zurn.

PART 3 - EXECUTION

3.01 GENERAL

A. This system to be installed by an experienced firm regularly engaged in the installation of automatic sprinkler system as specified by the requirements of the Specifications.

3.02 PERFORMANCE OF WORK

A. Examine areas and conditions under which materials are to be installed. Layout the system to suit the different types of construction and equipment as indicated on the drawings and in accordance with NFPA 13, 14, 20 and 24.

B. Work to start immediately after authorization has been given to proceed so that the overall progress of the construction is not delayed.

C. Coordinate with other trades as necessary to properly interface components of the sprinkler system.

D. Follow manufacturer's directions and recommendations in all cases.

E. The omission from the drawings or Specifications of any details of construction, installation, materials, or essential specialties shall not relieve the Contractor from furnishing the same in place for a complete system.

3.03 TEMPORARY FIRE PROTECTION

A. Provide all temporary valving, piping, Siamese connections and other components as directed by the fire agency office during all phases of construction.

3.04 INSTALLATION - GENERAL

A. Fire protection system shall be installed in accordance with the approved Drawings. The finished ceiling is not to be erected until all fire protection piping has been installed, tested, and inspected. Sprinkler heads located in the electrical equipment, elevator machine, or similar rooms shall be furnished with deflectors to prevent water spray on equipment.

B. Before connection to the overhead piping, all underground piping shall be flushed with water flowing at velocity and quantity required by the installation standards specified above in this Section of the Specifications.

C. The arrangement of all pipes shall conform to all architectural requirements and field conditions, shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and shall be neatly spaced. Offsets will be permitted only where required to permit the pipes to follow the walls. Standard fittings shall be used for offsets. All risers shall be erected plumb and true, shall be parallel with the walls and other pipes, and shall be neatly spaced. All work shall be coordinated with HVAC, Plumbing, Electrical and Structural work in order to avoid interference and unnecessary cutting of floors or walls. All underground or concealed work shall be inspected before the construction is closed up.

D. All sprinkler heads to be installed in ceilings throughout the scope of work building as listed in Part 2 sections. All areas without ceilings shall have rough brass upright or pendent heads.

E. Sprinkler heads in all finished areas are to be installed on a true axis line in both directions, with maximum deviation from the axis line of 1/2 inch plus or minus and shall be plus or minus 1" within center of tile. At the completion of the installation, if any heads are found to exceed the above-mentioned tolerance, they shall be removed and reinstalled.

F. No pipes or other apparatus shall be installed so as to interfere in any way with full swing of doors.

G. The arrangement, positions, and connections of pipes, drains, valves, etc., shall be as required by NFPA-13 for all areas requiring sprinklers. At all low points provide drains and provide drains or capped tees fittings at isolated low points in the piping system. However, the right is reserved by the Owner’s Representative to change the location of any item to accommodate conditions, which may arise during progress of the work, without additional compensation for such changes provided that no additional heads are required prior to the installation of the work.

H. Where required, piping shall be installed concealed in building construction, or though steel beams, to obtain adequate head room.

I. All pipe throughout the job shall be reamed smooth before being installed. Pipe shall not be split, bent, flattened, or otherwise injured either before or during installation.

J. Provide protective pans under pipes passing over high voltage electrical bus duct or switchgear equipment. The pan shall be constructed of 22-gauge black iron with a 6-inch lip, the corners being welded to make the pans watertight. Each pan shall be given two coats of gray primer paint and shall be supported by pipe hangers. The pan shall drain clear of the bus duct or switchgear.

K. All pipe interiors shall be thoroughly cleaned of foreign matter before installation, and shall be kept clean during installation by plugging or other approved means. Piping shall be covered with waterproof plastic sheeting during storage. Piping that shows signs of rusting will be removed from job site and replaced.

L. Field Connections: Any modifications to system required by field conditions, physical equipment changes or compliance with code regulations shall be made promptly without cost to Owner.

M. Interference: No piping or sprinkler devices shall interfere with the operations of any door, window, or mechanical and/or electrical systems. No part of this system shall visibly installed in the physical parameter of any window.

N. Threaded Pipe: Threads shall be clean cut, standard and tapered. Threads shall be made up using flaked graphite and lubricating oil, piping compound or Teflon tape applied to the male threads only.

O. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the same manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

P. Keep all pipe and other openings closed to prevent entry of foreign matter. Cover all equipment and apparatus to protect against dirt, water, chemical or mechanical damage, before and during construction period. Restore to original condition all apparatus and equipment damaged prior to final acceptance, including restoration of damaged shop coats of paint.

Q. Location of sprinkler piping is critical.

1. Where ceiling space is at a minimum under beams location of ductwork takes precedence, coordinate accordingly.
2. Include in base bid, multiple coordination meetings, as required with Owner’s Representative for coordination of sprinkler pipe routing, at no additional cost to the Owner.
3. Coordinate beam and shear wall penetrations with Structural Engineer. Obtain written approval for all beam penetrations from Structural Engineer.

3.05 WELDING

A. Conform to welding procedures per recommendations of American Welding Society.

3.06 EXCAVATION AND BACKFILL

A. Trench and excavation work shall be done in a neat workmanlike manner, of the depth required by the authorities and/or agencies having jurisdiction. Pipe crown shall not be less than 30 inches below the finished ground surface. After the pipe has been properly tested and inspected, trench shall be backfilled with sand, or an approved sandy material, to a depth of 6 inches above the pipe. Backfill material shall be consolidated by tamping or by saturating with water and vibrating. Subsequent backfill shall consist of the original excavated material, free of organic matter, placed in 6 inch layers and compacted layer by layer by means of power driven vibrators.

B. Replace to original condition all turf, plants, concrete, asphalt, or other improvements disturbed by trenching. In graded, unpaved areas, backfill trenches with crown 8 inches above the surrounding surface.

3.07 SLEEVES AND FLASHINGS

A. Wherever pipes are exposed and pass through walls, floors, partitions or ceilings, they shall be fitted with chromium plated steel escutcheons held in place with setscrews. Care shall be taken to protect the escutcheons during the course of construction.

B. Penetrations through fire rated walls and floors shall be sealed with listed mastic of similar fire rating.

3.08 HANGERS, INSERTS, SUPPORTS, AND SWAY BRACING

A. Hangers and supports shall be installed per NFPA-13 sections on Hangers and Protection of Piping Against Damage Where Subject to Earthquake. Provide restraint from movement at end sprinkler on branch line per NFPA-13.

B. Bending of threaded hanger rod is not allowed. Powder driven anchor pins in concrete are not allowed.

C. Upgrade existing end sprinklers on branch line with new restraint from movement device.

3.09 SAFETY TESTING & VERIFICATION

A. Flush, test, and inspect sprinkler piping systems according to NFPA-13 Chapter "System Acceptance."

B. Provide NFPA-13 Contractor's Material & Test Certificate Form 85A for above ground piping and Form 85B for underground piping.

C. Provide manpower to test the function and performance of all Life Safety System components and devices per floor and per zone basis in accordance with the local requirements.

3.010 IDENTIFICATION

A. In addition to the requirements of Section 21 05 00, provide engraved pipe markers every 20 feet, once in every room, and at each building level traversed, minimum. Text shall include riser and/or zone numbers to align with drawings and fire alarm panel.

B. Provide hydraulic design data nameplates (engraved text) on the riser of each sprinkler system in accordance with NFPA-13

C. Equipment such as valves, drains, etc., shall be provided with signs that identify type of equipment and service. The tag shall be securely fastened to the handle or spindle of the valve by a brass chain. Furnish four schedules of valves so tagged. There shall also be furnished four diagrammatic charts showing schematically the complete sprinkler system with major control valves and numbers thereof. One set of Schedules and charts shall be mounted in glazed frames located where directed.

3.011 AS-BUILT RECORD DRAWINGS AND CERTIFICATION

A. As-built Record Drawings are to be kept up-to-date and the Master Copy kept at the job site. Prior to final acceptance of work being approved, these drawings are to be turned over to the Owner's Representative for approval.

B. Written certification from the insuring agents, and authorities having jurisdiction that the tests were satisfactory.

C. After installation is complete and tests satisfactorily approved, deliver test certificates and approval by the local Fire Authorities and the insurance company to the Owner’s Representative. Final acceptance of sprinkler/standpipe system by Owner's Representative shall be contingent upon receipt of certificate and approval from authorities having jurisdiction and for the delivery of final As-Built Drawings.

3.012 INSPECTION, TESTING, AND MAINTENANCE

A. Where steel pipe is used in dry pipe and preaction systems, it shall be assumed that the water supplies and environmental conditions contribute to unusual corrosive properties.

B. A corrosion protection plan shall be developed to address steel piping corrosion in accordance with NFPA-13 and NFPA-25.

C. Sprinkler piping and fittings shall be inspected annually by the Owner’s Representative for signs of corrosion, leakage, and physical damage, in accordance with NFPA-25.

D. Inspection, testing, and maintenance activities shall be followed to determine that components are free of corrosion, foreign material, physical damage, tampering, or other conditions that adversely affect system operation.

E. An internal corrosion evaluation of system piping shall be conducted at intervals not to exceed five (5) years.

F. The evaluation shall include an internal inspection of the piping condition near the sprinkler riser and the opening of the flushing connection on a system main.

END OF SECTION

SECTION 22 05 00

BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and all Plumbing Sections specified herein.

1.02 SCOPE OF THIS SECTION

A. Work to be furnished and installed under this Section shall include, but not necessarily be limited to, the following:
   1. Compliance with all codes and standards applicable to this jurisdiction.
   2. Shop Drawings for Equipment
   3. Coordination Documents
   4. Record drawings
   5. Start-up and commissioning service
   6. Instruction, Training, and Operations & Maintenance Manuals
   7. Work associated with delivery, storage, and handling of products
   8. Work associated with provision of temporary facilities
   9. Preparation of posted operating instructions
   10. Meeting project safety and indemnity requirements
   11. Proper cleaning and closing
   12. Supplying proper Warranty information
   13. Supply specified Guarantee documentation
   14. Design and provision of supports and anchors
   15. Design and provision of seismic restraints
   16. Design and provision of vibration isolation
   17. Through-penetration firestop assemblies
   18. Hangers and supports
   19. Pipe portals
   20. Pipe stands
   21. Equipment supports
   22. Access panels and doors
   23. Roof flashings
   24. Water hammer arrestors
   25. Drains
   26. Trap primers
   27. Miscellaneous fixtures
   28. Identification markers, equipment labels, pipe labels, valve tags, warning signs.
   29. Coordination of electrical requirements for equipment provided

1.03 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to include all material and labor to install complete plumbing systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate the work with that of the other

trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipe lines and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

D. Where project involves interface with existing building and/or site systems, existing utilities and services have been indicated on the drawings to the extent possible based on available record drawings. The Contractor shall thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

E. Refer to Basis of Design on drawings. Systems as specified under this section shall include but not necessarily be limited to the following:
   1. Connection to utilities at five (5) feet from the building. Coordinate with the Civil Engineering Plans and/or Division 02 work.
   2. Connection of all waste, vent, and water piping to all plumbing fixtures, drinking fountains, sinks, water coolers, drains and mechanical equipment.

1.05 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:
   1. Supports and anchors
   2. Access panels and doors
   3. Identification markers, labels and tags
   4. Electrical equipment
   5. Pipe portals
   6. Emergency showers and eye washes
   7. Plumbing specialties
   8. Trap primers
   9. Cleanouts
   10. Drains
   11. Roof flashing
   12. Wall hydrants and hose bibbs
   13. Backwater valves

B. Contractor shall submit a letter that all products used in the plumbing system are certified for use in the State and Municipality of the project site.

1.06 DESCRIPTION OF BID DOCUMENTS

A. Specifications:
   1. Specifications, in general, describe quality and character of materials and equipment.
   2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:
   1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and details of installation.
   2. Before proceeding with work check and verify all dimensions.

3. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
4. Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
5. Verify exact location and elevation of existing piping, ductwork, conduits and structure and coordinate to accommodate installation of new work as indicated on the drawings.
6. If any part of Specifications or Drawings appears unclear or contradictory, apply to the Owner's Representative for interpretation and decision as early as possible, including during bidding period.

1.07 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

C. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

D. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

E. "Connect": Complete hook-up of item with required service.

F. "Exposed": Not installed underground or "concealed."

G. "Furnish": To supply equipment and products as specified.

H. "Indicated," "Shown" or " "Noted": As indicated, shown or noted on Drawings or Specifications.

I. "Install": To erect, mount and connect complete with related accessories.

J. "Lead Free": Materials containing not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect to the wetted surfaces of pipes and pipe fittings, plumbing fittings, and fixtures, providing a specified definition and formula for determining "weighted average".

K. "Motor Controllers": Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

L. "Must": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

M. "NRTL": Nationally Recognized Testing Laboratory, including UL, CSA and/or ETL.

N. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

O. "Provide": To supply, install and connect as specified for a complete, safe and operationally ready system.

P. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner's Representative.

Q. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

R. "Shall": An exhortation or command to complete the specified task.

S. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

T. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

U. "Typical" or "Typ": Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

V. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

W. "Wiring": Raceway, fittings, wire, boxes and related items.

X. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.08 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 22 Plumbing sections included herein.

B. Division 01: General Requirements
   1. Including commissioning requirements.

C. Division 02: Existing Conditions
   1. Coordination of excavation of trenches and the installation of mechanical systems and piping on site.

D. Division 03: Concrete.
   1. All concrete work required for plumbing work shall be coordinated by Division 22 with Division 03 including:
      a. Concrete curbs and housekeeping pads for the mechanical equipment.
      b. Thrust blocks, pads, and boxes for mechanical equipment.
      c. Coordination of floor drain and floor sink installations in sloped floors.

E. Division 07: Thermal and Moisture Protection.
   1. Flashing and sheet metal
   2. Sealants and caulking
   3. Firestopping

F. Division 09: Finishes:
   1. Division 22 installers shall perform all painting, except where specifically stated otherwise in Division 09.
   2. Painting of all exposed steel, piping, insulation, equipment, and materials.
   3. All exposed gas piping located exterior to the building and as required by Authority Having Jurisdiction.

G. Division 26: Electrical is related to work of:
   1. Power connections to all plumbing equipment
   2. Life safety provisions

1.09 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 22 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

E. Provide in accordance with rules and regulations of the following:
   1. Building Codes enforced by the Authority Having Jurisdiction in California:
      a. 2016 Building Standards Administrative Code, Part 1, Title 24 CCR
      b. 2016 California Building Code (CBC), Part 2, Title 24 CCR (2015 International Building Code with California Amendments)
      c. 2016 California Electrical Code (CEC), Part 3, Title 24 CCR (2014 National Electrical Code with California Amendments)
      d. 2016 California Mechanical Code (CMC) Part 4, Title 24 CCR 2015 Uniform Mechanical Code with California Amendments)
      e. 2016 California Plumbing Code (CPC), Part 5, Title 24 CCR (2015 Uniform Plumbing Code with California Amendments)
      f. 2016 California Building Energy Efficiency Standards for Residential and Nonresidential Buildings (T24), Part 6, Title 24 CCR
      g. 2016 California Fire Code, Part 9, Title 24 CCR (2015 International Fire Code with California Amendments
      h. 2016 California Green Building Standards Code (CALGreen), Part 11, Title 24 CCR
      i. 2016 California Referenced Standards, Part 12, Title 24 CCR
      j. Title 19 CCR Public Safety, State Fire Marshal Regulations.
   2. Local jurisdiction codes and amendments
   3. State Fire Marshal Office
   4. Health Department
   5. State Administrative Codes

F. All accessible plumbing work shall comply with the Americans with Disabilities Act (ADA)and local amendments. Compliance requirements applicable to plumbing work includes, but is not limited to, the following ADA requirements:
   1. Section 309: Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be five (5) pounds maximum.
   2. Section 609: No plumbing fixtures or valves may impede on grab bar clearances. Grab bars are installed in a horizontal position between 33” and 36” above the finish floor to the top of the grab bar. The clear space between the wall and the grab bar shall be 1-1/2” minimum with no obstructions created by valves, fittings or controls. The space between

the grab bar and projecting objects above shall be 12" minimum. The space between the grab bar and projecting objects below shall be 1-1/2" minimum.

3. Section 604.4: The seat height of a water closet above the finish floor shall be 17" minimum and 19" maximum measured to the top of the seat. Seats shall not be sprung to return to a lifted position. A water closet in a toilet room for a single occupant accessed only through a private office and not for common use or public use shall not be required to comply. In residential dwelling units the height of water closets shall be permitted to be 15" minimum and 19" maximum above the finish floor measured to the top of the seat.
4. Section 605.2: Urinal shall be a stall-type or wall-hung type with the rim 17" maximum above the finish floor or ground. Urinals shall be 13-1/2" deep minimum.
5. Section 606.3: Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface 34" maximum above the finish floor.
6. Section 606.4: Hand-operated metering faucets shall remain open for 10 seconds minimum.
7. Section 606.5: Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.
8. Section 602: Drinking fountain spout height shall be 36" maximum above the finish floor. The spout shall provide a flow of water 4" high minimum and shall be located 5" maximum from the front of the unit.
9. Section 608.6: A shower spray unit with a hose 59" minimum that can be used both as a fixed-position shower head and as hand-held shower. The shower spray unit shall have an on/off control with a non-positive shut-off. The shower unit shall not obstruct grad bar clearances. Shower spray units shall deliver water that does not exceed 120^0F maximum.
10. Section 608.7: Thresholds in roll-in type shower compartments shall be 1/2" high maximum.

G. Provide in accordance with appropriate referenced standards of the following:
   1. NFPA - National Fire Protection Association
   2. CSA - Canadian Standards Association
   3. ADC - Air Diffuser Council
   4. ANSI - American National Standards Institute
   5. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
   6. ASME - American Society of Mechanical Engineers
   7. ASTM - American Society for Testing Materials
   8. AWS - American Welding Society
   9. AWWA - American Water Works Association
   10. FM - Factory Mutual
   11. MSS - Manufacturer's Standardization Society
   12. NEMA - National Electrical Manufacturer's Association
   13. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
   14. UL - Underwriter's Laboratories
   15. ADA - Americans with Disabilities Act
   16. ETL - Electrical Testing Laboratories
   17. ASSE - American Society of Sanitary Engineers
   18. PDI - Plumbing and Drainage Institute
   19. IAPMO - International Association of Plumbing and Mechanical Officials
   20. CISPI - Cast Iron Soil Pipe Institute

H. Provide compliance in accordance with the following referenced standard which applies to general system compliance in contrast to specific equipment standards referenced elsewhere:

1. UL-2043: Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces. This is applicable to spaces above suspended ceilings and below raised floors.

1.10 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Owner's Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Owner's Representative for a decision before proceeding.

1.11 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be affixed to each piece of equipment and resistant to ambient conditions.

B. All work shall include the following:
   1. Manufactured items and equipment shall be a current, cataloged product of the manufacturer.
   2. Replacement parts shall be readily available and stocked in the USA.

C. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

D. Welding Qualifications:
   1. Steel Support Welding: Qualify procedures and personnel according to American Welding Society AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."
      a. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation per pressure and temperature operating class.
      b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.12 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications in Divisions 02 through 48 for rough-in requirements.

F. Coordinate plumbing equipment and materials installation with other building components.

G. Verify all dimensions by field measurements.

H. Arrange for chases, slots, and openings in other building components to allow for plumbing installations.

I. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

J. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted.

K. Where mounting heights are not detailed or dimensioned, install plumbing services and overhead equipment to provide the maximum headroom possible.

L. Install plumbing equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

M. Coordinate the installation of plumbing materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

N. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

O. Coordinate with Owner's Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

P. All materials (such as insulation, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method and UL-2043.

Q. Coordinate installation of floor drains and floor sinks with work of other trades. Finished floors shall slope to floor drains as shown on Architectural drawings. Floor sinks will typically be installed flush with surrounding floor. Review plans and design intent for floor sinks that may require elevated rims.

R. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

S. Pipes, pipe fittings, plumbing fittings and fixtures that come into contact with the wetted surface of a public water system or any plumbing in a facility providing water for human consumption shall be “Lead Free”.

1.13 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all plumbing work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting the work. The contractor's scope of work shall include
   1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications
   2. Minor deviations from the plumbing plans required by architectural and structural coordination.

C. The Contractor shall study the operational requirements of each system, and shall arrange the work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems within the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work." Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

D. Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

E. Advise the Owner’s Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner’s Representative of conflict.

1.14 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:
   1. The proposed substitution does not affect dimensions shown on drawings.
   2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.
   3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
   4. Maintenance and service parts are available locally and readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to the proposed substitution.

1.15 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Provide submittals for all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner's Representative for review and approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings:
   1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per Division. Multiple submissions will not be accepted without prior approval of the Owner's Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.
   2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.
   3. Paper submittals will only be acceptable if specifically required by Division 01.
   4. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.

1.16 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.
   1. The shop drawings shall serve to record the coordination of the installation and location of all piping, fixtures, HVAC equipment, ductwork, grilles, diffusers, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances.
   2. The Drawings shall include all mechanical rooms and floor plans.
   3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.
   4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:
   1. Two dimensional AutoCAD / Revit based documents:
      a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.

b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
c. Plumbing drawings shall indicate locations of all fixtures and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
e. Drawings shall incorporate all addenda items and change orders.
f. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

2. Three dimensional Revit / BIM based documents (if required for project):
a. Provide three dimensional Revit model and BIM input information locating all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
b. Contractor shall obtain Revit model and BIM input from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
c. Model shall indicate locations of all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
e. Model shall incorporate all addenda items and change orders.
f. Distribute Revit model and BIM input information to all other trades and provide additional coordination as needed to assure adequate space for equipment and piping and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner's Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner's Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

1.17 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).
1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
2. RFIs shall address single questions and related issues only.

3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner's Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect and Construction Manager.
   6. RFI number, numbered sequentially and unique.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
       a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Incomplete RFIs or inaccurately prepared RFIs.
      b. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.
      c. RFIs addressing multiple unrelated issues.
      d. Requests for approval of submittals.
      e. Requests for approval of substitutions.
      f. Requests for approval of Contractor's means and methods.
      g. Requests for information already indicated in the Contract Documents.
      h. Requests for adjustments in the Contract Time or the Contract Sum.
      i. Requests for interpretation of Engineer's actions on submittals.
   2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.18 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked "Record Set" at the job site at all times, and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall indicate revisions to piping, size and location both exterior and interior; including locations control devices, and equipment requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions

located, and with items requiring maintenance (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.).

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record Documents and CD/DVD disks labeled with all drawings and specifications and other supporting documentation.

E. Refer also to Division 01 for full scope of requirements.

1.19 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Contractor shall submit to the Owner’s Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section.

B. The Contractor shall be responsible for proper instruction of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 22, to be no less than two (2) hours for each type of equipment.

C. Refer to Division 01 for additional requirements.

1.20 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with manufacturer’s names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment that is damaged or showing signs of rust shall be removed from site and replaced with new.

1.21 START-UP SERVICE

A. Prior to start-up, assure that systems are ready for start-up and commissioning, including checking the following: proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of controls, pumps, water heaters, and other major pieces of equipment. Certify in writing, compliance with this paragraph, stating names of personnel involved and the date work was performed.

C. Refer to other Division 01 and Division 22 sections for additional requirements.

1.22 TEMPORARY FACILITIES

A. Refer to Division 01 for the requirements of temporary water and sewer for construction and safety. Provide temporary water, and sewer, etc. services as necessary during the construction period and as required to maintain operation of existing systems.

1.23 UNIT PRICING SUBMITTALS

A. Prior to construction submit for review all materials and equipment and pricing in accordance with Division 01 requirements.

1.24 POSTED OPERATING INSTRUCTIONS

A. Print or engrave operating instructions and frame under glass or UV resistant plastic. Post instructions as directed by Owner's Representative. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.25 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work for the duration of the project.

B. No act, service, Drawing, review, or Construction Review by the Owner, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.26 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner's Representative.

1.27 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, or longer, as defined in each subsequent specification section. Warranty shall include all parts, material, labor and travel.

D. Warranty Start Date: The start date for all warranty periods shall be defined as starting from the date of Substantial Completion which shall include the Certificate of Occupancy from the Authority Having Jurisdiction.

E. Refer to individual Specification sections for additional extended warranty requirements.

F. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

G. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

H. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.28 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year, minimum, after the Certificate of Occupancy, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in this work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

C. All materials and equipment under this Division of the Specifications shall be new, of best grade and as listed in printed catalogs of the manufacturer.

D. All manufactured materials shall be delivered and stored in their original containers. Equipment shall be clearly marked or stamped with the manufacturer's name and rating.

E. For secure facilities, schools and public safety buildings exposed equipment and access shall be Vandal Proofed. One type of vandal proof screw is to be used throughout this facility. Coordinate with General Contractor for type.

F. The following products to be included as part of this work but specified under Section 22 05 00 Basic Plumbing Materials and Methods and Section 22 10 00 Plumbing Piping, Valves and Specialties:
   1. Piping.
   2. Valves.
   3. Hangers and supports.
   4. Escutcheon plates, flashings, and sleeves.
   5. Identification markers and signs.
   6. Anchors and alignment guides to comply with seismic requirements as indicated on structural plans.
   7. Excavation and backfill.
   8. Pressure and temperature gauges.
   9. Access Panels.

G. Plumbing Fixtures: Refer to Section 22 40 00.

H. Plumbing Equipment: Refer to Section 22 30 00.

I. Products made of, or containing, lead, asbestos, mercury, or other known toxic or hazardous materials are not acceptable for installation under this Section. Any such products installed as part of the work of this Section shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor(s).

2.02 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:
   1. UL: Provide products which are UL listed.
   2. FM: Provide products which are FM approved.
   3. ASCE 7-05: “American Society of Civil Engineers.”
   4. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).
   5. SMACNA: "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   6. NFPA: Pamphlet number 13 and 14 for fire protection systems.
   7. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.
   8. Manufacturer: Hilti Inc, B-Line/Tolco (Eaton), Anvil International, Erico, Kin-Line, Simpson, or Superstrut.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.
   1. (Note to Editor: refer to MSS-58 images for styles allowed and not allowed:
   3. Adjustable Steel Clevis Hangers: MSS Type 1.
   4. Adjustable Steel Swivel Band Hangers: MSS Type 10.
   5. U-Bolts: MSS Type 24.
   6. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
      a. Plate: Unguided type.
      b. Plate: Guided type.

c. Plate: Hold-down clamp type.

7. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.
8. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.
9. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.
10. Upper Attachment Side Beam Bracket: MSS Type 34
11. Upper Attachment Side Beam Angle Bracket: MSS Type 34, UL listed and FM Approved.
12. Single Pipe Roller with Malleable Sockets: MSS Type 41.
13. Adjustable Roller Hangers: MSS Type 43.
14. Pipe Roll Stands: MSS Type 44.
15. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8 and or four-bolt riser clamps for heavy loads, MSS Type 42.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.
1. Steel Turnbuckles: MSS Type 13.
2. Steel Clevises: MSS Type 14.
3. Swivel Turnbuckles: MSS Type 15.
4. Malleable Iron Eye Sockets: MSS Type 16.
5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments of one of the following types listed.
1. Concrete Inserts: HCI-MD (for metal deck) or HCI-WF (for wood forms) cast-in anchors by Hilti Inc. or MSS Type 18 or Blue Banger Hanger by Simpson
2. Steel Brackets: One of the following for indicated loading:
   a. Light Duty: MSS Type 31.
   b. Medium Duty: MSS Type 32.
   c. Heavy Duty: MSS Type 33.
3. Horizontal Travelers: MSS Type 58.
4. Concrete Screw Anchors: KWIK HUS EZ-I by Hilti Inc., Titen HD by Simpson or approved equal.
5. Torque-Controlled Expansion Anchor: KWIK BOLT-TZ by Hilti Inc., Strong-Bolt 2 by Simpson Strong-Tie Co. Inc or approved equal.
6. Screws and Bolts: Bolt Depot, Fastenal, National Bolt & Nut, or equal.
7. Eye Bolts: Lawson Products, Sierra Pacific, US Cargo Control, or equal.

G. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

2. Insulation Protection Shields: MSS Type 40, 18" minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.
3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert. Alternately Polyisocyanurate Urethane with a minimum flexural strength of 60psi, fully encased in 360 PVC (1.524 mm thick) SNAPPITZ. Provide assembly of same thickness as adjoining insulation.
4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:
1. Metal Framing: Provide products complying with NEMA STD ML1.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.
3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume, with minimum amount of water required for placement and hydration.
4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.
5. Pipe Brackets: "HoldRite" copper plated brackets. Insulate brackets attached to metal studs with felt.

2.03 SEISMIC RESTRAINT/VIBRATION ISOLATION REQUIREMENTS

A. Equipment, piping, and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest code editions with State Amendments, applicable local codes, and applicable Importance Factors and Soil Factors. Refer to Section 22 05 48 Vibration Isolation for Plumbing Equipment or Section 220549 Seismic Restraint for Plumbing Piping and Equipment, as applicable.

2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-penetration firestop assemblies and caulking systems as required to maintain the fire/smoke integrity of the penetrated surface and install per manufacturer's installation instructions. Refer to drawings for additional requirements.

B. Manufacturers: 3M, Hilti, ProSet or equal.

2.05 PIPE PORTALS

A. Where pipe portals are not provided by other sections of Specification, provide prefabricated insulated pipe portals as required for piping penetrating through the roof where shown on plans. Field built pipe portals are acceptable alternatives - provide detail of construction for review.

B. Standard pipe portals, unless otherwise noted, shall be constructed as follows:
1. Curb shall be constructed of heavy gauge galvanized steel with continuous welds on shell seams.
2. Insulation to be 1-1/2" thick, 3 lb density rigid fiberglass.
3. Curb to have a raised 3" (minimum), 45° cant.

4. Curb to have 1-1/2" x 1-1/2" wood nailer (minimum).
5. Curb height to be 8" (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.
7. Cover or flashing to be constructed of galvanized steel or other suitable material to provide sturdy weather tight closure. Provide collars and rubber nipples with draw bands of sizes required by piping. Size curb, cover and nipples per manufacturer's recommendations.
8. Manufacturer: Roof Products Systems or Pate.

2.06 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

G. Manufacturer: Pate, PHP Syst3ems/Design, Roof Products Systems, Portable Pipe Hangers, Roof Top Blox, or Erico Caddy Pyramid.

2.07 EQUIPMENT/PIPING RAILS

A. Where equipment/pipe rails are not provided by other sections of Specification, provide prefabricated reinforced equipment rails as required for support of equipment and piping. Field built curbs are acceptable alternatives - provide detail of construction for review.

B. Standard equipment rail, unless otherwise noted, shall be constructed as follows:
1. Construct of heavy gauge galvanized steel with continuous welds on shell seams.
2. Provide internal reinforcing supports welded as required to meet application requirements.

3. Equipment rails to have raised 3” (minimum), 45° cant.
4. Equipment rails to have 1 1/2" x 1 1/2" wood nailer (minimum) and counterflashing.
5. Equipment rail height to be 6” (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.

C. Equipment rails to be constructed to meet equipment size and weight requirements. Provide tapered rails to match roof pitch where required.

D. Manufacturer: Pate, Vent Products, Thy Curb or Roof Products Systems.

2.08 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20-gauge steel. 1” flange width, continuous piano hinge, key operated, prime coated. Refer to Architectural Specifications for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels is not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each trap primer or concealed valve. Use no panel smaller than 12” x 12” for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Owner’s Representative. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Acceptable Manufacturers: Milcor, Karp, Nystrom, or Elmdor/Stoneman.

D. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Owner’s Representative.

2.09 PIPING

A. Refer to Section 22 10 00 Plumbing Piping, Valves and Specialties

2.10 VALVES

A. Refer to Section 22 10 00 Plumbing Piping, Valves and Specialties.

2.11 PLUMBING EQUIPMENT

A. Refer to Section 22 30 00 Plumbing Equipment.

2.12 PLUMBING FIXTURES

A. Refer to Section 22 40 00 Plumbing Fixtures.

2.13 CLEANOUTS

A. Acceptable Manufacturers: J. R. Smith, Zurn, Wade, Sioux Chief and Josam.

B. Cleanout Plugs: Bronze, taper thread countersunk head.

C. Floor Cleanouts: Service weight cast-iron body and frame, flange with flashing clamp, adjustable cast-iron collar, caulk inside, Ty-seal or No-hub joints, neoprene plug gasket seal.
   1. Carpeted Areas: Zurn ZN-1400-KC-VP-BP-CM or J. R. Smith 4028 C - F- C - Y - U
   2. Tiled Areas: Zurn ZN-1400-X-KC-VP-BP or J.R. Smith 4148 - F - C - U
   3. Unfinished Areas: Zurn ZN-1400-HD-KC-VP-BP or J.R. Smith 4108 C - F - C - U
   4. Yard Areas: Zurn Z 1474-IN-VP or J.R. Smith 4258 - C - U

D. Cleanout Tee: Cast iron cleanout tee with countersunk brass plug, neoprene plug gasket seal and smooth stainless steel cover.
   1. Manufacturer: Zurn Z-1446-BP or J. R. Smith 4532 S (Y)

2.14 ROOF FLASHING

A. Flashing: Unless indicated otherwise on the drawings flashings for pipes through the roof shall be galvanized sheet metal, 24-gauge minimum, with seams and joints lapped and soldered watertight. Coordinate with Architectural Sections for flashings and roofing.

B. Vent Pipes: Provide caulk type, vandal proof hood with Allen head vandal proof screws for all vent pipes through roof or preformed vinyl/galvanized steel assembly.

2.15 WATER HAMMER ARRESTORS

A. Provide a water hammer arrestor before each quick closing valve, including but not limited to, flush valves, solenoid valves, electronic trap primers, pre-rinse faucets, dishwashers and banks of fixtures.

B. Piston or Bellows Type: Hard drawn copper construction or stainless steel, mirror finished internal surfaces; machine finished brass piston or stainless steel bellows, lead free, air pre-charged, 150 psi rated, threaded connection, tested and certified per PDI WH-201 and ASSE/ANSI 1010.

C. Water hammer arrestors shall be sized based on the PDI WH-201 Standard method.

D. Manufacturers: Watts #LF15 Series, Precision Plumbing Products #SC Series, Sioux Chief #650 Series, Mifab #WHB Series, JR Smith #5000 Series, or equal.

2.16 TRAP SEAL PRIMER

A. Single Fixture Trap Seal Primer Device:
   1. Device shall conform to ASSE Standard 1018. Provide ball valve upstream of trap primer to allow for future maintenance and replacement.
   2. Pressure Operating Range: 20-80 psi.
   3. Pressure Activation: Minimum 3 psi differential and mounted with ten (10) feet of fixture source of pressure drop. Or, minimum 10 psi differential and mounted within three (3) feet of fixture source of pressure drop. Maximum pipe distance is 20 feet to floor drain.
   4. Brass body with lead free construction and removable filter screens. Chrome plated in exposed areas.
   5. Inlet and outlet connections may be threaded, unions or soldered.
   6. Manufacturer: Mifab #M-500 Series (3 psi activation), PPP #PR-500 (10 psi activation), Sioux Chief #695-01 (10 psi activation), or equal.

B. Multiple Fixture Trap Seal Primer Device:

1. Device shall conform to ASSE Standard 1018. Provide ball valve upstream of trap primer to allow for future maintenance and replacement.
2. Manifold or distribution unit to serve 2 to 10 floor drains.
3. Pressure Operating Range: 20-80 psi.
4. Pressure Activation: Minimum 3 psi differential and mounted with ten (10) feet of fixture source of pressure drop. Or, minimum 10 psi differential and mounted within three (3) feet of fixture source of pressure drop. Maximum pipe distance is 20 feet to floor drain.
5. Brass body with lead free construction and removable filter screens. Chrome plated in exposed areas.
6. Inlet and outlet connections may be threaded, unions or soldered.
7. Manufacturer: Mifab #M-500 Series (3 psi activation), PPP #P1-500 (10 psi activation), Sioux Chief #695-01 (10 psi activation), or equal.

C. Electronic Trap Seal Primer Device:
1. Device shall conform to ASSE Standard 1044. Provide ball valve upstream of trap primer to allow for future maintenance and replacement.
2. Manifold or distribution unit to serve 1 to 10 floor drains.
3. Recessed steel cabinet with stainless steel cover or galvanized steel painted to match wall.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 volt AC power. Coordinate power requirements with electrical design. Listed and labeled as defined in NFPA-70.
5. Vacuum breaker compliant with ASSE 1001.
6. Water hammer arrestor shall be integral or externally mounted upstream.
7. Pressure Operating Range: 20-80 psi.
8. Brass body with lead free construction.
9. Inlet and outlet connections may be threaded or soldered.
10. Manufacturer: Mifab #MI-100 Series, PPP #MP-500 Series, Sioux Chief #695-E Series, or equal.

2.17 DRAINS

A. Manufacturers: J.R. Smith, Zurn, Wade, Sioux Chief, Josam, Watts, or equal.

B. Provide drains of type and size as indicated in plumbing schedule on Drawings, including features, as specified herein.

C. Floor drains and shower drains installed above food preparation, food handling and patient healthcare areas shall be provided with integral seepage holes that drain into the drain body/pan.

2.18 ANTI-CONTAMINATION WALL HYDRANTS AND HOSE BIBBS

A. Provide fixtures of type and size as indicated in plumbing schedule on drawings, including features, as specified herein.

2.19 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 22 Sections. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category. Stencils, hand printed, painted, and felt pen markers are not acceptable.

B. Plastic Pipe Markers:

1. Pre-tensioned Pipe Labels: Precoiled, semi-rigid plastic formed to partially or fully cover the circumference of pipe, or insulated pipe, and to attach to pipe without fasteners or adhesive complying with ANSI A13.1. Minimum letter size shall be 1/2" high.
2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape. Minimum letter size shall be 1/2" high.
3. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
4. Arrows: Point each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
5. Pipe Label Color Schedule:
    a. Domestic Cold Water piping:
        1) Background Color: Green.
        2) Letter Color: White.
    b. Domestic Hot Water Supply and Domestic Hot Water Recirculation piping:
        1) Background Color: Green.
        2) Letter Color: White.
    c. Sanitary Sewer, Storm Drainage and Vent piping:
        1) Background Color: Green.
        2) Letter Color: White.
    d. Natural Gas piping:
        1) Background Color: Yellow.
        2) Letter Color: Black.
    e. Other piping services:
        1) Background Color: Comply with ANSI and ASME A13.1standards.
        2) Letter Color: Comply with ANSI and ASME A13.1standards.

C. Valve Tags:
1. Brass Valve Tags: Provide 1-1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Fill tag engraving with black enamel.
2. Plastic Laminate Valve Tags (indoors only): Provide 3/32" thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fasteners.
3. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Access Panel Markers: Provide 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve.

E. Plastic Equipment Signs:
1. Provide 3" x 5" (minimum) plastic laminate sign, ANSI A.13 color coded with engraved white core lettering. Minimum letter size shall be 1/2" high.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2”x11” bond paper, tabulate each equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

F. Underground-Type Plastic Line Markers: Provide 6” wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

G. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., or Brimar.

2.20 ELECTRICAL

A. General:
1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
2. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.
3. Set and align all motors and drives in equipment specified herein.
4. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.
5. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.
6. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

B. Quality Assurance:
1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:
1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment Specifications.
2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Unless otherwise noted on plans, all motors ½ HP or larger shall be rated for 208 or 460 volt, 3-phase, operation. Unless otherwise noted on plans, all motors less than 1/2 HP shall be rated for 120 volt, single phase operation.
4. Temperature Rating: Motor meets class B rise with class F insulation.
5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
   a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
   b. VFD driven motors. To be provided rated for inverter duty (NEMA Standard MG-1, Part 31) and equipped with a shaft grounding device or as an insulated bearing motor.
   c. Bearings:

1) Ball or roller bearings with inner and outer shaft seals.
2) Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.
4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.
5) Enclosure Type:
   a) Open drip-proof (ODP) motors for indoor use in clean air environments.
   b) Totally enclosed fan cooled (TEFC) motors for outdoor use and indoor application in dirty environments.
   c) Totally enclosed air over (TEAO) motors for motors in the airstream of cooling towers and fluid coolers.
   d) Guarded drip-proof motors where exposed to contact by employees or building occupants.
   e) Weather protected Type I for outdoor use, Type II where not housed.

d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
e. Noise Rating: "Quiet."
f. Efficiency:
g. Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.
h. And, motors shall meet the NEMA premium efficiency standard.
i. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:
1. Motor Starter Characteristics:
   a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs.
   b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.
2. Manual switches shall have pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).
3. Magnetic Starters:
   a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
   b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).
   c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
   d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.
   e. Externally operated manual reset.
   f. Under-voltage release or protection for all motors over 20 hp.
4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:
1. General: 14 gauge, Type THHN, color coded, installed in conduit.
2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:
   1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.
   2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.01 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal or otherwise irregular work, unless so indicated on Drawings or approved by Owner’s Representative.

C. Install all items specified in this section of the Specification under the full purview of local and state governing agencies.

3.02 PERFORMANCE OF WORK

A. Examine areas, physical conditions and phasing requirements under which materials are to be installed. Layout the system to suit the different types of construction and equipment as indicated on the drawings.

B. Work shall start immediately after authorization has been given to proceed so that the overall progress of the construction is not delayed. No foundry items to be installed until submittals have been approved.

C. Coordinate with other trades as necessary to properly interface components of the plumbing system.

D. Follow manufacturer's directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the drawings or covered in these Specifications.

E. The omission from the drawings or Specifications of any details of construction, installation, materials, or essential specialties shall not relieve the Contractor from furnishing the same in place for a complete system.

3.03 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles provided on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.04 INSTALLATION

A. Coordinate the work between the various Plumbing Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision, coordination or failure to make proper and timely provisions, the alterations shall be made to the satisfaction of the Owner's Representative and at the Contractor's cost.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defective materials.

3.05 SUPPORTS AND HANGERS

A. Prior to installation of hangers, supports, anchors, and associated work, installer shall meet at project site with all trades and testing agency representatives to coordinate work associated with placement of such work.

B. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed. Fasten insert securely to forms. Where gypcrete is indicated, install reinforcing bars through opening at top of inserts.

C. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

D. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

E. Install hangers within 12 inches of every change in piping direction, end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

G. Support fuel gas piping independently of other piping exterior to the building. All fuel gas piping shall be installed in compliance with NFPA-54 (National Fuel Gas Code). Fuel gas piping inside the building shall not be installed in or through elevator shafts, air ducts, laundry chutes, chimneys, vents or combustion air pathways. Where piping is anchored to prevent undue strains on connected appliances and equipment this piping shall not be supported by other piping.

H. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

I. Horizontal Hanger Spacing in accordance with following minimum schedules (other spacings and rod sizes may be used in accordance with the SMACNA Seismic Restraint Manual using a safety factor of five):

1. Cast Iron:

Pipe Size	Max. Hanger Spacing	Rod Size
Up to 4”	Each joint, 10 feet max	3/8"
6” and larger	Each joint, 10 feet max	1/2"

2. Steel Pipe (Water Filled):

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 1-1/4"	5 feet	3/8"
1-1/2" to 2"	7 feet	3/8"
2-1/2" to 3"	10 feet	1/2"
4" and larger	10 feet	5/8"

3. Copper Pipe:

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 1-1/2"	6 feet	3/8"
2" and larger	8 feet	1/2"

4. Caulked Bell and Spigot and Glass Pipe: Provide hanger for each section of pipe, located at shoulder of bell. Where an excessive number of fittings are installed between hangers, provide additional reinforcing.

J. Vertical Support Spacing in accordance with following minimum schedules:

1. Cast Iron:

Pipe Size	Max. Vertical Support Spacing
All sizes	Base and each floor, not to exceed 15 feet

2. Steel Pipe (Water and Air Filled):

Pipe Size	Max. Vertical Support Spacing
All sizes	Base and every other floor, not to exceed 25 feet

3. Steel Pipe (Gas Filled):

Pipe Size	Max. Vertical Support Spacing
1/2"	6 feet
3/4” to 1”	8 feet
1-1/4” and larger	Every floor level

4. Copper Pipe:

Pipe Size	Max. Vertical Support Spacing
All sizes	Base and each floor, not to exceed 10 feet

K. Sloping, Air Venting, and Draining:

1. Slope all piping as specified and as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in the direction of flow as follows:

Service	Inclination	Slope
Soil and Waste	Down	1/4" per foot
Storm Water	Down	1/4" per foot
Sanitary Vent	Up (towards roof terminal)	1/4" per foot

2. Provide drain valves and hose adapters at all low points in piping.
3. Slope all compressed air branch piping down toward main risers at 1” per 100’.

L. Provisions for Movement

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. Where hot water pipes are

installed inside walls and ceilings do not firmly attach pipes to framing as necessary to avoid noise generation during expansion and contraction.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.
3. Insulated Piping: Comply with the following installation requirements:
   a. Clamps: Attach clamps, including spacers, (if any), to piping with clamps projecting through insulation.
   b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold water piping, install shields or inserts.
   c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

M. Installation of Anchors:
1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.
3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
4. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

N. Equipment Supports:
1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.
2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

O. Adjusting:
1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.06 WALL, FLOOR, AND ROOF PENETRATION SIZING

A. All pipe penetrations through rated and non-rated assemblies shall be sized to allow for compliance with structural integrity and fire ratings, as applicable. Where sleeves are required, the sleeve size shall be installed with the inside clear diameter providing clearances as required below.
1. Uninsulated pipe penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each uninsulated pipe.
2. Insulated pipes penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each insulated pipe.
3. Uninsulated pipe penetrations through fire rated walls and floors, and through roof: penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside diameter of each uninsulated pipe to provide minimum 1/4” annular space between the

outside of the pipe surface and assembly. Coordinate with specific manufacturer requirements and UL listing.

4. Insulated pipe penetrations through fire rated walls and floors, and through roof: pipe penetration sizes shall be a 1/2" (minimum) to 1-1/2" (maximum) larger than the outside diameter of each insulated pipe to provide minimum 1/4" annular space between the outside of the insulation surface and assembly. Coordinate with specific manufacturer requirements and UL listing.
5. Uninsulated pipe penetrations through foundation and basement walls: penetration sizes shall be larger than the outside diameter of each uninsulated pipe to allow adequate space for installation of mechanical link seals. Coordinate with specific manufacturer requirements.

3.07 WALL AND PIPE SIZING COORDINATION

A. Pipes routed horizontally or vertically in framed wall enclosures shall be limited to sizes that fit within the available free area without impacting the construction of the wall or intent of architectural floor plans. Maximum piping diameters shall be adjusted as necessary to accommodate insulation, fittings and pipe crossings inside the wall enclosure. Sizing is based on the following criteria:
   1. 3-5/8" Stud Wall: Maximum 2" diameter piping.
   2. 4" Stud Wall: Maximum 3" diameter piping.
   3. 6" Stud Wall: Maximum 4" diameter piping.
   4. 8" Stud Wall: Maximum 6" diameter piping.
   5. 10" Stud Wall: Maximum 8" diameter piping.
   6. 12" Stud Wall: Maximum 10" diameter piping.

3.08 WATER HAMMER ARRESTERS

A. Install as per PDI WH-201 Standard and equipment manufacturer's recommendation and as shown on working drawings. Install at each plumbing fixture, bank of fixtures, equipment as required by code and where indicated on the drawings.

B. Provide upstream of quick closing valves, including but not limited to, flush valves, solenoid valves, electronic trap primers, pre-rinse faucets, dishwashers and banks of fixtures.

C. Water hammer arrestors shall only be installed in the upright position above the piping and connected as close to pipe as possible to maximize effectiveness. Provide a manual ball valve (to remain in open position) at the inlet of the water hammer arrestor to allow for future replacement without shutting water supply to fixtures.

D. Where water hammer arrestors are installed in walls or above ceilings provide access panels as required for future maintenance. Coordinate locations with Architect or Owner's Representative prior to installation or water hammer arrestor and access doors.

E. On multiple fixture branch lines up to 20 feet in length, the water hammer arrestor should be installed on the branch line between the last two fixtures being served. The water hammer arrestor should have a fixture unit rating equal to, or greater than, the total fixture units connected to the branch line.

F. On multiple fixture branch lines over 20 feet in length, two water hammer arrestors should be used on each line with the second unit placed at the approximate midpoint of the line. The sum of the fixture unit ratings of the water hammer arrestors on each branch should be equal to, or greater than, the total fixture units connected to the branch line.

G. Water hammer arrestors shall be sized based on the PDI WH-201 Standard method as follows for water pressures up to 65 psi. For water pressures in excess of 65 psi provide the next larger size.

Water Hammer Arrestor Sizing	
PDI Size Rating	Fixture Units Served
A	1-11
B	12-32
C	33-60
D	61-113
E	114-154
F	155-330

3.09 ROOF CURBS, EQUIPMENT RAILS, PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust cant to match.

3.10 PIPING INSTALLATION

A. The word “piping” shall mean all pipes, fittings, nipples, valves and all accessories connected thereto.

B. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts flues, conduits and work of other trades and close to ceiling or other construction as practical, free of unnecessary traps or bends.

C. Run horizontal sanitary drainage piping at uniform pitch of not less than 1/4" per foot (2%), unless otherwise indicated on the drawings. Pipe sizes 4” (100 mm) and larger may be sloped at 1/8” per foot (1%) as allowed by local plumbing code to serve required invert elevations. Pitch horizontal vent piping downward from stack to fixtures.

D. Run horizontal condensate drainage piping at uniform pitch of not less than 1/8" per foot (1%).

E. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageway.

F. All piping shall be inspected for defects and flaws prior to installation. Remove any damaged piping from job site. Piping shall be thoroughly cleaned of dirt, debris or rust.

G. Cleanouts to be provided at each change in direction greater than 135° or 100' maximum intervals on underground piping.

H. Cleanout elevations shall be mounted flush with finished floor elevation.

I. Cleanouts to be same size as pipe except cleanout plugs larger than 4" shall not be required.

J. Cleanouts on concealed piping to be extended through and terminate flush with the finished wall or floor. Cover plates to be provided on all cleanout plugs in finished areas.

K. The bodies of cleanout ferrules to conform in thickness to that required for pipe and fittings of the same metal.

L. Mount piping on roof to manufactured polypropylene pipe supports: Caddy Pyramid, Roof Top Blox or equal.

3.11 VIBRATION CONTROL ISOLATORS

A. Comply with manufacturer's recommendations for selection and application of vibration isolation materials and units except as otherwise indicated. Comply with minimum static deflections recommended by ASHRAE, of vibration isolation materials and units where not otherwise indicated.

B. Comply with manufacturer's instructions for installation and load application to vibration control materials and units except as otherwise indicated. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

C. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

D. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

E. Flexible Pipe Connectors: Install on equipment side of shutoff valves.

F. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

3.12 ELECTRICAL COORDINATION

A. Division 22 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer’s written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA’s “Standard of Installation” to ensure that products fulfill requirements.

C. Division 22 has responsibilities for electrically powered plumbing equipment which is specified in Division 22 Specifications or scheduled on Division 22 Drawings as follows:
   1. Motors: Furnish and install all motors necessary for mechanical equipment.
   2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 22 equipment, also furnish and install the power wiring between starter and motor.

3. Variable Frequency Drives: Provide all VFD's associated with fire protection equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.
4. Disconnects: Provide the disconnects which are part of factory wired Division 22 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.
5. Controls: Division 22 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:
   a. Control relays necessary for controlling Division 22 equipment.
   b. Control transformers necessary for providing power to controls for Division 22 equipment.
   c. Low or non-load voltage control components.
   d. Non-life safety related valve or damper actuators.
   e. Float switches.
   f. Solenoid valves, EP and PE switches.
   g. Communications wiring and conduit between control devices and plumbing equipment.
   h. Raceway to support control cabling.

D. Division 26 Electrical Responsibilities:
1. Motors: Provide the power wiring for the motors from servicing panel to motor controller.
2. Magnetic Starters: Except where magnetic starters are factory installed on Division 22 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 22 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring from source panel/disconnect to the starter.
3. Variable Frequency Drives: Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 22.
4. Disconnects: Provide all disconnects necessary for Division 22 equipment which are not provided as part of factory wired Division 22 equipment. Provide power wiring to all disconnects. In addition provide power wiring between motor and disconnect when the disconnect is not factory installed.
5. Controls: Division 26 is responsible for providing power to control panels and provide final power connection to Division 22 provided control transformers.
6. Fire Sprinkler System: Division 26 is responsible for providing power wiring to fire protection controls including flow switches and alarm bells.
7. Specialized fire suppression systems: Division 26 is responsible for providing power wiring to suppression system and its controls.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.13 PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Division 9: Painting. Painting schemes shall comply with ANSI A13.1. Paint all exposed materials such as piping, equipment, insulation, steel, etc. Exposed gas piping outside the building shall be painted.

B. All exposed work under Division 22 shall receive either a factory finish or a field prime coat finish, except:
   1. Exposed copper piping.
   2. Aluminum jacketed outdoor insulated piping.

3.14 IDENTIFICATION MARKERS

A. General: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identification is not required inside wall assemblies or under concrete slabs.

B. Piping System Identification:
   1. Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.
   2. Locate pipe markers as follows:
      a. Near each valve and control device.
      b. Near each branch, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
      c. Near locations where pipes pass through walls, floors, ceilings, or inaccessible enclosures.
      d. At access doors, manholes, and similar access points which permit view of concealed piping.
      e. Near major equipment items and other points of origination and termination.
      f. Spaced horizontally at maximum spacing of 50' along each piping run, with minimum of one in each room. Vertically spaced at each story traversed.
   3. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipe where flow is allowed in both directions.
   4. Provide pipe identification on:
      a. Domestic cold water.
      b. Domestic hot water (supply and recirculation).
      c. Sanitary sewer and vent piping.
      d. Storm drainage piping.
      e. Natural gas piping.
      f. Compressed air piping.
      g. Other piping systems.

C. Valve Tag Identification: Install tags on valves and control devices in piping systems, except at check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
   1. Provide valve tags for:
      a. Domestic cold water.
      b. Domestic hot water (supply and recirculation).
      c. Gas/fuel piping.
      d. Compressed air piping.
      e. Other piping systems.

D. Plumbing Equipment Identification: Locate engraved plastic laminate signs on or near each major item of plumbing equipment and each operational device. Additional labels are not required if systems are properly labeled by equipment manufacturers.

1. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.
2. Provide signs for the following equipment:
   a. Main control and operating valves, including safety devices.
   b. Pumps, compressors and similar motor-driven units.
   c. Hot water system mixing valves and similar equipment.
   d. Water heaters, heat exchangers and similar equipment.
   e. Tanks and pressure vessels.
   f. Strainers, filters, treatment systems and similar equipment.

E. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install one underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. Identification is only required on piping to five feet outside the building perimeter. Underground piping identification is not required below concrete slabs.

F. Where upstream gas pressure exceeds 2 psi, each gas pressure regulator shall have a metal tag attached stating, "Warning: upstream natural gas pressure. Do not remove."

3.15 CLEANING EQUIPMENT AND MATERIALS

A. In addition to the requirements of Section 22 05 00, provide for the safety and good condition of all materials and equipment until final acceptance by the Owner's Representative. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care to be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors, and similar equipment.

B. All piping, finished surfaces, and equipment to have all grease, adhesive labels, and foreign materials removed.

C. All piping to be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves, and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation for ten days.

D. When connections are to be made to existing systems, the Contractor is to do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

3.16 TESTING

A. Provide all tests specified herein, in other Division 22 Sections, and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner's Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Owner's Representative to witness all field tests and conduct all field inspections. The Contractor to give the Owner's Representative ample notice of the dates and times scheduled for tests. Any deficiencies to be completely retested at no additional cost.

C. Inspection to continue during installation and testing. Perform a final inspection of the equipment prior to installation to determine conformity to the type, class, grade, size, capacity, and other characteristics specified herein or indicated. Correct or replace all rejected equipment prior to installation.

3.17 DISINFECTING - PLUMBING SYSTEMS

A. Disinfection of potable water distribution system shall be as prescribed by the local health authority or the following minimum requirement. After pressure tests have been made thoroughly flush the entire domestic water distribution system with water until all entrained dirt and mud have been removed, and sterilize by chlorinating material. The chlorinating material shall be liquid chlorine. The chlorinating material shall provide a dosage of not less than 50 parts per million and shall be introduced into the system or part thereof in an approved manner. Retain the treated water in the pipe for 24 hours, or, fill the system or part thereof with a water-chlorine solution containing at least 200 parts per million of chlorine and allow to stand for three (3) hours. Open and close all valves in the system being disinfected three times during the contact period. Then flush the system with clean potable water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period open and close all valves and faucets three times. From at least three divergent points in the system, take samples of water in properly sterilized containers for bacterial examination. Repeat the disinfecting until tests indicate that satisfactory bacteriological results have been obtained.

B. Taking of samples shall be witnessed by Owner's Representative. Samples are to be taken and tested by an independent analytical testing laboratory. Written reports shall be supplied to Owner's Representative for approval.

3.18 OPERATING TESTING AND CERTIFICATION - PLUMBING SYSTEMS

A. Upon completion and disinfection, and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory, functional, and operating efficiency. Such operating tests to include the following information in a report with conclusions as to the adequacy of the system.
   1. Time, date, and duration of tests.
   2. Water pressures at most remote location.
   3. Operation of all valves and hydrants.
   4. Operation of all floor drains by flooding with water.
   5. Quality of domestic water.
   6. Read all indicating instruments at half-hour intervals unless otherwise directed. Supply four copies of the test report to the Owner's Representative.

3.19 VIBRATION AND DYNAMIC BALANCING

END OF SECTION

SECTION 22 05 49

SEISMIC RESTRAINT FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SUMMARY

A. This Section includes the following:
   1. Seismic restraint and support of piping, ductwork and mechanical equipment as required by code and as designed by project registered professional Structural Engineer.
   2. Plumbing (mechanical) component supports and the means by which they are attached to the plumbing component shall be designed for the forces and displacements determined in ASCE 7 Chapter 13. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the plumbing component.

1.03 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. ASCE: American Society of Civil Engineers

C. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers

D. IBC: International Building Code with Amendments

E. ICC-ES: ICC-Evaluation Service

F. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association

G. Building Seismic Design Category: The directions of application of seismic forces used in the design shall be those which will produce the most critical load effects. Seismic Design Categories are classified as A, B, C, D, E or F. Refer to Architectural and Structural Designs for project specific classification.

H. Mechanical Attachments: Means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

I. Mechanical Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

J. Mechanical Components: Elements, including, but not limited to, pumps, air handling units, boilers, chillers, pipes, ductwork, and exhaust fans.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 22 05 00: Basic Plumbing Materials and Methods

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Structural Performance: Restraint devices and systems shall withstand the effects of locally defined gravity loads, seismic loads, dead loads, live loads, winds loads and stresses within limits and under conditions indicated according to the Building Code and ASCE 7. Coordinate all support structures and restraint systems with project registered professional Structural Engineer.

C. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

D. Codes and Standards: Provide components conforming to the seismic load requirements of the latest addition of the local building code and the following:
   1. International Building Code with State Amendments.
   2. ASCE 7-10 (Latest Edition) - Minimum Design Loads for Buildings and Other Structures
      a. Ductwork and piping requirements defined in Chapter 13 Seismic Design Requirements for nonstructural Components. Nonstructural components in Seismic Design Category A are exempt from seismic design requirements.
   3. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems (Latest Edition)
      a. Seismic guidelines for ductwork and piping bracing as adopted by Authority Having Jurisdiction.
   4. ASHRAE – Practical Guide to Seismic Restraint (Latest Edition)
   5. Mason West Inc. - Seismic Restraint Guidelines (Latest Edition)
      a. For all suspended piping.

1.06 APPLICABILITY

A. Seismic restraints are required for nonstructural plumbing systems, but may not be required for the following conditions related to nonstructural components per ASCE 7 Section 13.1.4:
   1. Plumbing components in Seismic Design Category B facilities.
   2. Plumbing components in Seismic Design Category C facility provided that the component Importance Factor, I_p, is equal to 1.0.
   3. Plumbing components in Seismic Design Categories D, E, or F facilities where **all** of the following apply:
      a. The component Importance Factor, I_p, is equal to 1.0;
      b. The component is positively attached to the structure;
      c. Flexible connections are provided between the component and associated ductwork, piping, and conduit; and any of the following applies:

1) The component weighs 400 lbs. (1,780 N) or less and has a center of mass located four feet (1.22 m) or less above the adjacent floor level; or
2) The component weighs 20 lbs. (89 N) or less; or
3) The distributed piping system weights 5 lbs./ft. (73 N/m) or less.

B. Provide seismic bracing at the following locations per SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems (Latest Edition):
1. Piping:
a. Transverse bracing shall be provided at 40 feet (12.2 m) maximum except where a lesser spacing is indicated in SMACNA tables.
b. Longitudinal bracing shall be provided at 80 feet (24.4 m) maximum except where a lesser spacing is indicated in SMACNA tables. Anchor locations for thermal expansion may be used as longitudinal braces. Longitudinal braces must be capable of resisting the additional force induced by expansion and contraction.

C. Seismic restraints may be omitted where the following conditions apply and as allowed by the local Authority Having Jurisdiction (AHJ):
1. Pipes suspended by hangers 12" (305 mm) or less in length from the top of the pipe to the bottom of the supporting structure for the hanger. Where pipes are supported by trapeze, the trapeze shall be supported by hangers having a length of 12” (305 mm) or less.
2. Pipe bracing shall not be required where the following conditions apply:
a. For Seismic Design Category C where the I_p value is greater than 1.0 and pipe sizes are 2” (50 mm) in diameter or less, and piping weighs less than 10 lbs./ft. (146 N/m).
b. For Seismic Design Category D, E, or F where the I_p is greater than 1.0 and pipe sizes are 1” (25 mm) in diameter or less, and piping weighs less than 10 lbs./ft. (146 N/m).
c. For Seismic Design Category D, E, or F and where the I_p equals 1.0 and pipe sizes are 3” (80 mm) in diameter or less, and piping weighs less than 10 lbs./ft. (146 N/m).
3. Equipment:
a. All equipment weighing more than 400 lbs. (1,780 N) shall be seismically braced or attached directly to structure.
b. All suspended mechanical components weighing more than 20 lbs. (89 N) shall be seismically braced.

D. Seismically restrained systems shall not move more than 2” when pushed and shall not impact other nonstructural components or building structure.

1.07 PERFORMANCE REQUIREMENTS

A. Component Importance Factor and Risk Category:
1. Ip=1.0: Standard Occupancies and components associated with Risk Category I, II, and III, including offices and schools.
2. Ip=1.5: Components associated with Risk Category IV Buildings (Essential Services); or for conditions outlined in ASCE 7 Section 13.1.3 regardless of Risk Category, or Hospitals and Correctional Treatment Centers. Components include, but are not limited to the following:
a. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.
b. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the AHJ and is sufficient to pose a threat to the public if released.

B. Mechanical Seismic Coefficients for Mechanical Components: Refer to ASCE 7 Table 13.6-1 for a_p factor (component amplification factor) and R_p factor (component response modification factor) as required for each unique mechanical component.

1.08 SUBMITTALS

A. Product Data:
   1. Include rated load, rated deflection, and overload capacity for each device or system.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Submit seismic brace product details from the Mason West Seismic Restraint Guidelines detailing compliance with the specifications.
   4. Where products from the Mason West Seismic Restraint Guidelines cannot be used, special details must be submitted for approval.

B. Seismic Restraint Calculations
   1. Seismic restraint calculations must be provided for all connections to the structure.
   2. Calculations must be stamped by a registered professional Structural Engineer.
   3. Where seismic restraint sizes, spacing and anchorage are included in the Mason West Seismic Restraint Guidelines no further calculations are required.

1.09 ENGINEERED PIPING SYSTEMS

A. Where the piping system design indicated on the plans utilizes Mason Industries, Inc. - Mason West, Inc. seismic restraint components, vibration isolators, guides, anchors, expansion compensators and flexible connectors the following requirements apply:
   1. Mason Industries, Inc. - Mason West, Inc. products must be installed as shown.
   2. If product substitutions or design changes are made the contractor must provide certified design of the piping system and meet the following conditions:
      a. Certification must be provided by a registered professional Structural Engineer.
      b. Certification shall include a statement that all systems have been checked for loads and stresses and that no excessive loads or stresses exist.
      c. Forces on all anchors, guides, supports, and restraints must not exceed those shown in the original design unless the structure is checked for the larger loads at no cost to the owner.

B. Where the piping system design is not indicated on the drawings the design is delegated to the contractor with the following requirements for piping certification and analysis:
   1. The supports, anchors, guides and seismic braces for systems with significant thermal motion including steam, condensate, high temperature hot water and heating hot water systems must be designed for combined gravity, seismic, pressure and thermal loads.
   2. The results of the analysis shall include reactions at restraints and anchors, maximum pipe displacements and a code compliant report indicating maximum pipe stresses.
   3. Where required, seismic restraint components, vibration isolators, guides, anchors, expansion compensators and flexible connectors manufactured by Mason Industries, Inc. and Mason West, Inc. shall be incorporated into the design of the systems.
   4. The analysis and design must be performed by a Structural Engineer with 5 years of experience in this field.

1.10 MANUFACTURER AND CONTRACTOR RESPONSIBILITIES

A. All seismic restraints shall be designed by a registered professional Structural Engineer.

B. Seismic restraint layouts for piping shall be added to the contractor's shop drawings and shall include:
   1. The number, size and location of seismic braces.
   2. Maximum support loads and seismic loads at the seismic brace locations.
   3. Reference to specific details or pages from the Mason West Seismic Restraint Guidelines.

C. Installations not addressed by the state pre-approval process must be designed, detailed and submitted along with the shop drawings.

D. Submit seismic restraint layout drawings and special details for approval of the project registered professional Structural Engineer per the requirements listed in the Mason West Seismic Restraint Guidelines.

E. Seismic restraint layout drawings shall bear the stamp and signature of the registered professional Structural Engineer who designed the layout of the braces.

1.11 LOADS ON STRUCTURE

A. The responsibility of determining allowable loads on the structure is the sole responsibility of the project registered professional Structural Engineer.

B. Maximum support loads and seismic brace loads on the structure must be less than the maximum allowable loads defined by the project registered professional Structural Engineer, as shown on the plans.

C. Where maximum loads are not listed on the plans or the maximum allowable loads cannot be met, any additional support steel required to reduce support and seismic bracing loads on the structure shall be designed by the project registered professional Structural Engineer.

D. Mechanical component supports and the means by which that are attached to the component shall be designed for the forces and displacements determined in ASCI 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.

E. Mechanical supports are those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Mechanical attachments are the means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

1.12 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 INTENT

A. All seismic restraints described in this section shall be the product of a single manufacturer.

B. Mason Industries products are the basis of these specifications; products of other manufacturers may be submitted for review provided their systems strictly comply with the specifications.

2.02 SEISMIC SWAY BRACING

A. Seismic sway braces shall consist of galvanized steel aircraft cables, steel angles or steel struts.

B. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads. Brace end connections shall be steel assemblies that swivel to the final installation angle.

C. Cable brace assemblies shall have published strength and stiffness ratings based on testing per FM-1950 standards.

D. Angle or strut bracket assemblies shall be FM Approved except as noted below.

E. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps.

F. Cable brace bracket assemblies shall be Type SCB or SCBH. Solid brace bracket assemblies shall be Type SSB-FM, SSBS-FM or SHB-FM. All bracket assemblies shall have published strength and stiffness values based on testing per FM-1950.

G. Rod clamps shall be Type SRC or UCC.

PART 3 - EXECUTION

A. Contractor's Statement of Responsibility: Each contractor responsible for installing a Designated Seismic System or any seismic resisting component must submit a statement of responsibility prior to the commencement of work to include acknowledgment of awareness of the need for Special Inspections.

B. All seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

C. Installation of seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

D. No connections between the piping and the building structure shall be made that degrades the seismic restraint system herein specified.

E. Any conflicts with other trades due to inadequate space or other unforeseen conditions should be brought to the attention of the Owner's Representative prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

END OF SECTION

SECTION 22 05 93

PLUMBING TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 WORK RELATED IN OTHER SECTIONS

A. Section 22 05 00: Basic Plumbing Materials and Methods

B. Section 22 10 00: Plumbing Piping, Valves and Specialties

C. Section 23 05 93: Testing, Adjusting and Balancing (HVAC)

D. Section 23 09 00: Building Automation System (BAS) Controls

E. Division 26: Electrical.

1.03 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 22 05 00 - Basic Plumbing Materials and Methods.

B. Systems: Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:
   1. Domestic hot water recirculation system and branch water flows.
   2. Domestic hot water mixing valves.
   3. Hands-free sensor operated flushometer valves and faucets.
   4. Pressure regulating valves serving domestic and closed hydronic systems.
   5. Instruction of Owner's personnel for future balancing of systems.

1.04 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Reference Standards
   1. ANSI/ASHRAE Standard 111 - Measurement, Testing, Adjusting and Balancing of Building HVAC Systems (current edition).
   2. ASHRAE - HVAC Applications Handbook: Chapter 38 - Testing, Adjusting and Balancing (current edition).
   3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings, Chapter 6 (current edition).

4. AABC - National Standards for Total System Balance.
5. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
6. Local Nonresidential Energy Code.

1.05 QUALITY ASSURANCE

A. Contractor's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, is not the installer of the system to be tested and is otherwise independent of the project. Testing, adjusting, and balancing shall be performed by a certified NEBB technician or a certified AABC technician under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor. Testing and balancing agency must submit qualifications for review and approval prior to acceptance for work.

B. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

C. Retainages: In addition to any other sums retained or withheld pursuant to the provisions of this Contract, the amount of dollars will be withheld from payments to the contractor until such time as the work has been completed and accepted. In no event will this amount be paid to the Contractor prior to 60 days following acceptance of the project; during such time, the Contractor shall investigate and correct any reported deficiencies unless such deficiencies are a result of unauthorized tampering by building occupants.

D. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over six (6) months.

E. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer.

F. The testing and balancing agency shall provide with his bid a performance guarantee covering all phases of the work as herein specified.

G. The General and Plumbing Contractors shall cooperate with the selected testing and balancing agency in the following manner:

1. Provide sufficient time before final completion dates so that tests and balancing can be accomplished.
2. The various system installers, suppliers and contractors shall provide all required materials, labor and tools to make corrections when required without undue delay. Install balancing valves as required by testing and balancing agency.

3. The contractor shall put the domestic hot recirculation system and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.
4. Testing and balancing agency shall be kept informed of any major changes made to the system during construction, and shall be provided with a complete set of Record Drawings.
5. The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work.

1.06 SUBMITTALS

A. Conform to the Submittals requirements of Division 01.

B. Forms: The Contractor shall deliver a complete copy of either NEBB or AABC standard forms for testing and balancing work associated with the project. These forms shall serve as specific guidelines for producing final test report. Hybrid or non-standards forms are not acceptable.

C. Test Reports: Provide six (6) certified test reports, signed by the test and balance supervisor who performed the work. The final reports shall include key plans identifying location of all balancing valves and pumps. Final test reports shall be typed. Hand written reports are not acceptable.

D. Maintenance Data: Include, in maintenance manuals, copies of certified and approved test and balance reports and identification of instruments.

E. Qualifications: The Test and Balance Agency shall submit qualifications of all persons responsible for supervising and performing the on-site testing and balancing work and the name of the certifying engineer. Provide a reference list of five (5) similar size projects with contact person and telephone number.

1.07 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating and cooling.
3. The agenda shall include a list of all domestic hot water flows to be performed at all mechanical equipment.
4. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.08 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.
1. Installation and start-up work on equipment or systems to be tested has been completed and documented.

2. Work area scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.
3. All related mechanical systems which may affect the operation of the system to be tested shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.01 TEST INSTRUMENTS

A. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. The Owner's Representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

B. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against Certified Calibrated instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.

PART 3 - EXECUTION

3.01 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by approved project drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four-hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.
   1. All instruments shall be applied in accordance with the manufacturer's certified instructions.
   2. All labor, instruments, and appliances required shall be furnished by the Contractor.

3.02 WATER SYSTEM PROCEDURES

A. Preparation:
   1. Open all valves to full open position.
   2. Check that pressure regulating valves are operational over full range.
   3. Check that hot water heaters are fully operational.
   4. Check circulation pump rotation.
   5. Check all air vents at high points of water systems and determine that all are installed and operating freely.
   6. Operate each variable frequency drive (VFD) and verify controls installation is complete.
   7. Check that heat exchangers are fully operational.
   8. Check expansion tank(s) to determine they are not air bound and the system is completely full of water.

B. Metering: Water quantities and pressures shall be measured with calibrated meters.
   1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems.
   2. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils except room units, converters, etc.) prior to the capacity testing.

C. Automatic Controls: Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests.

D. Distribution: Adjustment of distribution shall be effected by means of balancing valves and automatic flow control valves as provided. Manual service valves shall not be used for balancing.
   1. Where automatic flow control valves are utilized in lieu of manual balancing valves, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

E. Water System Test and Balance Procedure: Perform the following tests, and balance each system in accordance with the following requirements:
   1. Set domestic recirculating pumps and associated balancing valves to proper gallons per minute delivery.
   2. Set pressure booster pumps and associated balancing valves to proper gallons per minute delivery.
   3. Adjust recirculation hot water flow at each branch.
   4. Coordinate with recirculation pump control system and record timeclock periods and setpoint.
   5. Test and record entering and leaving water temperatures through heat exchangers.
   6. Test and record entering and leaving water temperatures through central water distribution mixing valves (does not include fixture mounted mixing valves).
   7. Test, verify and record operation of domestic water pressure booster systems.
   8. Upon completion of flow readings and adjustments at balancing valves, mark all settings and record data.
   9. List all mechanical specifications of pumps.
   10. Rated and actual running amperage of pump motor.
   11. Adjust each pressure regulating valves and document final setpoint.

3.03 WATER SYSTEM DATA

A. Report: The certified report for reach water system shall include the data listed below.
   1. Pumps (Recirculating and Booster):
      a. Installation data
         1) Manufacturer and model
         2) Size
         3) Type drive
         4) Motor hp, voltage, phase, and full load amps
      b. Design data
         1) GPM
         2) Head
         3) RPM
         4) Amps
      c. Recorded data
         1) Discharge pressures (full-flow and no-flow)
         2) Suction pressures (full-flow and no-flow) operating head
         3) Operating gpm (from pump curves if metering is not provided) no-load
         4) Amps

5) Full-flow amps
6) No-flow amps
7) Inlet temperature to each pump under normal operating conditions

2. Water Heaters and Mixing Valves:
   a. Installation Data
      1) Manufacturer, model, and type
      2) Flow rate
      3) Inlet (entering) and outlet (leaving) temperatures
      4) Inlet (entering) and outlet (leaving) pressures
   b. Recorded Data
      1) Flow rate
      2) Entering and leaving water temperatures
      3) Entering and leaving pressures
3. Domestic Water Service
   a. Recorded Data
      1) Incoming domestic water pressure from the serving utility upstream of all building pressure regulating valves with time and date
      2) Incoming domestic water temperature with time and date

3.04 SENSOR ACTIVATED FLUSHOMETER VALVES (TOILETS AND URINALS)

A. Verify that each hands-free sensor operated flushometer valve is operating properly. Adjust factory default settings as necessary, and as available, to prevent unnecessary flushing and to allow for efficient flushing. Settings that may be adjusted include: user dwell time; flush delay; and user detection range.
   1. Dwell time: should not be less than 7 seconds. Adjust to 10 seconds as necessary to limit excessive flushing cycles.
   2. Flush delay: the delay when the person leaves the range to start a flush should not be less than 2 seconds. Adjust up to 5 seconds to limit excessive flushing cycles.
   3. User detection range:
      a. Urinal: the user must be within 20” to activate a flushing cycle. Adjust from 15” to 36” as necessary to limit excessive flushing cycles.
      b. Toilet: the user must be within 30” to activate a flushing cycle. Adjust from 15” to 36” as necessary to limit excessive flushing cycles.

B. Recorded Data

   1. Dwell time: Initial timing and final setpoint.
   2. Flush delay: Initial timing and final setpoint.
   3. User detection range: Initial activation range and final setpoint.

3.05 SENSOR ACTIVATED FAUCETS

A. Verify that each hands-free sensor operated faucet is operating properly during the hand washing cycle and limiting excessive water usage. Adjust factory default settings as necessary, and as available, though most faucets are factory preset and may not be adjustable. Settings that may be adjusted include: recognition range; after flow period; and maximum water flow period.
   1. Recognition range: Should not be greater than 6” from sensor.
   2. Maximum water flow period per cycle: Should not exceed 10 seconds.
   3. Maximum after flow period after removing hands: Should not exceed 1 second.

B. Recorded Data

1. Recognition range: Initial activation range and final setpoint.
2. Maximum water flow period per cycle: Initial timing and final setpoint.
3. Maximum after flow period after removing hands: Initial timing and final setpoint.

3.06 TOLERANCES

A. Set domestic hot water flow rates within plus or minus 10 percent of specified flow rates.

3.07 CERTIFIED REPORTS

A. Submittals: Six (6) copies of the reports described herein final inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious malfunction and design deficiencies.

D. Certification: Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:
   1. Piping Services:
      a. Domestic hot water supply and return.
      b. Domestic cold water, unless otherwise noted on drawings.
      c. Irrigation water, unless otherwise noted on drawings.
      d. Roof and overflow roof drain piping and drain bodies. (See Drains below)
      e. Sanitary vent piping in unheated spaces.
      f. Drains from electric water coolers to first connection.
      g. Cooling coil condensate drainage.
      h. Flush water.
      i. Pumped discharge piping in unheated spaces.
      j. All heat traced piping.
      k. All valves, separators, strainers and fittings for systems listed above.
   2. Roof Drains and Associated Piping: All roof and overflow drain bodies and associated piping are to be insulated except in Hot-dry and Mixed-Dry climate zones as defined by the National Renewable Energy Laboratory Building America zone map. See Pacific Northwest National Laboratory publication PNNL 17211, Guide to Determining Climate Regions by County.
   3. Types of plumbing piping insulation specified in this Section include the following:
      a. Pipe insulation: Fiberglass.
      b. Pipe insulation: Flexible elastomeric closed cell foam.
   4. Insulation jackets:
      a. Interior application
      b. Exterior application
      c. Removable covers
   5. Types of plumbing equipment insulation specified in this Section include the following:
      a. Flexible elastomeric closed cell foam.
      b. Fiberglass blanket
      c. Fiberglass board
      d. Cellular glass.
   6. Insulation accessories.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 22 05 00: Basic Plumbing Materials and Methods.

1.04 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room, typically between 70□F and 78□F.

B. Insert: Spacer placed between the pipe support system and the piping to allow for the space required for insulation.

C. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

D. Insulation Shield: Buffer material placed between the pipe support system and the insulation to prevent the insulation material from crushing.

E. Jacket: Protective covering over the pipe insulation; may be factory applied such as “all service jacket” or field applied to provide additional protection; of such materials as canvas, PVC, aluminum or stainless steel.

F. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system.

G. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

H. Freezing Climate: Where outdoor design temperature is less than 34°F (1°C), as stated in ASHRAE Fundamentals under 99% column for winter design conditions.

1.05 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:
   1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:
      a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.
      b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.
      c. C167 - Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
      d. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission.
      e. Properties by Means of the Guarded-Hot-Plate Apparatus.
      f. C195 - Specification for Mineral Fiber Thermal Insulating Cement.
      g. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
      h. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.
      i. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.
      j. C305 - Test for Thermal Conductivity of Pipe Insulation.
      k. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.
      l. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.
      m. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
      n. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

o. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
p. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
q. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
r. C547 - Specification for Mineral Fiber Preformed Pipe Insulation.
s. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
t. C553 - Specification for Mineral Fiber Blanket-Type Pipe Insulation (Industrial Type).
u. C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered).
v. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
w. C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
x. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
y. C1104 – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
z. C1071 - Standard Specification for Thermal and Acoustical Insulation.
aa. C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
bb. E84 - Test Method for Surface Burning Characteristics of Building Materials.
cc. E119 - Test for Fire Resistance.
dd. G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
ee. G22 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:
   a. 90 Energy Conservation in New Building Design.

3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:
   a. 255 Test Methods, Surface Burning Characteristics of Building Materials.

B. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

C. Products Containing Prohibited Chemicals:
   1. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable:
      a. Pentabrominated diphenyl ether (CAS#32534-81-9)
      b. Octabrominated diphenyl ether (CAS#32536-52-0)
      c. Decabrominated diphenyl ether (CAS#1163-19-50

D. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

E. Corrosiveness: Provide insulation such that when tested in accordance with the following test, the steel plate in contact with the insulation shows no greater corrosion than sterile cotton in contact with a steel plate for comparison.

1. Test Specimen: Two specimens shall be used, each measuring 1” by 4” by approximately 1/2” thick.
2. Apparatus: Provide a humidity test chamber in which two polished-steel test plates, 1” wide, 4” long and 0.020” thick, shall be placed. Plates shall be clear finish, cold-rolled strip steel, American quality, quarter hard, temper No. 3, weighing 0.85 lb/sq. ft.
3. Procedure: The steel test plates shall be rinsed with cp benzol until their surfaces are free from oil and grease and allowed to dry. One piece of cold-rolled steel shall be placed between the two insulation specimens and secured with tape or twine. The test specimen and uncovered plate shall be suspended vertically in an atmosphere having a relative humidity of 95% (plus or minus 3%), and a temperature of 120°F (plus or minus 3°F), for 96 hours, and then be examined for corrosion.

F. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

1.06 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation. Also furnish necessary test data certified by an independent testing laboratory. Submit samples.

B. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:
1. Pentabrominated diphenyl ether (CAS#32534-81-9)
2. Octabrominated diphenyl ether (CAS#32536-52-0)
3. Decabrominated diphenyl ether (CAS#1163-19-50

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.08 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Johns Manville, Owens-Corning, Knauf, Armstrong, Pittsburgh-Corning, Trymer, IIG, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.02 PIPE INSULATIONS

A. Type PI-A: Glass Fiber: Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547 and meet ASTM C 585 for sizes required in the particular system. UL 723 or ASTM E84 compliant for Flame Spread Index of 25 or less and Smoke Developed Index of 50 or less. For all fluid distribution temperatures below 45□F the system shall be of a wicking type.
   1. Fiberglass, Non-Wicking:
      a. Manufacturers:
         1) Johns Manville Micro-Lok HP meeting ASTM C547; or FSK faced Micro-Flex (pipe sizes larger than 18")
         2) Owens Corning SSL II
         3) Knauf
         4) einsulation
      b. Applications: Insulation of piping up to 18" in diameter and 3" thick insulation.
      c. 'K' Value: 0.23 at 75°F.
      d. Maximum Service Temperature: 850°F.
      e. Vapor Retarder Jacket: AP-T PLUS white kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples or vapor barrier mastic as needed.

B. Type PI-B: Flexible Elastomeric Closed Cell Thermal Insulation: Armacel AP Armaflex, Rubatex K-Flex ECO, Aeroflex Aerocel, closed-cell, halogen free, elastomeric insulation. Comply with ASTM-C177, ASTM E 84 and UL 181.
   1. 'K' Value: 0.27 at 75°F.
   2. Density: 3.0 to 6.0 lbs./cu.ft.
   3. Maximum Service Temperature: 260°F.
   4. Seal all seams and joints with contact adhesive.

C. Type PI-C: Cellular Glass- Pittsburgh-Corning Foamglas Meeting ASTM C522: Cellular Glass Thermal Insulation:
   1. 'K' Value: 0.35 at 75°F.
   2. Density: 8.0 lbs./cu. ft.
   3. Maximum Service Temperature: 900°F.
   4. Provide with Pittsburg Corning Pittwrap jacketing.

D. Field Applied Jackets (For Interior Applications):
   1. All longitudinal seams shall be located on bottom of pipes.
   2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.
   3. Canvas Jacket: UL listed fabric, 6 oz/sq. yd. plain weave cotton, treated with dilute fire retardant lagging adhesive.

4. Aluminum Jacket: 0.016" thick sheet, [smooth/embossed] finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.
5. Secure aluminum jackets with 3/8" or ½" stainless steel bands on 12" centers.

E. Field Applied Jackets (For Exterior Applications):
1. All longitudinal seams, on horizontal pipe runs, shall be installed on the bottom of pipes.
2. Aluminum Jacket: 0.016" (minimum) thick sheet, [smooth/embossed] finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.
3. Stainless Steel Jacket: Type 304 stainless steel, 0.010" minimum (smooth/corrugated) finish.
4. Secure stainless steel or aluminum jackets with ⅜" or ½" stainless steel bands on 12" centers.
5. Manufacturers: Pabco, Childers, RPR, or approved equal.

F. Removable Covers:
1. Provide removable covers on pumps, backflow devices, valves greater than 2", flanges, strainers, etc., where periodic maintenance or removal of insulation may is required.
2. Use of pre-molded fittings with PVC covers is acceptable, unless noted otherwise.
   a. Cold systems: Provide PVC covers on elbows.
   b. Cold systems: Provide Armaflex elastomeric foam for flanges, valves, pumps and strainers.
   c. Hot systems: provide PVC covers on elbows and flanges.
   d. Hot Systems: provide removable blanket covers on valves, pumps, and strainers.
3. Removable- type silicon cloth fiberglass filled insulating blankets:
   a. Mfg: Fit Tight Covers, GLT products, or equal custom fabrication by Insulation Contractor, 0-350□F service operating temperature:
      1) Jacket: silicon impregnated fiberglass cloth
      2) Liner: silicon impregnated fiberglass cloth
      3) Liner reinforcement: stainless steel mesh cloth
      4) Insulation: 1" type E glass matt
      5) Fastening: 2" nomex Velcro
      6) Fastening: 1" straps and stainless steel D-rings
      7) Fastening: 12 gage stainless steel hooks and stainless steel wire
      8) Thread: Kevlar/stainless steel thread

2.03 EQUIPMENT INSULATIONS

A. Type EI-A: Flexible Fiberglass Blanket: Johns Manville Microlite Type 75 Flexible Blanket:
1. 'K' Value: ASTM C518, 0.27 Btu□in./(hr□ft²□°F) at 75°F installed full thickness.
2. Maximum Service Temperature: 250°F.
3. Density: 0.75 lb/cu ft.
4. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with fiberglass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.

B. Type EI-B: Rigid Fiberglass Board: Johns Manville Spin-Glass 814:
1. 'K' Value: ASTM C518, 0.23 Btu□in./(hr□ft²□ºF) at 75°F.
2. Maximum Service Temperature: 250°F.
3. Density: 3.0 lb/cu ft.
4. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with fiberglass yarn and laminated to fire-resistant kraft, secured with UL listed pressure

sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.
5. Facing: 1" galvanized hexagonal wire mesh stitched on one face of insulation. (Optional.)

C. Type EI-C: Cellular Glass: Pittsburgh-Corning Foamglas Meeting ASTM C552; Cellular Glass Thermal Insulation:
1. 'K' Value: 0.35 at 75°F.
2. Density: 8.0 lb/cu. ft.
3. Maximum Service Temperature: 900°F.

D. Type EI-D: Flexible Elastomeric Closed Cell Thermal Insulation: Armacel AP Armaflex, Rubatex K-Flex ECO, Aeroflex Aerocel, closed-cell, halogen free, elastomeric insulation. Comply with ASTM-C177, ASTM E 84 and UL 181.
1. 'K' Value: 0.27 at 75°F.
2. Density: 3.0 to 6.0 lbs./cu.ft.
3. Maximum Service Temperature: 260°F.
4. Seal all seams and joints with contact adhesive.

E. Type EI-E: Hydrous Calcium Silicate Johns Manville, IIG Thermo-12/Gold Meeting ASTM C533; Rigid Molded Block; Asbestos-Free Coded Throughout Material Thickness and Maintained Throughout Temperature Range:
1. 'K' Value: 0.40 at 300°F.
2. Maximum Service Temperature: 1,200°F.
3. Compressive Strength (block): Minimum of 200 psi to produce 5% compression, based on 1½" thickness.
4. Securement: Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge galvanized or stainless steel wire or ½" x .015" galvanized steel bands on 12" maximum centers for large areas.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that piping has been tested for leakage in accordance with specifications before applying insulation materials. All piping shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.02 INSTALLATION

A. General:
1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
2. Remove and replace any insulation that has become wet or damaged during the construction process.
3. Continue insulation and vapor barrier at penetrations and supports, except where prohibited by code.

B. Piping Insulation:
   1. Locate insulation and cover seams in least visible locations unless otherwise specified.
   2. Neatly finish insulation at supports, protrusions, and interruptions.
   3. Insulate all hot water and cold water pipes as defined in the following tables.
   4. Provide vapor retardant jackets on all insulated dual temperature pipes and cold pipes, and drain pipes, conveying fluids below 60°F with self-sealing laps. Insulate complete system. No staples shall be used on pipes conveying fluids below ambient temperatures (cold systems).
   5. For insulated pipes conveying fluids above 105°F, secure jackets with self sealing lap or outward clinched, expanded staples. Seal ends of insulation at equipment, flanges, and unions.
   6. Provide insert between support shield and piping on piping 1-1/2” diameter or larger. Fabricate of Johns Manville Thermo-12, or other heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:
      a. 1-1/2" to 2-1/2" pipe size 10" long
      b. 3" to 6" pipe size 12" long
      c. 8" to 10" pipe size 16" long
      d. 12" and over 22" long
   7. Use of metal saddles is acceptable as specified in Section 22 0500. Fill interior voids with segments of insulation matching adjoining pipe insulation.
   8. Use of pipe hangers designed as an insulation coupling is acceptable in lieu of saddles and other devices. Klo-Shure coupling or equal.
   9. For pipe exposed in mechanical equipment rooms or in finished spaces below 7 feet above finished floor, finish with Johns Manville Zeston 2000 PVC jacket and fitting covers.
      a. Where pumps, valves, strainers, etc., with insulation require periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.
      b. Cold systems: Provide Armaflex elastomeric foam for pumps and strainers.
   10. Insulate all sanitary sewer pipes and drainage fixture bodies where piping is located above food preparation, food handling and patient healthcare areas conveying fluids below 60°F.
   11. For exterior applications:
      a. Provide weather protection jacket. Insulated pipe lengths, pumps, fittings, joints, and valves shall be covered with aluminum jacket or stainless steel jacket. Jacket seams shall be located on bottom side of horizontal piping. All lateral joints shall be caulked with a minimum 20-year silicone sealant (clear). All longitudinal joints, except those at the bottom of a horizontal pipe run, shall be caulked with a minimum 20-year silicone sealant (clear).
      b. Apply weather-resistant protective finish such as WB Armaflex to flexible elastomeric insulation. Insulation seams shall be located on the bottom side of horizontal piping. All lateral and longitudinal joints to be sealed with low V.O.C., UV inhibitive adhesive, such as Armaflex 520 BLV adhesive.
   12. For underground installations, install per manufacturer's written instructions and recommendations.
   13. When maintenance or service access for equipment will result in foot traffic over floor mounted insulated piping the contractor is to fabricate a permanent removable walkway to prevent damage to the piping and insulation.

C. Equipment Insulation:
   1. See Piping Insulation above for additional requirements.
   2. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands, per manufacturer’s recommendations.

3. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retardant cement.
4. Provide insulated dual temperature equipment or cold equipment containing fluids below ambient temperature with vapor retardant jackets.
5. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.
6. Cover insulation with metal mesh and finish with heavy coat of insulating cement, mastic, or aluminum jacket as indicated in the drawings.
7. For equipment in mechanical equipment rooms or in finished spaces, finish with Johns Manville Zeston 2000 jacketing and fitting covers or aluminum or stainless steel jacketing.
8. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
9. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage. Use of lace-on type insulation blankets is acceptable.

3.03 PIPING INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed State Energy Code requirements as noted below. Increase thickness 1/2" if exposed to exterior ambient air. Minimum thermal resistance in range of 4.2 to 4.6 per inch of thickness. Insulation thicknesses are based on fiberglass insulation and may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. Insulation Table:

SERVICE	PIPE SIZE (inches)	THICKNESS (inches)	REMARKS/MATERIAL OPTIONS
Domestic hot water.	Up to 2 2-1/2 and over	1 1-1/2	Type PI-A or B
Domestic hot water return.	All Sizes	1	Type PI-A or B
Safety shower tempered water – indoors.	All Sizes	N/A	Not required for indoor piping
Safety shower tempered water - outdoors	All sizes	1	Type PI-A or B
Domestic cold water.	All Sizes	1	Type PI-A or B
Roof and overflow roof drainage.	Up to 2 2-1/2 and over	1	Type PI-A or B within 20 linear feet of drain body
Roof and overflow drain bodies.	All sizes	1	Type PI-B
Heat-Traced liquid containing piping exposed to freezing.	All Sizes	1-1/2	Type PI-A or B. Provide aluminum jacket and label "heat traced" along with service designator label
Plumbing vents within 10 feet of the exterior in freezing climates.	All Sizes	1	Type PI-A or B
Misc. drains from electric water coolers, ice machines, etc.	All Sizes	1	Type PI-A or B
Sanitary drain pipes and fixture bodies located above healthcare spaces and food service areas conveying fluid below 60°F.	All Sizes	1	Type PI-A or B
Cooling coil condensate drain	All Sizes	1/2	Type BI-B. Provide on all

SERVICE	PIPE SIZE (inches)	THICKNESS (inches)	REMARKS/MATERIAL OPTIONS
pipes.			pipe sizes, except where piping is located exterior to the building or at floor level routed adjacent to air handling equipment in mechanical rooms. Coordinate with Division 23.
Pumped discharge - waste and storm drainage.	All Sizes	1	Type PI-A or B. Required where pumped waste is installed exposed in an area subject to freezing.

A. Domestic Cold Water Insulation (Building Interior): For domestic cold water piping, not already insulated subject to freezing and which is located within the conditioned interior of the building and located in a humid climate or environment, shall be insulated for the first 100 feet of piping, from the point of building entry, with 1/2" (minimum) fiberglass insulation or elastomeric foam. Exposed cold water piping in restaurants and kitchen areas shall also be insulated to prevent condensation. Piping strategically installed inside insulated walls, roof or ceiling construction may not require additional insulation as deemed appropriate by the Owner's Representative.

B. TABLE 2: CODE MINIMUM PIPING INSULATION THICKNESS BASED ON FLUID TEMPERATURE AND PIPING SIZE.

1. California

Insulation Based on California T-24 Energy Code Table 120.3-A Minimum Pipe Insulation Thicknesses or Greater							
FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			<1	1 and 1-1/2	2 to <4	4 to <8	8 and larger
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating systems (steam, steam condensate and hot water) and Domestic Services Water Heating Systems							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.31	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	2.0	2.0	2.0
Space cooling systems (chilled water, refrigerant and brine)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.20-0.27	75	1.0	1.5	1.5	1.5	1.5

END OF SECTION

SECTION 22 10 00

PLUMBING PIPING, VALVES AND SPECIALTIES

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to the following:
   1. Pipe and Fittings
      a. Sanitary waste and vent
      b. Rainwater drain and overflow
      c. Potable Cold water
      d. Potable Hot water
      e. Fuel gas
   2. Valves
      a. Water valves
      b. Natural gas valves
      c. Seismic (earthquake) gas shutoff valves
      d. Balancing valves
      e. Backflow prevention valves
      f. Pressure reducing valves
      g. Gas pressure regulator valves
      h. Thermostatic mixing valves
      i. Solenoid valves
   3. Water meters
   4. Thermometers and gauges
   5. Piping specialties
   6. Pipe escutcheons
   7. Strainers
   8. Drip pans
   9. Air vent
   10. Dielectric unions
   11. Unions
   12. Flanges
   13. Pipe sleeves
   14. Sleeve seals
   15. Valve boxes
   16. Pipe coating
   17. Gas connectors

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 22 05 00: Basic Plumbing Materials and Methods, including:

1. Hangers and supports
2. Roof flashings
3. Water hammer arrestors
4. Trap primers
5. Cleanouts
6. Access panels
7. Identification

B. Section 22 30 00: Plumbing Equipment

C. Section 22 40 00: Plumbing Fixtures

D. Division 26: Electrical

E. Division 09: Finishes/Painting

1.04 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)/American Welding Society (AWS):
1. ANSI/AWS A5.8: Specification for Filler Metals for Brazing
2. ANSI/AWS A5.31: Specification for Fluxes for Brazing and Braze Welding
3. ANSI/AWS B2.2: Standard for Brazing Procedure and Performance Qualification
4. ANSI/AWS C3.4: Specification for Torch Brazing
5. ANSI LC4: Press-Connect Metallic Fittings for use in Fuel Gas Distribution System
6. ANSI/NSF 14: Plastics Piping System Components and Related Materials

B. American Society of Mechanical Engineers (ASME):
1. ASME Boiler and Pressure Vessel Code, latest edition
2. ASME B1.20.1: Pipe Threads, General Purpose
3. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
4. ASME B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
5. ASME B16.23: Cast Copper Alloy, Solder-Joint, DWV Drainage Fittings
6. ASME B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150 and 300
7. ASME B16.29: Wrought Copper, and Wrought Copper Alloy Solder-Joint Drainage Fittings, DWV
8. ASME B16.26: Cast Copper Alloy Fittings for Flare Copper Tubes
9. ASME B16.50: Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
10. ASME B16.51: Cast and Wrought Copper and Copper Alloy Press-Connect Pressure Fittings
11. ASME B31.8: Gas Transmission and Distribution Piping Systems

C. American Society for Testing and Materials (ASTM)
1. Mechanical Couplings: ASTM A 536, ductile iron, or ASTM A 47, malleable iron coupling housing fabricated to manufacturer's specifications
2. ASTM B584: Cast Copper Alloy for Grooved-End Fittings
3. ASTM B75: Seamless Copper Tube for Grooved-End Fittings
4. ASTM B32: Standard Specification for Solder Metal
5. ASTM B819: Standard Specification for Seamless Copper Tube for Medical Gas Systems
6. ASTM B88: Standard Specification for Seamless Copper Water Tube
7. ASTM B828: Standard Practice for Making Capillary Joints by Soldering Copper and Copper Alloy Tube and Fittings
8. Hard Copper Tube: (Drawn Temper)

a. ASTM B75: UNS Number C12200, drawn temper, seamless copper tube, wall thickness as specified
b. ASTM B88: Types K, L, and M, drawn temper, seamless copper tube
c. ASTM B306: Type DWV, drawn temper, seamless copper tube
d. ASTM B819: Type K and L, drawn temper, seamless copper tube
e. ASTM B837: Type GAS, drawn temper, seamless copper tube

9. Soft Copper Tube:(Annealed Temper)
   a. ASTM B75: UNS Number C12200, annealed temper, seamless copper tube, wall thickness as specified
   b. ASTM B88: Types K and L, annealed temper, seamless copper tube
   c. ASTM B280: Type ACR, annealed temper, seamless copper tube
   d. ASTM B837: Type GAS, annealed temper, seamless copper tube
10. ASTM B306: Copper Drainage Tube (DWV)
11. ASTM B584: Copper Alloy Sand Castings for General Applications
12. ASTM B813: Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
13. ASTM B819: Seamless Copper Tube for Medical Gas Systems
14. ASTM B828: Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
15. ASTM B837: Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems
16. ASTM D3311: Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
17. ASTM D2513: Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
18. ASTM A47: Ferritic Malleable Iron Castings
19. ASTM A536: Ductile Iron Castings
20. ASTM D1784: Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
21. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
22. ASTM F2014: Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications
23. ASTM F2389: Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems
24. ASTM F2618: Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems
25. ASTM F441: Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
26. ASTM F493: Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

D. Factory Mutual (FM):
   1. FM-1680: Standard to evaluate intended application for long-term connection to hubless cast iron soil pipe above and below ground. Class I for Industrial/Commercial and Residential to 15 psi working pressure.

E. National Fire Prevention Association (NFPA):
   1. NFPA-54/ANSI-Z223.1: National Fuel Gas Code
   2. NFPA-58: Liquefied Petroleum Gas Code

F. Joining Materials
1. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents and exterior environment.
a. ASME B16.21, nonmetallic, flat, asbestos-free, full-face type for Class 150 and 300 cast copper alloy flanges. 1/8-inch maximum thickness, except where thickness or specific material is indicated.
2. Mechanical Coupling Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents and exterior environment.
a. Gasket design shall be such that the entire coupling housing is isolated from the system contents to prevent galvanic action and inhibit galvanic corrosion.
3. Proprietary filler metals having compositions not conforming to the exact ANSI/AWS A5.8 classifications for BCuP and BAg Series filler metals shall be permitted when used according to the manufacturer's written instructions.
4. Soldering and Brazing Fluxes: Soldering and brazing fluxes having greater than 0.20-percent Lead (Pb) content are prohibited from use in potable water systems and shall not be used.
a. Soldering Fluxes: ASTM B813, liquid or paste type.
b. Brazing Fluxes: ANSI/AWS A5.31, Type FB3-A or FB3-C.
c. The use of brazing flux is not necessary if the components being joined are wrought copper tube, wrought copper fittings and the filler metal being used is of the BCuP series.

5. ASTM B32 Solder Filler Metal:
a. Alloy Sn95 or Alloy Sn94: Tin (Sn) approximately 95%, and Silver (Ag) approximately 5%, having 0.10% maximum Lead (Pb) content.
b. Alloy Sb5: Tin (Sn) 95%, and Antimony (Sb) 5%, having 0.20% maximum Lead (Pb) content.
c. Alloy E: Tin (Sn) approximately 95%, and Copper (Cu) approximately 5%, having 0.10% maximum Lead (Pb) content.
6. ANSI/AWS A5.8 Brazing Filler Metals:
a. BCuP Series: Copper-Phosphorus alloys. The following brazing filler metals shall be used. Brazing filler metals shall conform to the requirements of the individual piping systems.
1) BCuP - 2: Copper (Cu) and Phosphorus (P) 7.0 - 7.5%.
2) BCuP - 3: Copper (Cu), Phosphorus (P) 5.8 - 6.2%, and Silver (Ag) 4.8 - 5.2%.
3) BCuP - 4: Copper (Cu), Phosphorus (P) 7.0 - 7.5%, and Silver (Ag) 5.8 - 6.2%.
4) BCuP - 5: Copper (Cu), Phosphorus (P) 4.8 - 5.2%, and Silver (Ag) 14.5 - 15.5%.

1.05 QUALITY ASSURANCE

A. Manufacturers Qualifications:
1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

B. Codes and Standards:
1. All work shall be in full accordance with all applicable codes, ordinances and code rulings.
2. The Contractor shall furnish without any extra charge the labor and material required for compliance of codes.

3. Perform all tests required by governing authorities and as required under all Division 22 Sections. Provide written reports on all tests.
4. Electrical devices and wiring shall confirm to the latest standards of NEC; all devices shall be UL listed and so identified.
5. All plumbing work shall comply with the Americans with Disabilities Act (ADA).
6. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.
7. Provide thermostatic mixing valves and fixtures conforming to ASSE 1070 to limit the maximum water temperature to 110°F for all public lavatories and 120°F for all other public fixtures served with hot water. Handle position stops and temperature mixing valves shall be used as required to limit maximum temperature to prevent scalding. Water heater thermostats shall not be considered a suitable control.

C. All materials (such as piping, insulation, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 or UL 723. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified elsewhere in the construction drawings. Contractor shall review all mechanical and architectural plans and be fully aware of all building design criteria prior to installation of any work. Any work installed that does not comply with applicable life/safety requirements of all codes and standards shall be replaced and/or repaired at no additional cost to the Owner.

D. Welding Qualifications:
1. Steel Support Welding: Qualify procedures and personnel per the American Welding Society AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. Pipe Welding: Qualify procedures and operators per the ASME Boiler and Pressure Vessel Code: Section IX “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.”
   a. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation per pressure and temperature operating class.
   b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.06 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. CSA: Formerly known as the Canadian Standards Association (CSA). CSA Group is a member of ISO. CSA is accredited by US OSHA as a Nationally Recognized Testing Laboratory (NRTL).

C. Gas Appliance Pressure Regulator: A pressure regulator for controlling pressure to the appliance manifold.

D. Line Pressure Regulator: A pressure regulator placed in a gas line between the service regulator and the appliance regulator.

E. Lead Free: Materials containing not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect

to the wetted surfaces of pipes and pipe fittings, plumbing fittings, and fixtures, providing a specified definition and formula for determining “weighted average”.

F. NRTL: Nationally Recognized Testing Laboratory, including UL, CSA and/or ETL.

1.07 WORKING PRESSURES

A. All fittings, valves, pipe, specialties equipment shall be rated for the working pressure subjected in the installed locations.

B. Drawings indicate working pressure in each system. The rating of the equipment and material shall not be less than that of the system pressures.

C. Low pressure gas service generally includes pressures ranging from 7” to 11” (less than 0.5 psi) to serve gas appliances downstream of pressure regulators.

D. Medium pressure gas service generally includes pressures ranging from 0.5 psi to 5 psi to distribute gas downstream of utility provided service regulators.

E. High pressure gas service generally includes pressures greater than 5 psi including utility distribution pressures and additional installation restrictions where installed within buildings.

1.08 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data for all piping, valves and specialties indicating dimensions, valve CV, tolerances etc.

B. Shop Drawings: Submit shop drawings indicating underground piping installation showing all fittings with inverts. Indicate all footings and grade beams.

C. Maintenance Data: Submit maintenance instructions on accordance with requirements of Division 01.

1.09 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

C. Provide the additional extended warranty requirements that apply to all plastic piping systems with all types of joints and fittings.
   1. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.
   2. Contractor and Manufacturer warrant that, for a period of twenty-five (25) years from the date of Substantial Completion, the tubing will conform to the requirements of the Contract Documents and will be free from defects.

3. Contractor and Manufacturer warrant that, for a period of ten (10) years from the date of Substantial Completion, the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.
4. In addition to the Contractor's and Manufacturer's obligations set forth above and elsewhere, if, within two (2) years after the date of the Substantial Completion, any part of the system is found to be defective or not in accordance with the requirements of the Contract Documents, the Contractor or Manufacturer, or both, shall correct it at their own expense promptly after receipt of written notice from the Owner to do so.
5. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.
   1. All pipe, pipe fittings and valves shall be manufactured in North America, or may be import products where manufacturers are specifically identified below. Alternatives may be acceptable, but must be submitted and approved by the Owner's Representative prior to bidding.

OR

   2. Upon request, the Owner's Representative shall be furnished certification by the manufacturer, stating samples representing each lot have been tested and inspected as indicated in governing ASTM specifications have been met. Certification shall be accompanied by test reports as prepared in accordance with relevant ASTM sections governing Test Methods and Inspection. Tension Tests reports shall include breaking load, machined diameter of the test bars, and calculated tensile strength. Certification shall include the legal name and address of the manufacturer.

B. Type M copper piping is not acceptable for any pressure water piping unless specifically noted otherwise.

C. For all Grade B piping specified below grade provide a mill report with production identification numbers for piping submitted to permit tracking of pipe by mill and production lot.

D. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturer's names used herein, unless specifically noted that substitutes are not allowed.

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2.01 STANDARD PIPE AND FITTING

A. Domestic Water Pipe & Fittings (Below Grade):
   1. Seamless copper tube, pipe sizes 1/2" to 8":
      a. ASTM B88 or B75, Type K, annealed (soft) temper.
      b. ASTM B88 or B75, Type K, hard temper.
      c. ASTM B819, Type K, hard temper.
   2. Fittings-Brazed:
      a. ASME B16.50 wrought or copper alloy
   3. Joints:
      a. Brazed joints: ANSI/AWS A5.8 filler metals.
   4. For all piping installed below grade wrap pipe with two layers of 20 mil PVC tape, minimum 2" wide, with 50% overlap and no exposed pipe surface. Manufacturer: 3M Scotchrap #51, Pasco Specialty #9000 Series, or equal.

B. Domestic Hot and Cold Water Pipe & Fittings and Pumped Systems (Above Grade):
   1. Seamless copper tube, pipe sizes 1/2" to 8":
      a. ASTM B88 or B75, Type K or L, annealed (soft) temper.
      b. ASTM B88 or B75, Type K or L, hard temper.
      c. ASTM B819, Type K or L, hard temper.
   2. Fittings-Soldered:
      a. ASME B16.22 wrought copper alloy.
      b. ASME B16.18 cast copper alloy.
   3. Fittings-Brazed:

a. ASME B16.50 wrought or copper alloy.
4. Joints:
a. Soldered joints: ASTM B32 filler metals.
b. Brazed joints: ANSI/AWS A5.8 filler metals.
c. Manufacturer: Canfield, Sil-Fos, or equal.

C. Condensate and Indirect drains:
1. Seamless copper tube, pipe sizes 1/2” to 8”:
a. ASTM B88 or B75, Type L, annealed (soft) temper.
b. ASTM B88 or B75, Type M or L, hard temper.
c. ASTM B819, Type L, hard temper.
2. Fittings-Soldered:
a. ASME B16.22 wrought copper alloy
b. ASME B16.18 cast copper alloy
3. Fittings-Brazed:
a. ASME B16.50 wrought or copper alloy
4. Joints:
a. Soldered joints: ASTM B32 filler metals.
b. Brazed joints: ANSI/AWS A5.8 filler metals.
c. Manufacturer: Canfield, Sil-Fos, or equal.
5. Insulate condensate drain pipes with minimum 1/2" insulation to prevent moisture dripping from pipe.

D. Trap Primer Piping:
1. Seamless copper tube:
a. ASTM B88 or B75, Type K, annealed (soft) temper.
2. Fittings (below grade):
a. No joints allowed below grade or bottom slab level.
3. Fittings (above grade):
a. ASME B16.22 wrought copper alloy
b. ASME B16.18 cast copper alloy
4. Joints:
a. Soldered joints: ASTM B32 filler metals.
b. Manufacturer: Canfield, Sil-Fos, or equal.
5. PEX tubing may be allowed as an alternate material as approved by the local authority having jurisdiction.
6. For all copper piping installed below grade wrap pipe with two layers of 20 mil PVC tape, minimum 2” wide, with 50% overlap and no exposed pipe surface. Manufacturer: 3M Scotchrap #51, Pasco Specialty #9000 Series, or equal.

E. Sanitary Sewer, Vent, Rainwater Pipe & Fittings:
1. Pipe and Fittings: Cast iron, bituminous coated or epoxy coated with “No-Hub” fittings complying with ASTM A74, ASTM A888, CISPI 301. Manufactured by AB&I, Charlotte, Tyler, New Age or equal.
2. Couplings Below Grade: Heavy Duty Type 304 stainless steel couplings conforming to ASTM C1540 with heavy-duty shield and neoprene sealing sleeve conforming to ASTM C564, CISPI 301 and FM-1680. Minimum four bands up to 4” diameter and six bands for 5” and larger diameters. Manufacturer: Anaco Husky SD-4000, Clamp-All Hi-Torq 125, Ideal Tridon HD, Fernco Proflex or equal.
3. Couplings Above Grade: Type 301 or 304 stainless steel couplings conforming to ASTM C1540 with heavy-duty shield and neoprene sealing sleeve conforming to ASTM C-564, CISPI 310 and FM-1680. Manufacturer: Anaco Husky HD-2000, Clamp-All Hi-Torq 80, Mission Heavy Weight, Ideal Tridon MD, Frenco Proflex, or equal.

F. Rainwater Leader Pipe and Fittings-Alternative for Exposed Areas Above Grade:
   1. Seamless copper tube, pipe sizes 1-1/4" to 8":
      a. ASTM B306, DWV class, hard temper.
      b. ASTM B88 or B75, Type K or Type L, hard temper.
   2. Fittings: ASME B16.23 cast copper alloy solder joint drainage fittings, DWV.
   3. Joints:
      a. Soldered joints: ASTM B32 filler metals.
      b. Brazed joints: ANSI/AWS A5.8 filler metals.

G. Aboveground Sanitary Sewer and Rainwater Forced Mains (Pumped Discharge):
   1. Seamless copper tube, pipe sizes to 8":
      a. ASTM B88 or B75, Type K or L, hard temper.
      b. ASTM B819, Type K or L, hard temper.
   2. Fittings-Soldered:
      a. ASME B16.22 wrought copper alloy
      b. ASME B16.18 cast copper alloy
   3. Fittings-Brazed:
      a. ASME B16.50 wrought or copper alloy
   4. Joints:
      a. Soldered joints: ASTM B32 filler metals.
      b. Brazed joints: ANSI/AWS A5.8 filler metals.
      c. Manufacturer: Canfield, Sil-Fos, or equal.

H. Alternate Aboveground Sanitary Sewer and Rainwater Forced Mains (Pumped Discharge):
   1. Galvanized-steel pipe:
      a. ASTM A53 Schedule 40, pressure fittings, and threaded joints.
      b. Pressure rated transition coupling where connecting to dissimilar materials.

I. Underground Sanitary Sewer and Rainwater Forced Mains (Pumped Discharge) shall be one of the following:

   1. Hard temper copper tube:
      a. Seamless copper tube, pipe sizes to 8":
         1) ASTM B88 or B75, Type K, hard temper.
         2) ASTM B819, Type K, hard temper.
      b. Fittings-Brazed:
         1) ASME B16.50 wrought or copper alloy
      c. Joints:
         1) Brazed joints: ANSI/AWS A5.8 filler metals.
         2) Manufacturer: Canfield, Sil-Fos, or equal.
   2. Ductile Iron:
      a. Pipe (Sizes 2" and larger): ANSI/AWWA C150/A21.50, ductile iron for grooved-joint piping and grooved joints.
      b. Fittings: Mechanical grooved-end couplings, carbon steel or ductile iron or 316 stainless steel. Painted or galvanized. ASTM A536 compliant. 316 Stainless-steel bolts and nuts. EPDM-rubber gaskets. Minimum Pressure Rating: 250 psig. Manufacturers: Victaulic #31, Anvil (Gruvlok), Grinnell, Shurjoint, or equal.

   3. For all metallic piping installed below grade wrap pipe with two layers of 20 mil PVC tape, minimum 2" wide, with 50% overlap and no exposed pipe surface. Manufacturer: 3M Scotchrap #51, Pasco Specialty #9000 Series, or equal.

J. Domestic Hot and Cold Water Pipe & Mechanical Fittings-Alternate for Non-Pumped Systems with Pre-Approval (Above Grade):

1. Pipe: ASTM B88, Type L, hard drawn copper water tube.
2. Fittings: Domestic Water Pipe Fitting (See Part 3): Copper press fittings shall conform to the material and sizing requirements of ASME B16.22. O-rings for copper press fittings shall be EPDM. Viega/Ridgid #ProPress and MegaPress, Elkhart #ApolloXpress, or approved equal.
3. Warranty-Additional Requirements for Mechanical Fittings.
    a. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.
    b. Contractor and Manufacturer warrant that, for a period of ten (10) years from the date of Substantial Completion, the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.
    c. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

K. Natural Gas Pipe & Fitting (Above Grade):
1. Pipe: ASTM A53, Schedule 40 black steel.
2. Fittings: 150 lb. rating, ASME B16.3, malleable iron threaded; ASME B16.5, flanged; ASME B16.9, steel.
3. Joints 2" and smaller: Threaded in accessible areas. Welded in concealed areas such as shafts and plenums.
    a. Optional: Steel compression fittings shall conform to the material and sizing requirements of ASME B16.3 or ASTM A420. Fittings shall have an HNBR O-ring seal, 420 stainless steel grip ring, and 304 stainless steel separator ring. Viega #MegaPress G, or approved equal.

4. Joints 2-1/2" and larger: ASME B16.25 bevelweld, ASME B16.5 flanges, or ASME B16.11 socket weld. Welded in concealed areas such as shafts and plenums.
5. Welded Fittings: Comply with ASTM A234/A234M, ASME B16.9, ASME B16.25, and ASME B16.11.
    a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
    b. Shop fabricated Bonney Forge “Weldolet” or “Thredolet” type fittings may be used in lieu of tee fittings, but field (site) welding will not be permitted.

L. Natural Gas Piping (Below Grade):
1. Polyethylene, plain ends, heat fused joints. Compliant with ASTM D-2513, ASME D-B31.8, NFPA-54 and NFPA-58. Manufacturer: Gastite or equal.
2. Building gas service riser, annodeless polyethylene to steel riser, epoxy coated steel. Manufacturer: Lyall Lyco or equal.

2.02 PIPE COATINGS AND WRAPPING

A. Pipe coatings and/or wrapping may be required for certain pipe materials where pipes are buried in corrosive soils or located in corrosive air environments. Verify local soil and air conditions with building department and soils report, when available. Protect all underground buried steel and copper pipe and fittings. Protect all aboveground exposed steel and copper

pipe and fittings located in corrosive air environments. Buried cast iron does not require protection unless specifically required by the AHJ or project Soils Report.

B. Provide buried pipe protection using one of the tape following methods:
   1. Wrap pipe with two layers of 20 mil PVC tape, minimum 2" wide, with 50% overlap and no exposed pipe surface.
   2. Or, cover with pre-fabricated extruded plastic cover with joints sealed with two layers of 20 mil PVC tape.
   3. Manufacturers: 3M Scotchrap #51, Pasco Specialty #9000 Series, or equal.

C. Provide buried pipe protection using one of the coating following methods:
   1. Apply general purpose black asphalt paint to exposed buried piping to prevent corrosion. All surfaces should be clean, dry, and free of oil, grease, dirt, loose paint, or other foreign matter. Brush or spray coating at a rate of 1 to 1.5 gallons per 100 sq.ft.
   2. Manufacturers: Karnak #118, or equal.

D. Furnish corrugated stainless steel tubing (CSST) with factory-applied corrosion–resistant polyethylene jacket for use in corrosive atmosphere. Coating properties include the following:

   1. Gastite corrugated stainless steel tube jacket shall be UV-Resistant polyethylene meeting the requirements of ASTM E84 for flame spread and smoke density.

2.03 VALVES: GENERAL

A. General: Valve ratings shall exceed respective system operating pressures by 50% (minimum). All valves shall be line size unless otherwise noted.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

C. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

D. Acceptable manufacturers (manufacturer and model number listed for individual valves indicates minimum acceptable by all manufacturers):
   1. Gate, Ball, Check or Butterfly: Apollo, Hammond, Nibco (commercial grade, US manufacturer only), Milwaukee, Victaulic or Watts.
   2. Lubricated Plug Valves: Homestead, Resun, or Rockwell.
   3. Backflow Preventors: Apollo, Ames, Febco, Cla-Val, Watts or Wilkins.
   4. Pressure Reducing Valves: Apollo, Cash-Acme, Cla-Val, Watts, or Wilkins.
   5. Solenoid Valves: ASCO, Automatic or Magnatrol.
   6. Circuit Setters: Griswold (Venturi with characterized ball valve only), Wheatley (Y-globe type only), Armstrong, CircuitSolver, or Tour & Anderson.

E. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on the valve body.

F. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, other than plug valves. Provide one wrench for every 10 plug valves, and one in each size. Provide extended levers/stems for valves on

insulated lines. For manual valves 2-1/2" and larger located 8 feet above the floor in mechanical rooms provide chain operator to permit operating the valve from 4'-0" above floor.

G. Valve Features:
1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
2. Drain: Comply with MSS SP-45, and provide threaded pipe plugs.
3. Flanged: Valve flanges complying with ASME B16.1 (cast iron), ASME B16.5 (steel), or ASME B16.24 (bronze).
4. Threaded: Valve ends complying with ANSI B2.1.
5. Solder-Joint: Valve ends complying with ASME B16.18.
6. Flangeless: Valve bodies manufactured to fit between flanges complying with ASME B16.1 (cast iron), ASME B16.5 (steel), or ASME B16.24 (bronze).

2.04 DOMESTIC PLUMBING SERVICE VALVES

A. Ball Valves:
1. 2" and Smaller: 600 psi, 2-piece, bronze body, soldered ends for copper pipe and threaded ends for iron pipe, chrome plated brass ball, Teflon seat, brass stem, steel handle, full port, low lead compliant. Apollo Lead Free #77CLF Series or equal.

B. Butterfly Valves:
1. 2-1/2" and Larger: MSS SP-67, lug wafer, ductile iron body, stainless steel disc, stainless steel stem, EPDM seat, low lead compliant, memory stop control, lever handle thru 5" size and worm gear operator for 6" and larger. Mount stem in horizontal position. Apollo #LD141/WD141 Series or equal.

C. Check Valves:
1. 2" and Smaller: Class 125, MSS SP-80, ASTM B62 and ASTM B16, cast bronze body, soldered ends for copper pipe, screwed cap, swing type, Teflon bronze disc, low lead compliant. Apollo Lead Free #163LF Series or equal.
2. 2-1/2" and Larger: Class 125, MSS SP-71, ASTM A126 class B cast iron body, bolted bonnet flanged ends, bolted cap, swing type, cast iron disc with bronze face rings, low lead compliant. Apollo Lead Free #910F Series or equal.
3. Vertical or High Flow: Class 125, cast bronze, high-flow body, TFE seat, brass check, low lea compliant, stainless steel guide and spring. Apollo Lead Free #61LF Series or equal

D. Angle Stop Valves:
1. Heavy duty 1/4 turn commercial stop, brass body, chrome plated, 125 psi working pressure, ASME A112.18.1, low lead compliant. Provide with loose key handle in public access spaces for vandal resistance. Chicago Faucets #ST Series, Brasscraft #KT Series, or equal.

2.05 NATURAL GAS, LP GAS AND OIL SERVICE VALVES

A. General: All valves to be UL listed for the required fluid service.

B. Ball Valves:
1. 1/2" and 3/4": Brass body, UL listed, CSA approved for pressure of system, bronze ball valve, 175 WOG, with integral lever handle. Apollo #77F Series, Watts #FBV-1 or equal.

2. 1" thru 1-1/2": 175 psi working pressure, CSA and UL approved, bronze body, welded ends, stainless steel ball, stainless steel stem, steel handle with memory stop tab, conventional port. Apollo #77F-140 Series or equal.
3. Lubricated Plug Valve, 2" and Larger: Class 125, MSS SP-78, 200 PSI, UL listed, CSA approved for pressure of system, lubricated plug type, semi-steel body, loose wrench operated, straight way pattern round port, combination button head fitting and lubricant screw, Teflon seal and discs.

C. Seismic (Earthquake) Gas Shutoff Valves:
1. 3/4” thru 2” (low and medium pressure, screwed body): UL Listed valve meeting ASCE 25-97, positive closure, soft seal seating, visual open-close indicator, manual reset, and closure time interval within 5 seconds when subjected to a sinusoidal oscillation with peak acceleration of 0.3G and a period of 0.4 seconds. California Valve Series EV, Pacific Seismic Products, or equal, sized for 0.5 PSI or 20 PSI max operating pressure, respectively.
2. 2”, 3” and 4” (High pressure, screwed body): UL Listed valve meeting ASCE 25-97, manual reset, soft seat construction for positive sealing, visual open-close indicator, tripping mechanism with non-creeping rolling latch, and closure time interval within 5 seconds when subjected to sinusoidal oscillation with peak acceleration of 0.3G and a period of 0.4 seconds. California Valve Series EV315, Pacific Seismic Products or equal, sized for 20 psi maximum operating pressure.
3. 6” (high Pressure, Flanged body): UL Listed valve meeting ASCE 25-97, manual reset, soft seat construction for positive sealing, visual open-close indicator, tripping mechanism with non-creeping rolling latch, and closure time interval within 5 seconds when subjected to sinusoidal oscillation with peak acceleration of 0.3G and a period of 0.4 seconds. California Valve Series EV317, Pacific Seismic Products or equal, sized for 60 PSI maximum operating pressure.

2.06 BALANCING VALVES: MAXIMUM 125 PSIG SYSTEM WORKING WATER PRESSURE

A. Pressure Dependent Water Flow:
1. 1/2" and Larger: Construction and attachment style as required by piping system. Ball or globe valve design with memory stop. Valves shall be field adjustable. Install in pipe with minimum length of unrestricted straight pipe equivalent to five pipe diameters upstream and two pipe diameters downstream. Presso #Venturi B-Plus series, Armstrong, Tour & Anderson, or equal.

2.07 BACKFLOW PREVENTION VALVES

A. General: All backflow prevention valves shall be State approved and listed.

B. Reduced Pressure Principal Backflow Prevention Assembly for High Hazard Applications:
1. 2" and Smaller: Assembly shall consist of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies shall be lead free and include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1013 and AWWA C511. Bronze construction, threaded ends, stainless steel internal parts, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Apollo #RP4ALF Series valve with #AGD4A air gap fitting, Watts #LF009 Series with #909 air gap fitting, or equal.
2. 2-1/2" and Larger: Assembly shall consist of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies shall be lead free and include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1013 and AWWA C511. Stainless Steel body construction, flanged ends, center stem guided check valves, and air gap fitting.

Route pipe from air gap fitting to approved waste receptor. Apollo Lead Free #RP4ALF-OS&Y valve with #AGD4A air gap fitting, Watts #LF9090 Series with #909 air gap fitting, or equal.

C. Double Check Valve for Low Hazard Applications:
   1. 2" and Smaller: Assembly shall consist of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts. Apollo Lead Free #DC4ALF Series or equal.
   2. 2-1/2" and Larger: Assembly shall consist of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C506. Epoxy coated cast iron body construction, flanged ends, and stainless steel internal parts. Apollo Lead Free #DC4ALF Series or equal.

D. Atmospheric Vacuum Breaker: Assembly shall consist of a bronze vacuum breaker body with silicone disc, and full size orifice. Device shall be IAPMO listed, lead free and comply with ASSE 1011. Chrome plated in finished occupied areas. Apollo #HB Series or equal.

E. Pressure Vacuum Breaker: Assembly shall consist of a bronze or stainless steel body, with stainless steel spring loaded check, lead free, atmospheric vent and ASSE 102 compliant. Chrome plated in finished occupied areas. Apollo #PVB Series or equal.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers: Assembly shall consist of a non-metallic body, Acetal or equal, or stainless steel for corrosion resistance. Assembly shall include replaceable/repairable check valves, strainer, atmospheric vent, and ASSE 1022 and ANSI/NSF-61 compliant. Apollo #CBBP Series or equal.

2.08 PRESSURE REDUCING VALVES

A. Single seated, direct operated type; high capacity, having bronze body with strainer, by-pass feature, pressure gauge tappings and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and fail-off at inlet and outlet pressure indicated. Apollo Lead Free #36HLF Series or equal by Watts or Cash Acme.

B. Single seated, pilot operated globe valve type having ductile iron body with FDA approved epoxy coating inside and out, with Y strainer, stainless steel seat, FDA approved diaphragm, copper control tubing, pressure gauge tappings and complying with requirements of ANSI Standard A112.26.2. Select proper size for maximum flow rate and fall-off at inlet and outlet pressure indicated. Apollo #A108 series or equal by Watts or Cash Acme.

2.09 PRESSURE RELIEF VALVES

A. Pressure Relief Valve: Lead free bronze body construction, thermostat and test lever, and initial pressure relief set at 125 psi (adjust for system requirements). Certified to meet ASME low pressure heating boiler code.

B. Manufacturers: Watts #LF3L, Cash Acme #LFF-95 Series or equal.

2.010 TEMPERATURE AND PRESSURE RELIEF VALVES

A. Temperature and Pressure Relief Valve: Lead free bronze body construction, thermostat and test lever, temperature relief set at 210^0F, and pressure relief set at 125 psi. Certified to meet ASME low pressure heating boiler code and ANSI Z21.22.

B. Manufacturers: Watts #LF Series (100XL, 40, 140, N240, 340), Cash Acme #FVX Series or equal.

2.011 GAS PRESSURE REGULATOR VALVES – VENTED

A. Operation: Direct operated lever acting, spring-loaded diaphragm style with adjusting screw and vent connection port.

B. Gas capacity and pressure as indicated in schedules on drawings:
   1. Maximum inlet pressure: 5 psi.
   2. Minimum inlet pressure: 1 psi.
   3. Outlet pressure range: 7-14 inches w.c. as required by appliances.
   4. Ambient temperature limits: -40°F to 205°F (-40°C to 96°C).

C. Body: Steel, cast iron, aluminum or ductile iron construction as required for application.

D. Line gas pressure regulators shall be listed as complying with ANSI Z21.80/CSA 6.22. Regulators shall be approved for use by the serving gas supplier.

E. Where gas supply regulator will be located indoors provide internal relief valve with overpressure protection and set to discharge at 10% above equipment operating setpoint. Route relief vent pipe to exterior of building in compliance with code.

F. Manufacturer: Maxitrol #325 or #210 Series, Emerson Fisher #CS Series, Pietro Fiorentini Governor #30000 Series, Sensus #243 Series, Elster American Meter (Honeywell) #1800 Series, or equal.

2.012 GAS PRESSURE REGULATOR VALVES (LINE PRESSURE) – VENT LIMITING

A. Operation: Direct operated lever acting, spring-loaded diaphragm style with adjusting screw and vent connection port.

B. Gas capacity and pressure as indicated in schedules on drawings:
   1. Maximum inlet pressure: 2 psi.
   2. Minimum inlet pressure: 1 psi.
   3. Outlet pressure range: 7-14 inches w.c. as required by appliances.
   4. Ambient temperature limits: -40°F to 205°F (-40°C to 96°C).

C. Body: Steel, cast iron, aluminum or ductile iron construction as required for application.

D. Line gas pressure regulators shall be listed as complying with ANSI Z21.80/CSA 6.22. Regulators shall be approved for use by the serving gas supplier.

E. Where gas supply regulator will be located indoors provide with vent limiting device for installation in ventilated (occupied) spaces. Vent piping to outdoor is not required. Install per manufacturer's installation instructions.

F. Manufacturer: Maxitrol #325 Series with vLimiter, Pietro Fiorentini Governor #30000 Series with vent limiter, Elster American Meter (Honeywell) #J48 with vent limiter, or equal.

2.013 THERMOSTATIC MIXING VALVE – LAVATORIES AND BATHTUBS

A. Mixing valve shall be ASSE 1070 (Performance Requirements for Water Temperature Limiting Devices) compliant with adjustable and lockable means to limit the hot water temperature setting for individual fixtures such as lavatories and bathtubs. Where fixtures have integral ASSE 1070 compliant valves there is no additional requirement for upstream temperature limitation control. Provide valve for individual fixtures or combined flows up to 6 gpm.

B. Refer to drawings for locations, capacities, pressure drops, flow rates, and models.

C. Thermostatic valve constructed of brass, bronze or stainless steel body, with screwdriver locking temperature regulators, check stops, removable/replaceable cartridge, stainless steel piston, brass pipe fittings, and unions. Interior parts in standard rough bronze, nickel or chrome finish. Valve shall be lead-free.

D. Provide wall mounting bracket where valve is installed inside a concealed cabinet. Provide chrome or nickel plated body where installed exposed under a lavatory. Provide stainless steel cabinet with wall mounting bracket for all other applications.

E. Manufacturers: Chicago Faucet #131 Series, Symmons #Maxline 7 Series, Apollo #34 Series, Leonard #LF Series or equal.

2.014 THERMOSTATIC MASTER MIXING VALVE ASSEMBLY – HIGH/LOW FLOW

A. Master mixing valve assembly shall be ASSE 1017 certified and meet low lead requirements of wetted surface area containing less than 0.24% lead by weight. Compliant with ASME A112.18.1/CSA B125.2, CA 116875 and NSF 372. For master flow rates serving multiple fixtures with a demand greater than 6 gpm.

B. Factory assembled cabinet with two thermostatic mixing valves to serve broad range of flow conditions and adjustable to leaving water temperature of 140°F. Refer to drawings for locations, capacities, pressure drops, flow rates, and models.

C. Full cabinet enclosure for all components. Stainless steel or powder coated steel cabinet for recessed or surface mounting with hinged access door. Refer to drawings for mounting requirements. Top or bottom water supplies as required. Provide access door with cylinder lock. Finish color as selected by Architect or Owner's Representative.

D. Thermostatic valve constructed of brass and stainless steel, with screwdriver locking temperature regulators, pressure reducing valve, check stops, removable/replaceable cartridge, stainless steel piston, ball valves, two pressure gauges, bimetal dial thermometer (20°F to 200°F range), brass pipe fittings, and unions. Interior parts in standard rough bronze, nickel or chrome finish.

E. Manufacturers: Leonard #TM Series or equal.

2.015 WATER METERS

A. Water meter shall have a mechanical drive with hermetically sealed registers; meter shall be equal to or exceed AWWA Standards and shall have an all bronze case. Meter shall also

include “dual-output” capability using a programmable frequency pulse output compatible with BAS (Building Automation System) integration. Coordinate BAS integration requirements with BAS Controls Installer for monitoring and trend logging of water use (gallons). Provide water meter with shutoff valves on each side of meter. Provide flanges on valves and support stands or wall brackets for meter support. Meter shall be approved for use by local water district.

B. Manufacturers: Hersey Products, Niagara, Rockwell, Mueller, Neptune, Sensus or equal.

2.016 GAS UTILITY METERS

A. Gas meter shall be approved for use by local gas district.

B. Meter shall include “dual-output” capability using a programmable frequency pulse output compatible with BAS (Building Automation System) integration. Coordinate BAS integration requirements with BAS Controls Installer for monitoring and trend logging of natural gas use.

C. Provide gas meter with shutoff valves on each side of meter

2.017 BACKWATER VALVE

A. Provide backwater sewer valve in gravity discharge piping to protect the ground floor, and lower levels of the sanitary sewer system, where any floor levels are below the next upstream street manhole cover.

B. Fixtures installed on a floor level that is lower than the next upstream manhole cover of the public or private sewer shall be protected from backflow of sewage by installing an approved type of backwater valve. Fixtures on such floor level that are not below the next upstream manhole cover shall not be required to be protected by a backwater valve. Fixtures on floor levels above such elevation shall not discharge through the backwater valve. Cleanouts for drains that pass through a backwater valve shall be clearly identified with a permanent label stating "backwater valve downstream.”

C. Cast iron body with backwater valve, bolted cover, and wheel handle to provide complete closure. Valve design shall permit access to backwater valve assembly, for servicing or cleaning, through a "full opening" bolted cover or threaded cover. Provide full-size, cast iron, soil pipe extension to field-installed cleanout at floor level. Provide 30” diameter fiberglass or cast iron basin with access top appropriate for finished floor surface or grade level.

D. Manufacturer: JR Smith #7050 Series, Zurn #Z1088, or equal.

2.018 SOLENOID VALVES

A. UL listed, globe pattern bronze valve with threaded ends, stainless steel pilot, bronze piston, malleable iron solenoid assembly with 1/2" tapped conduit connections and Class "A" coil, 120 Volt, 60 Hertz. Solenoid valve shall be wired to the Fire Alarm System. The valve shall close instantly on application of current and open when de-energized. Provide solenoid valve on gas line into boiler and water heating rooms where the aggregate gas input is over 400,000 Btuh. Wire to “mushroom” button(s) outside of each door to room.

2.019 THERMOMETERS AND GAUGES

A. General:

1. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.
2. No mercury shall be used in thermometers due to hazardous material classification.
3. Acceptable Manufacturers: Weksler, Winters, Trerice, Marshalltown or US Gauge.

B. Thermometers:
   1. Bi-Metal Type: Provide bi-metal glass thermometers of materials, capacities, and ranges indicated, designed and constructed in service indicated. Accuracy shall be 1% +/- full scale with adjustable recalibration.
      a. Case: Type 300 series stainless steel, hermetically sealed, glass window, 3" diameter dial, with adjustable angle.
      b. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
      c. Scale: Satin faced, non-reflective aluminum, permanently etched markings.
      d. Stem: Stainless steel, adjustable angle socket, length to suit installation.
   2. Glass Thermometer: Provide adjustable angle 9” thermometer of materials, capacities and ranges as appropriate to medium being measured and designed and constructed for service indicated. Accuracy to be 1% +/- of full scale.
      a. Case: Aluminum or reinforced plastic.
      b. Temperature Sensitive Gage Liquid: Organic non-toxic. No mercury permitted.
      c. Scale: Aluminum painted white with black markings.
      d. Connection: 1/2” NPT with thermowell or 1-1/4” UNF swivel nut without thermowell.
   3. Photovoltaic Cell Powered LCD Thermometer
      a. Case: ABS Plastic
      b. Accuracy: 1% of full scale.
      c. Display: 16 LUX rating LCD display. Switchable Fahrenheit and Celsius.
      d. Connection: 3/4” NPT with thermowell or 1-1/4” UNF swivel nut without thermowell.
   4. Conform to the following temperature ranges:
      1) Hot Water: 20°F - 240°F with 2°F scale divisions.
      2) Cold Water: -40°F - 160°F with 2°F scale divisions.

C. Thermometer Test Wells:
   1. Provide thermometer test wells as indicated, constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

D. Temperature Gauge Connector Plugs:
   1. Provide temperature gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" OD probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

E. Pressure Gauges:
   1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
   2. Type: General use, 1% accuracy ANSI B40.1 grade A, phosphor bronze bourbon type, bottom connection.
   3. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.
   4. Connector: Brass with ¼" male NPT.
   5. Scale: White coated aluminum, with permanently etched markings.

6. Pressure differential range shall be 100 psig minimum for the appropriate application with maximum 1 psig divisions.

F. Pressure Gauge Cocks:
   1. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Gauge cock constructed of brass with 1/4" female NPT on each end, and "T" handle brass plug.
   2. Syphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.
   3. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

G. Pressure Gauge Connector Test Plugs:
   1. Provide pressure gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Constructed of lead-free brass, with 1/4” or 1/2" NPT fitting, with self-sealing valve core type neoprene or Buna-N gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gauge. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

2.020 PIPING SPECIALTIES

A. General:
   1. Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option.

B. Pipe Escutcheons:
   1. Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.
   2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.
   3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.

C. Low Pressure Y-Type Pipeline Strainers:
   1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125% of the working pressure of piping system, with Type 304 stainless steel screens, with 3/64" perforations (233 @ 0.045" perforations per square inch).
   2. Threaded ends, 2" and smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with hose bibb. Sarco, Wheatley or Mueller.
   3. Flanged ends, 2-1/2" and larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with hose bibb. Sarco, Wheatley or Mueller.
   4. Grooved ends 2-1/2” and larger: Ductile iron body, bolted screen retainer with off center blowdown fitted with hose bibb. Victaulic or Gustin-Bacon.

D. Drip Pans:

1. Provide drip pans fabricated from 16-gauge galvanized sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top by structural angles. Provide hole, gasket, and flange at low point for watertight joint and 1" copper drain line connection. Extend 1" drain to nearest approved receptor.

E. Air Vent with Valves:
1. Cold water and hot water vent valve with 1/4 turn ball shut-off valve. Tapped at top for 1/8" or 1/4" NPT drain connection. Removable top and built-in check valve. Maximum operating pressure 75 psi. Maximum operating temperature 250^0F. Hoffman #79, Dole #75 or equal.

F. Dielectric Unions:
1. Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion. Watts #LF3000 Series or equal.

G. Dielectric Flanges:
1. Provide dielectric flanges for flanged transitions between dissimilar metal piping. Watts #LF3100 Series or equal.

H. Unions:
1. Unions shall be of type specified in following schedule:
   a. Black Steel, 2" and smaller: 250 lb. screwed malleable iron, ground joint, brass to iron seat.
   b. Black Steel, 2-1/2" and larger: 150 lb. cast iron screwed flanged, flat faced, full faced gasket.
   c. Soldered Copper or Brass Pipe, 2" and smaller: 150 lb. cast bronze or copper, ground joint, non-ferrous seat with soldered ends.
   d. Screwed Copper or Brass Pipe, 2" and smaller: 150 lb. cast brass, ground joint, brass to brass seat, with threaded ends.
   e. Flanged Copper or Brass Pipe, 2-1/2" and larger: two (2) 150 lb. cast bronze flanges.
   f. Manufacturer: EPCO, Mueller, Stanley G. Flagg, Watts, or equal.

I. Flanges:
1. Provide flanges at flanged connections to equipment, tanks and valves. Faces of flanges being connected shall be alike in all cases. Connection of raised-face flange to flat-faced flange not permitted.
2. Use ASTM A307, Grade B, bolts and nuts for cast iron flanges and ASTM A193 for steel flanges. Regular square head unfinished bolts with heavy semi-finished hex nuts ASTM A194. Cadmium plated where exposed to weather. Rating: 150 lb. or 300 lb. in high pressure portions.
3. Type of pipe and corresponding flanges as follows:
   a. Screwed Black Steel Pipelines: 125 lb. black cast iron screwed flange, flat faces.
   b. Welded Steel Pipe, 150 lb. black forges steel welding flanges, 1/16" raised face ASTM A181 Grade I. Use flat face when connected to flat faced companion flange.

J. Pipe Sleeves:
1. Provide fire proof sleeve assemblies utilizing UL rated sealant systems at all fire rated penetrations. For non-rated sleeve penetrations pack the annular space between the pipe and sleeve with fiberglass and/or mastic.

2. Sleeves shall provide a minimum 1/2" annular clearance around pipe. Where pipes cross through footings or footing walls provide a minimum 1” annular clearance between sleeve and pipe.
3. Sheet metal: Fabricate from 0.025” (0.64 mm) minimum, sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint.
4. Steel pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
5. Iron pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs.
6. Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
7. Sleeves through interior concrete walls and floors: Telescopic, submerged, adjustable sleeves by Adjust-to-Crete, AMI or Shamrock. Floor sleeves to extend a minimum of 1” above finished floor.
8. Through exterior walls and floor on grade: 150-pound class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe.
9. Cast-in-place watertight device for protecting penetrating objects from expansion and contraction of concrete. Factory-assembled for use in cast-in-place concrete floors and walls and consisting of two outer sleeves and a one-piece radial extended-flange waterstop gasket, with mid-body seal for embedment and sealing to concrete slab and continuous water seal extending to the penetrating pipe.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE, Hydro Preseal, or equal.
    b. Outer Sleeves: EPDM attached to the mid-body seal forming an area with which to attach the device to the structural reinforcing rod determining the position of sleeve in the wall.
    c. Water Stop Mid-Body Seal: Flexible polymer seal with radial extended flange consisting of one to three concentric raised rings which lock into concrete, maintaining seal over time as concrete contracts from sleeve.

K. Sleeve Seals:
1. All sleeves shall be sealed to prevent intrusion of moisture, dust or insects.
2. Underground: For sleeves passing through exterior or foundation walls, provide mechanical link seal assembly.
3. Aboveground: For sleeves passing through walls or floors provide a non-toxic 3-hour rated fire resistant silicone foam sealant with a Flame Spread Rating of 20. Sealant to be tested and approved under UL 263, ASTM E119, and NFPA 251 Standards. All fire rated penetrations shall be sealed with approved UL System.
4. Local Approvals: All seals to be provided shall be in accordance with the regulations of all governing agencies of the city, county, and State Fire Marshal's Office.

L. Watertight Sleeve-Seal Systems
1. Wood Decking Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE, Hydroflame Sleeve, or equal.
    b. Consists of an outer sleeve lined with an intumescent strip, and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork.
    c. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab.
    d. Provide one-hour, two-hour and/or three-hour fire-resistance rated assemblies as required and tested according to ASTM E 814 or ANSI/UL 1479.
2. Steel Decking Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in floors formed with steel decking to protect penetrating objects

from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, hot gasses and fire.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE; Hydroflame CMD Metal Deck Device, or equal.
b. Consists of an outer sleeve lined with an intumescent strip, and wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.
c. Includes a cone attached to the base for extending the device through the metal deck and a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab.
d. Provide one-hour, two-hour and/or three-hour fire-resistance rated assemblies as required and tested per ASTM E 814 or ANSI/UL 1479.

3. Concrete Description: Cast-in-place, watertight tub box drain block out firestop device for use in floors formed with wood decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke and fire, and hot gasses.
   a. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbard Enterprises/HOLDRITE, Hydroflame Tub Box, or equal.
   b. Consists of a reinforced polymer box containing a 2-1/2-inches (63.5 mm) thick polystyrene foam insert with an upper water seal consisting of absorbent material and a pitched water trough.
   c. Include a sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork.
   d. Include two support legs each with a radial extended flange for balance and for fastening to concrete formwork, and a lower water-seal and radial extended flange attached to the lower end of the sleeve for fastening to concrete formwork and a waterstop gasket with three concentric raised rings for embedment and sealing to the concrete slab.
   e. Provide one-hour, two-hour and/or three-hour fire-resistance rated assemblies as required and tested per ASTM E 814 or ANSI/UL 1479.

M. Valve Boxes: Concrete body, cast iron cover with vandal resistant screws, extensions as required to extend full depth to valve. Valve box cover lettering shall correspond to the valve service, "Water", "Gas", "Fire", "Sewer", etc. Christy #G8 or equal.

2.021 GAS CONNECTORS

A. General Areas: CSA rated, UL listed, braided stainless steel gas hose of size and capacity to meet appliance input requirements.

B. Food Service Equipment: CSA rated, UL listed, plastic coated braided stainless steel gas hose with quick disconnect, swivel fitting and coiled restraining device. Dormont #1675BPQS or approved equal.

C. Gas connectors for outdoor applications shall be listed for exterior use.

2.022 EXPANSION COMPENSATORS

A. General: Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ASME B31.1 for pressure piping. Vertical piping for domestic hot water, chilled water, heating water, steam and steam condensate shall be provided with

expansion joints at each floor. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints shall not require packing. Installer shall select materials and pressure/temperature ratings to suit intended service. Select packless expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application.

B. Expansion Compensators (Pipe Compression and Extension): Multiple stainless steel bellows and stainless steel liner with shroud and end fittings. Keflex #311 series or approved equal.

C. Flexible Expansion Joint/Seismic Connector for Steel Pipe: Stainless steel hose and braid, 180° return, CSA approved, and end fittings. Metraflex #Metraloop or approved equal.

D. Flexible Connection for Steel Pipe (Piping and Equipment Located Outside the Building): Stainless steel hose and braid, with threaded or flanged ends. Metraflex #SST or approved equal.

E. Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends. Metraflex #BBS or approved equal.
   1. For non-critical pump connections. Furnish with fluorelastomer tube and cover to ASTM D2000 Grade 1HK710. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/kevlar fabric rated 190#/26" vacuum at 250°F. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Garlock #206 EZ-FLO or approved equal.
   2. Flexible Ball Pipe Joints: Provide flexible ball pipe joints where indicated for piping systems, with materials and pressure/temperature ratings selected by installer to suit intended service. Design joints for 360° rotation, and with minimum of 50° angular flexing movement for sizes 1/4" to 4". Provide two composition gaskets for each joint. Barco or approved equal.

F. Pipe Alignment Guides: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated on drawings. Guide shall be of carbon steel construction with split guiding cylinder and integral anchor base and internal four finger two-piece spider. Cylinder wall thickness shall be equal to schedule 40 wall thickness of pipe being guided. Spider shall be capable of clamping directly to pipe and moving only in an axial direction while inside cylinder. Anchoring directly to building substrate. Metraflex #Style IV or equal.

G. Expansion Loops: Provide field fabricated pipe expansion loops as detailed on the drawings or in place of mechanical expansion joints.

2.023 FIRE PROTECTION VALVES:

A. Refer to Section 21 10 00.

PART 3 - EXECUTION

3.01 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install water piping and fixtures uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work, unless so indicated on Drawings or approved by Architect or Owner's Representative.

C. Pipe showing rust or cracks in coating shall be removed and replaced.

D. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

E. Coordinate the work between the various Plumbing Sections and with the work specified under other Divisions of the work or contracts toward rapid completion of the entire project. If any cooperative work must be altered due to lack of proper supervision or failure to make proper provisions in time, then the work hereunder shall include all expenses of such changes as are necessary in the work under other contracts, and such changes shall be directly supervised by and made to the satisfaction of the Owner's Representative.

F. The cooperative work not included in the Plumbing Division related to the general construction work is as follows:
   1. All formed concrete work.
   2. Framed openings in masonry and other Architectural and Structural elements.
   3. Wood grounds and nailing strips in masonry and concrete.
   4. Sloping of floors to drains and floor sinks.
   5. Sloping of roof surfaces to roof drains and overflow drains.

G. Inspect all material, equipment, and apparatus upon delivery and do not install any that may be subject to rejection as a result of damage or other defects. Provide tarps and visqueen cover to protect equipment and piping delivered to and stored at the site.

H. Installation of backflow prevention devices mounted more than five (5) feet above the floor shall be provided with a permanent platform capable of supporting a tester or maintenance person.

3.02 PIPES SIZES TO EQUIPMENT

A. General: Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of equipment.

B. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valve.

3.03 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints or couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Comply with ASME B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and

column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

C. Where buried piping, such as domestic cold water or natural gas, transitions into a building-on-grade the piping shall not penetrate the slab or perimeter structure and must extend vertically a minimum of 12” above finished floor level before penetrating the exterior perimeter wall.

D. Pipes Penetrating Foundation Walls and Grade Beams: Any pipe that passes through a foundation wall or grade beam shall be provided with a relieving arch or a pipe sleeve shall be built into the foundation wall or grade beam. The sleeve shall be constructed of a section of pipe that is two pipe sizes greater than the pipe passing through the structure. Coordinate the location and size of each penetration with the structural engineering design before any work is performed.

E. Install automatic air vents, with shutoff valves, in all closed specialty plumbing systems at high points of systems and at any other point necessary to free system of air. A shut-off valve shall be provided in riser to each vent valve to facilitate servicing. A 1/4” or 3/8" type "L" copper tubing drain line shall be run to drain receptor to carry away water that valve discharges.

F. Provide gas meter as required and where shown on drawings. Provide shut-off valves at inlet and outlet side of each meter. Coordinate communications wiring and programming with BAS and local gas utility as required.

3.04 CATHODIC PROTECTION OF METAL PIPE

A. Cathodic Protection: Provide cathodic protection for buried exposed steel or copper piping. Assume that 25 percent of the exterior of the steel casing is exposed metal. Cathodic protection systems shall have a minimum design life of 25 years and shall be designed in accordance with recommendations of NACE SP-01-69 Control of External Corrosion on Underground or Submerged Metallic Piping Systems (latest edition). Provide all anodes, wiring, dielectric pipe flange kits, and any additional required isolation devices, at points necessary within vaults or at building terminations. Provide test stations at grade on each section of the piping system. Isolation flanges and unions shall be rated for the carrier pipe service temperature and pressure. Coordinate with Section 26 42 00 Cathodic Protection.

3.05 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Pipes passing through foundation walls or grade beams shall be provided with a relieving arch or a pipe sleeve built into the foundation wall or grade beam. The sleeve shall be a minimum of two (2) pipe sizes larger than the pipe passing through the wall or beam. Coordinate specific sleeve penetration locations with structural design for placement of sleeves.

C. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) minimum annular clear space between piping and concrete slabs and walls.

1. When cast-in-place watertight sleeve seals are required, select sleeve size to match the size and type of pipe to be installed.
2. Sleeves are not required for core-drilled holes.

D. Install sleeves in concrete floors, concrete roof slabs, and concrete/masonry walls as new slabs and walls are constructed.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2” (50 mm) minimum above finished floor level.
2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

E. Install sleeves for pipes passing through fire rated interior partitions as required by assembly construction.
1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4” (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
4. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping." Exception: When fire-resistance-rated cast-in-place watertight sleeve seals are required for floor penetrations, additional firestopping is not necessary.

3.06 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

C. Aboveground, Cast-in-Place Watertight Sleeves. Select sleeve size based on pipe size and material to be inserted, and thickness of wall.
1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
2. Position cast-in-place water tight sleeve in wall space securing sleeve to reinforcing steel using tie wire.

D. Underground, Exterior-Wall, Cast-in-Place Watertight Penetrations. Select sleeve size based on pipe size and material to be inserted, and thickness of wall.
1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
2. Secure sleeve to the reinforcing steel using tie wire.

E. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails or staples. Place concrete, and finish even with top of sleeve.

3.07 PIPING SYSTEM JOINTS

A. All piping shall be cut squarely, free of rough edges and reamed to full bore. Piping shall be mechanically cleaned prior to make-up of joints and fully inserted into fittings.

B. Provide joints of type indicated in each piping system.

C. Thread pipe in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

D. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM. B-32, in accordance with IAPMO IS 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints shall be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes shall be applied liberally to the outside of the pipe and the solder cup of the fitting. Fluxes shall be water soluble for copper and brass potable water applications, and shall meet CDA standard test method 1.0 and ASTM B813-91. Solder shall be applied until a full fillet is present around the joint. Solder and flux shall not be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosive flux shall not be present at the jobsite.
   1. Manufacturers:
      a. Solder: JW Harris "Bridgit" or Englehard "Silvabrite 100".
      b. Flux: Laco "Flux-Rite 90", MW Dunton "Nokorode CDA Flux", Hercules "Fluid Action Solder Flux".

E. Extruded-Tee Connections (T-Drill): Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

F. Braze copper tube and fitting socket or extruded joints (T-drill) with BCUP series filler metal without flux. Listed brazing flux shall be used for joining of copper tube to brass or bronze fittings and shall meet AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet shall be visible around the completed joint. After cooling, flux residue shall be thoroughly removed with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10% nickel.
   1. Brazing fittings may use a mechanically limited depth that is not less than the minimum cup depth (overlap) specified by ANSI/ASME B16.50 for Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings. Manufacturer of mechanical dimpler: Brazing Dimpler Corp or equal.

G. Depth of solder joint and braze joint fitting:

Depth of Solder Joint and Braze Joint Fittings		
Pipe Size (inches)	ASME 16.22 Solder Joint	ASME B16.50 Brazed Joint

	Socket Depth (inches)	Socket Depth (inches)
1/2	0.50	0.22
3/4	0.62	0.25
1	0.75	0.28
1-1/4	0.97	0.31
1-1/2	1.09	0.34
2	1.34	0.40
2-1/2	1.47	0.47
3	1.66	0.53
3-1/2	1.91	0.59
4	2.16	0.64
5	2.66	0.73
6	3.09	0.83
8	4.09	1.28

A. Corrugated stainless steel tube (CSST) fittings joints: Gastite□ mechanical tube fittings manufactured from ASTM B16 type 360 brass whose design incorporates a double wall flare for gas-tight seal with Jacket Lock□, mechanical capture of the jacket for enhanced tubing protection.

B. Alternative domestic water piping mechanical press type connections with pre-approval from Owner's Representative. Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. Copper press fittings shall conform to the material and sizing requirements of ASME B16.22. O-rings for copper press fittings shall be EPDM. Viega/Ridgid or approved equal.

C. Piping shall be capped during construction to prevent entry of foreign material.

D. Weld pipe joints in accordance with recommendations of American Welding Society AWS D1.1 and ASME Boiler and Pressure Vessel Code Section IX.
   1. Weld pipe joints only when ambient temperature is above 0°F.
   2. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
   3. Use pipe clamps or tack-weld joints with 1" long welds, 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
   4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and at edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
   5. Do not weld out piping system imperfections by tack-welding procedures. Refabricate to comply with requirements.

6. At Installer's option, install forged branch-connection fittings whenever branch pipe is indicated, or install regular T-fitting.

E. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

F. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

3.02 VALVES

A. General: Except as otherwise indicated, comply with the following requirements:
1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided as necessary.
2. Install manual shutoff valves to isolate cold and hot water services to each restroom group. Back-to-back or adjacent men’s and women’s restrooms are considered a group. Shutoff valves shall be located immediately above or adjacent to the restroom(s) for easy maintenance access.
3. Install valves on all services connected to kitchen equipment.
4. Install valves, except butterfly valves, with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane without prior written approval. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
5. Install butterfly valves with stems mounted horizontally.
6. All valves mounted higher than 7' above floor in mechanical rooms and where indicated shall be installed with stem horizontal and equipped with chain wheels and chains extending to 6' above floor.
7. Provide seismic shut off valve on the natural gas or propane main downstream of meter adjacent to outside of building, mounted per manufacturer instructions, level in all planes, and anchored to the building structure wherever possible to avoid nuisance tripping.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends of types of pipe/tube connections:
1. Copper Pipe, 2-1/2" and Smaller: Soldered-joint valves.
2. Steel Pipe, 2" and Smaller: Threaded joint valves.
3. Larger Pipe Sizes: One of the following, at installer's option:
   a. Flanged valves.
   b. Lug valves.

D. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

E. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

F. Fluid Control: Except as otherwise indicated, install gate, ball, plug, circuit setter, globe, and butterfly valves to comply with ASME B31.9.

G. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.

H. Wafer Check: Install between 2 flanges in horizontal or vertical position.

I. Ball Valve: Ball valve used on gas systems shall be UL listed, CSA approved for pressure of system, no exception.

J. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

K. Valve Identification: Tag each valve in accordance with Section 22 05 00.

L. Cleaning: Clean factory-finished surfaces. Repair marred or scratched surfaces with manufacturer's touch-up paint.

3.03 TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor without supplemental illumination. All gages to be installed with snubbers to absorb system shock.

B. Install in the following locations, and elsewhere as indicated:
1. At outlet of hot water heaters.
2. At inlet and outlet of boilers.

3.04 MECHANICAL SLEEVE SEALS

A. Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form a watertight seal.

B. Fire Barrier Penetration Seals: Fill entire opening with sealing compound in compliance approved and listed UL system number. Adhere to manufacturer's installation instructions.

3.05 SUPPORTS AND HANGERS (See 220500-BASIC PLUMBING MATERIALS AND METHODS)

3.06 EQUIPMENT RAILS AND PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust raise of cant to match.

3.07 VIBRATION CONTROL ISOLATORS

A. Refer to Section 22 05 48 – Vibration Isolation for Plumbing Piping and Equipment.

3.08 EXPANSION LOOPS

A. Expansion Loops: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by installer to properly anchor piping in relationship to expansion loops.

B. Expansion Compensation for Risers and Terminals: Install connection between piping mains and risers with at least five pipe fittings including tee in main. Install connections between piping risers and terminal units with at least four pipe fittings including tee in riser.

3.09 EXPANSION COMPENSATORS

A. Install as noted on plans. Where plans do not indicate spacing of guides or other pertinent information, install per manufacturer's recommendations.

3.010 EXCAVATION AND BACKFILL

A. Underground piping shall be installed in stable, open trench work. Trench excavations shall be a minimum of 16” wide, true to line and grade. Contractor shall exercise all due shoring and safety procedures. No stones larger than 1” may be present in the trench to a minimum depth of 4” below the trench bottom. The trench shall be free of job site debris, and free of corrosive media. Pipe crown, outside the building footprint, shall be not less than 24” below the finished ground surface for metallic pipe, and 30” for non-metallic pipe, unless otherwise indicated on the Civil drawings or directed by the Owner’s Representative. Trenches shall be kept free of excess moisture, and shall be kept open for only a short a time as necessary for installation, testing and inspection. Dispose of surplus excavation and seepage water as directed by the Owner’s Representative.

B. Piping shall be properly bedded and backfilled over stable trench bottom to a level of at least 12” above the pipe crown with thin layers of unwashed sand, dampened but not puddle, and free of organic or corrosive materials and excessive moisture. Backfill shall be placed in thin layers not to exceed 6” and tamped by mechanical tampers to a minimum 90% Modified Proctor Density, in accordance with ASTM D-1557-58T. Trenches shall be backfilled to a minimum depth of 36” prior to being wheel loaded. Replace to their original condition all turf, plants, concrete, asphalt, or other improvements which constitute landscaping, traffic areas or other improved areas which become disturbed by excavation. In graded and undeveloped areas, in addition to procedures specified above, backfill trenches with crown 8” above the surrounding surface.

C. Excavated and backfill in soils of unstable nature shall be provided as directed the Owner’s Representative.

3.011 PIPE INSPECTIONS

A. Inspections shall be performed at each phase while under tests required for administrative authorities, and prior to concealment, i.e. “rough-in”, “top-out” and “final”.

B. Inspection – Below Grade: All piping installed below grade shall be inspected prior to burial by the Owner’s Representative. Contractor must notify Owner’s Representative no less than 24 working hours prior to inspection time. Should the piping be buried prior to inspection the

contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

C. Inspection – Above Grade: All piping installed above grade shall be made available for inspection upon completion and prior to finish of walls and ceilings. Contractor must notify Owner's Representative no less than 24 working hours prior to the desired inspection time. Should the piping be hidden within the structure prior to inspection the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

3.012 CLEANING, FLUSHING, DISINFECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any).

B. Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.

C. Inspect pressure piping in accordance with procedures of ASME B31.

D. Disinfect water mains and water service piping in accordance with Section 22 05 00.

3.013 TESTING

A. Provide all tests specified hereinafter. All tests shall meet or exceed the minimum requirements of applicable codes and local ordinances. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Architect, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Piping: Remove from the system, during testing, all equipment which would be damaged by test pressure. Replace removed equipment when testing has been accomplished. The system may be tested in sections as the work progresses; however, any previously tested portion shall become a part of any latter test of a composite system. Correct leaks by remaking joints with new material.

C. Test time will be accrued only while full test pressure is on the system, unless indicated otherwise. "Tolerance" shall be no pressure drop, except that due to temperature change in a 24-hour period. Inspect and test all work prior to burying or concealing. Test pressure shall be one and one-half times the system operating pressure or the listed test pressure below, whichever is greater:

System	Test Medium	Test Pressure	Tolerance-Test Period
Domestic Water	Water	150 psig	None – 8 hours
Sanitary Sewer (non-plastic)	Water	10 ft head (or 5 psi air)	No leaks – 8 hours
Sanitary Sewer (plastic)	Water	10 ft head	No leaks – 8 hours

Vent (non-plastic)	Air	5 psi	No leaks – 8 hours
Vent (plastic or non-plastic)	Water	10 ft head	No leaks – 8 hours
Rainwater	Water	10 ft head (or 5 psi air)	No leaks – 8 hours
Natural Gas/Propane	Air or Nitrogen	100 psig	None – 24 hours

D. Valves: Test all valve bonnets for tightness. Test operate all valves at least once from closed-to-open-to-closed position while valve is under test pressure. Test all automatic valves, including solenoid valves, and temperature and pressure relief valves, safety valves, and temperature and pressure relief valves not less than three (3) times.

E. Piping Specialties: Test all thermometers, pressure gauges, and water meters for accurate indication; automatic water feeders, air vents, trap primers, and vacuum breakers for proper performance. Test all air vent points to ensure that all air has been vented.

F. Backflow Preventers: Each testable backflow prevention device shall be tested and approved by certified testers after installation. Submit test results.

END OF SECTION

SECTION 22 11 23

PUMPS AND SPECIALTIES

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:
   1. Sump pumps
   2. In-line circulators
   3. Expansion tanks - diaphragm type pre-pressurized.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 22 05 00: Basic Plumbing Materials and Methods

B. Section 22 40 00: Plumbing Fixtures

C. Division 26.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products.

B. Codes and Standards: Provide pumps which conform to the requirements of:
   1. Hydraulic Institute (HI): Manufacturer pumps in accordance with "Standards for Centrifugal Rotary and Reciprocating Pumps."
   2. National Electrical Manufacturers Association (NEMA): Provide electrical components which comply with NEMA Standards.
   3. National Fire Protection Association (NFPA):
      a. 70: National electrical Code

   4. Underwriters Laboratories (UL):
      a. UL-778: Motor Operated Water Pumps

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for units showing dimensions, weights (shipping, installed, and operating), capacities, ratings, performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, and installation instructions.

1. Parallel pump plots: For all parallel and series pump applications submit a combined pump curve showing parallel pump operation and single pump non-overloaded operation verifying that the pump selections operate non-overloading on curve in a single pump operation.
2. Submittal information to verify all scheduled characteristics are met including efficiency.

B. Shop Drawings: Submit manufacturer's shop drawings indicating dimensions, weight (shipping, operating), required clearances, methods of assembly of components, and location and size of each field connection.

C. Maintenance Data:
1. Submit maintenance instructions, including instructions for lubrication, tube replacement, motor and drive replacement, and spare parts lists.
2. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals.

D. Wiring Diagrams:
1. Submit manufacturer's ladder-type wiring diagrams for power and control wiring required.
2. Differentiate between factory-installed and field-installed wiring.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products and units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

C. Rigging: Comply with the manufacturer's rigging and installation instructions.

1.07 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 SIMPLEX SUMP PUMP SYSTEM

A. Provide where indicated on drawings, a Simplex submersible sump pump. Pump to have a 2" I.P.S. discharge, bronze fitted construction with submersible sealed motor, stainless steel shaft, bronze impeller, mechanical seal, and waterproof power cord. Pump to have 50 GPM flowrate minimum. Motors to be as scheduled. Pump shall have a fully submersible float switch for mounting on pump discharge pipe.

B. Provide with differential mercury float switches for (1) on-off operation and (2) high water alarm.

C. Provide check valve and shut-off valve on discharge side of pump.

D. High water alarm: Local alarm with dry contacts for connection to BAS.

E. Warranty: One year.

F. Manufacturer: Meyers S-25, Weil, Federal, Liberty, Zoeller, Homa, or equal.

2.02 IN LINE WATER LUBRICATED CIRCULATING PUMPS

A. Furnish and install pumps with capacities as shown on plans. Pumps shall be in-line type for installation in vertical or horizontal piping. Pump must be capable of being serviced without disturbing piping connections.

B. Pump body shall be of all bronze construction, rated 175 psi working pressure, with gauge ports at nozzles, and with vent and drain ports.

C. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking cap screw or nut.

D. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat, and carbon seal ring, suitable for continuous operation at 225° F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal.

E. Motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans.

F. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

G. Provide H-O-A switch with overload protection. Pump shall run continuously. Wiring between switch and pump provided under Division 22, as stated in Section 22 05 00.

H. Manufacturer: Xylem Bell and Gossett, TACO, Armstrong, Grundfos, or equal.

2.03 EXPANSION TANKS

A. Diaphragm Type Pre-pressurized:
   1. The pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. It shall maintain minimum operating pressure necessary to eliminate all air. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. Bladder shall be heavy duty butyl, FDA approved.
   2. The expansion tank shall be welded steel, constructed, tested and stamped in accordance with Section VIII of the ASME Code for a working pressure of 125 psi and pre-charged to the minimum operating pressure. Tank shall be epoxy lined.
   3. Manufacturer: Wessels #FXA Series, Amtrol, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All equipment, unless otherwise shown or noted on the Drawings, is to be installed in accordance with industry standards and manufacturer's recommended installation instructions.

B. Grouting Pump Base: For all base mounted flexibly coupled pumps fill the pump base frame with grout after completing pump/motor alignment.

C. Provide vibration isolation, inertia bases, seismic snubber, flexible pipe connections, etc, as specified in related specification sections.

D. For variable flow pumping applications, see Section 23 09 02 Variable Frequency Drives for additional requirements.

E. Contractor to assist testing and balancing contractor in verifying correct pump rotation and system operation.

F. Flush and clean equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls.

G. Isolation for Service: Provide pump installations with a discrete isolation valve on both the supply and intake side of the pump to permit service of the pump and any related strainer, check or balancing valves. Triple duty valves are not equivalent for this shut-off service.

H. Balancing Coordination and Impeller Trimming: Coordinate final pump flow with test and balance contractor. For pumps larger than 5 horsepower, if the system tests and balance indicate that flow exceeds the specified flow by greater than 20%, it is not acceptable to reduce flow merely by adjusting balance valves to create additional head or reducing VFD peak flows. Excess system flow must be reduced by trimming the impeller to match the load.

3.02 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify pump systems mounting, verify piping installation, verify control wiring, verify power wiring, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours of travel from the jobsite.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this section shall include but not necessarily be limited to the following:
   1. Grease Interceptor
   2. Lint Trap

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 22 05 00: Basic Plumbing Materials and Methods

B. Section 22 11 23: Pumps and Specialties

C. Section 22 34 00: Domestic Hot Water Heating Equipment

D. Section 22 40 00: Plumbing Fixtures

1.04 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, colors, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:
   1. Grease Interceptor
   2. Lint Trap
   3. Water meters

B. Electrical Work: Refer to Division 22, Section 22 05 00 for requirements and coordinate with Division 26.

C. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.

D. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, elevations, sections, and methods of assembly of components and anchorages.

E. Wiring Diagrams: Submit manufacturer's electrical requirements for electrical power supply wiring. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring

required for final installation. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

F. Operation and Maintenance Data: Submit maintenance data and parts lists for each type and size of water heater, control, and accessory, including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual, in accordance with requirements of Division 01. Submit operational manuals.

G. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.

H. Start-up: Provide written report on start-up in accordance with Section 22 05 00.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products - remove from project site.

1.06 COORDINATION

A. Coordinate size and location of concrete bases and attachments with structural design. Coordinate with Divisions 03 for specification of concrete, reinforcement and formwork requirements.

1.07 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 GREASE TRAP

A. Grease traps to be constructed of duco coated steel. Provide with removal baffles and flow control.

B. Provide with extensions for flush with floor installation and vent.

C. Manufacturer: JR. Smith 8050, Zurn, Wade or equal.

2.02 GREASE INTERCEPTOR

A. Grease interceptor to be constructed of concrete with two / three 24” clear access manholes with traffic weight frame and covers.

B. Interceptor to be IAPMO listed and have a minimum of 2 components. See schedule for capacity.

C. Provide solids interceptor up stream of interceptor Utility Vault 576.

D. Provide sampling vault downstream of interceptor. Utility Vault 233-B-SAMP with 23-25C top.

E. Manufacturer: Utility Vault or equal.

2.03 LINT TRAP

A. Lint separator as shown on drawings. Furnish and install all-welded steel separator with extension up to finished floor, hubbed, inlet and outlet with vent connection, internal vent connection, visible double wall outside trap seal, anchor flange without clamping ring, epoxy coating, anodes, sediment basket, reinforced cover for light traffic, secured with stainless steel bolts, heavy duty leak proof gasket, enamel coating inside, and bituminous coating outside.

B. Manufacturer: Rockford #RLS Series or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Orient so controls and devices needing service and maintenance have adequate access.

D. Connect water piping to units with shutoff valves and unions as required for maintenance and system isolation.

E. Start-Up: Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls. Start-up to be by authorized manufacturer's representative or agent.

3.02 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections
   1. Installation and Startup Test: Perform installation and startup checks according to manufacturer's written instructions.
   2. Leak Test: Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion, if necessary.
   4. Controls and Safeties: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
      b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.03 OPERATION MANUALS, START-UP SERVICE, WARRANTIES, ACCEPTANCE AND GUARANTEES

A. General: Refer to Section 22 05 00 for requirements.

END OF SECTION

SECTION 22 34 00

DOMESTIC HOT WATER HEATING EQUIPMENT

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this section shall include but not necessarily be limited to the following:
   1. Water heaters
      a. Natural Gas Non-Condensing Tank Type
      b. Electric Tank Type
   2. Expansion Tank

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 22 05 00: Basic Plumbing Materials and Methods

B. Section 22 40 00: Plumbing Fixtures

C. Section 23 51 00: Breechings, Chimneys and Stacks

1.04 QUALITY ASSURANCE – WATER HEATERS

A. Manufacturers and Representatives Qualifications. Firms regularly engaged in manufacture of water heating equipment, systems and service shall have been active in the field and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values required by the local energy code. Water heater shall include automatic temperature control for maintaining leaving water temperature setpoint.

C. ASME Compliance: Condensing water heaters must be constructed in accordance with ASME Water heater and Pressure Vessel Code, Section IV (HLW) Potable Water Heaters.

D. ANSI Compliance: Condensing water heaters must be tested for compliance with ANSI Z21.10.3 (2011) / CSA 4.3 Gas Water Heater. For use as a potable water heater, "American National Standard / CSA Standard for Gas Water Heaters." Condensing water heaters shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.05 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, colors, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:
   1. Water heaters
   2. Expansion Tank
   3. Recirculating Pump
   4. Thermostatic Mixing Valve

B. HVAC Work: Coordinate with Division 23, Section 23 51 00 for flue and vent requirements.

C. Electrical Work: Refer to Division 22, Section 22 05 00 for requirements and coordinate with Division 26.

D. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.

E. Water Heater Pressure Drop Curve: Submit pressure drop curve for flows ranging from 0 gpm to maximum value of water heater.

F. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, elevations, sections, and methods of assembly of components and anchorages.

G. Wiring Diagrams: Submit manufacturer's electrical requirements for electrical power supply wiring. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

H. Operation and Maintenance Data: Submit maintenance data and parts lists for each type and size of water heater, control, and accessory, including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual, in accordance with requirements of Division 01. Submit operational manuals.

I. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.

J. Start-up: Provide written report on start-up in accordance with Section 22 05 00.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products - remove from project site.

1.07 COORDINATION

A. Coordinate size and location of concrete bases and attachments with structural design. Coordinate with Divisions 03 for specification of concrete, reinforcement and formwork requirements.

1.08 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

C. Tanks shall have a three-year (36 months) warranty against leaks.

D. Condensing Water Heaters: The heat exchanger shall carry a minimum five year warranty against any failure due to waterside corrosion, condensate corrosion, thermal stress, mechanical defects, or workmanship.

PART 2 - PRODUCTS

2.01 NATURAL GAS, NON-CONDENSING, TANK TYPE WATER HEATER

A. Water heater shall have nominal 80% thermal efficiency, with closed combustion venting. Refer to schedule on drawings for sizing, capacities, recovery rate, power requirements and models.

B. Water heater shall be of a seamless glass lined steel tank construction with sacrificial magnesium anode rods and include a powered blower with electronic flame safeguard, intermittent ignition, automatic gas valve, and gas pressure regulator. Maximum supply gas pressure to heater shall not exceed 14" W.C. Maximum operating pressure of 150 psig.

C. Category I appliance with “B” type flue venting.

D. Tank shall be foam insulated and equipped with an ASME rated temperature and pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IESNA 90.1.

E. Thermostatic temperature controller. Set initial water heater temperature to 140°F (minimum).

F. Manufacturer: A.O.Smith, Bock, Bradford White, Lochinvar or equal.

2.02 ELECTRIC TANK TYPE HOT WATER HEATER

A. Tank type electrical water heater with integral heating elements and insulated tank. Refer to drawings for locations, capacities, flow rates, power requirements and models.

B. All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel. Tank shall be cathodically protected with adequate extruded magnesium anode. The entire vessel is to be enclosed in a round steel enclosure with baked enamel finish. Tank shall have a 150 psig working pressure. Foam insulated (R-16 minimum) tank to meet or exceed US DOE, ASHRAE/IESNA 90.1 and local energy code requirements.

C. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. Factory wired for non-simultaneous operation. Set initial water heater temperature to 140°F (minimum).

D. Heater shall include ASME pressure and temperature relief valve.

E. Manufacturers: A.O.Smith, Bradford-White, Smith, American, Lochinvar, Rheem or equal.

2.03 TEMPERATURE AND PRESSURE RELIEF VALVES

A. Temperature and Pressure Relief Valve: Lead free bronze body construction, thermostat and test lever, temperature relief set at 210^0F, and pressure relief set at 125 psi. Certified to meet ASME low pressure heating boiler code and ANSI Z21.22.

B. Manufacturers: Watts #LF Series (100XL, 40, 140, N240, 340), Cash Acme #FVX Series or equal.

2.04 THERMAL EXPANSION TANK

A. Furnish and install one thermal expansion tank in each closed domestic hot water piping system as shown on drawings. Size tank per hot water piping system volume and operating conditions. Minimum three (3) gallon acceptance volume.

B. Construction:
1. Designed and constructed vessel per ASME Code Section VIII, Division 1.
2. Tanks rated for maximum 150 psig working pressure.
3. Steel tank with stainless steel connection and painted.
4. Butyl diaphragm bonded to polypropylene liner. Pre-charged air chamber to 55 psig with Schrader air valve.
5. Tank saddle support for wall or upper attachment support or ring base for floor attachment.

C. Manufacturer: Amtrol Therm-X-Trol, Watts PLT, Adamson, RECO or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected. Refer to drawings and other specification sections for locations, dimensions and features required for each piece of equipment.

B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Orient equipment so controls and devices needing service and maintenance have adequate access and code required clearances.

D. Connect piping with shutoff valves and unions as required for maintenance and system isolation.

E. Connect all drain outlets and route to approved termination locations as shown on the drawings and as required by code.

F. Start-Up: Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls. Start-up to be by authorized manufacturer's representative or agent.

3.02 WATER HEATER EXAMINATION

A. Before water heater installation, examine roughing-in for equipment bases, anchor-bolt sizes and locations. Examine piping and electrical connections to verify actual locations, sizes and other conditions affecting water heater performance, maintenance and operations.

1. Final water heater locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where equipment heaters will be installed. Coordinate with Owner’s Representative if there are concerns about proposed equipment locations. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 WATER HEATER INSTALLATION

A. Install water heaters and tanks level on bases or platforms as required and as shown on drawings. Coordinate with Division 03 for concrete materials and installation requirements.

B. Install water heaters in accordance with local, state, provincial, and national codes, laws, regulations, and ordinances.

C. Comply with manufacturer’s installation instructions, including required service clearances and venting guidelines.

D. Provide seismic anchorage attachments on vertical tanks heaters with support points at upper 1/3 and lower 1/3.

E. Assemble and install water heater ASME listed Pressure/Temperature Relief Valve.

F. Install electrical devices furnished with water heater but not specified to be factory mounted.

G. Install control wiring to field-mounted electrical devices.

3.04 WATER HEATER CONNECTIONS

A. Piping installation requirements are specified in other Division 22 sections. Drawings indicate general arrangement of piping, fittings and specialties.

B. Install piping adjacent to water heater to permit service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection and pitched for gravity flow.

D. For condensing water heaters, provide condensate neutralizer in condensate drain pipe before termination at floor sink or other approved termination.

E. Connect gas piping to water heater gas valve with unions. Piping shall be at least full size of gas train connection. Provide a reducer if required at final connection.

F. Install flue venting and combustion air intake duct full size to water heater connections.

G. Connect cold and hot water piping to inlet and outlet connections with shutoff valves and dielectric union or flanges at each connection.

H. Multiple heaters shall be piped such that all cold water entering the system will go through the heat exchanger first. Each water heater shall have individual isolation valves for servicing and a hot water hose connection for start-up and field testing.

I. Install piping from safety pressure and temperature relief valves to nearest floor sink or to the exterior of the building.

J. Install vacuum relief valve in incoming cold water pipe to water heaters.

K. Provide one (1) glass thermometer and thermowell in the hot water pipe on the discharge side of the water heater or water heating system. Thermowell shall be brass or stainless steel. Install thermowell into tee fitting within 36” of water heater outlet. Thermowell may be installed horizontally or vertically, but thermometer must be mounted vertically and positioned for easy reading from a standing position. Adjust installation of thermometer and thermowell to extend no more than 2” into water flow path. Thermowell probe shall not restrict the water flow in the hot water pipe, therefore the tee fitting must be enlarged. Tee fitting diameter shall be oversized to equal, or exceed, the diameter of the supply water pipe plus the diameter of thermowell for the entire depth of thermowell probe.

L. Drain valve shall be readily accessible for installation of hose to facilitate maintenance draining. Elevate water heater and tanks, as necessary, to accommodate hose connection. See drawings for additional requirements.

M. Ground equipment according to Division 26 Section - Grounding and Bonding for Electrical Systems.

N. Connect wiring according to Division 26 Section - Low-Voltage Electrical Power Conductors and Cables.

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections
   1. Installation and Startup Test: Perform installation and startup checks according to manufacturer's written instructions.
   2. Leak Test: Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion, if necessary.
   4. Controls and Safeties: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.06 OPERATION MANUALS, START-UP SERVICE, WARRANTIES, ACCEPTANCE AND GUARANTEES

A. General: Refer to Section 22 05 00 for requirements.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 22 05 00 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this section shall include, but not necessarily be limited to, the installation of plumbing fixtures and trim.

1.03 RELATED WORK IN OTHER SECTIONS

A. Section 22 05 00: Basic Plumbing Materials and Methods

B. Section 22 30 00: Plumbing Equipment

1.04 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, colors, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:
   1. Plumbing fixtures.
   2. Piping specialties.
   3. Toilets.
   4. Urinals.
   5. Lavatories.
   6. Sinks.
   7. Drinking fountains.
   8. Roof drains.

B. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, and methods of assembly of components and anchorages. Coordinate requirements with Architectural Woodwork shop drawings specified in Division 06 for fixtures installed in countertops and cabinets. Furnish templates for use in woodwork shop.

C. Samples: Submit samples of any piece of equipment requested by Architect for review and approval.

D. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed portions.

1.05 CODES AND STANDARDS

A. Applicable Plumbing Code with State Amendments.

A. State of Oregon Plumbing Specialty Code – SOPSC

B. All fixtures and faucets must meet all requirements of the State of Oregon Structural Specialty Code – SOSSC.

C. All fixtures and accessories must be approved for use by the State of <<Oregon>>.

D. All fixtures and faucets must meet all requirements of Americans with Disabilities Act (ADA).

E. State Energy Code

F. ARI Standard 1010: “Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.”

G. NSF 372: Materials containing not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect to the wetted surfaces of pipes and pipe fittings, plumbing fittings, and fixtures, providing a specified definition and formula for determining “weighted average”.

2.02 QUALITY ASSURANCE

A. For those plumbing fixtures provided with battery operated valves (toilets, urinals, and sink faucets) powered by lithium or alkaline batteries shall be selected with a minimum operational service life of six (6) years based on 4000 operations per month. Any failure of batteries during the first six years of service, from the date of Certificate of Occupancy, shall be replaced by the installing contractor at no additional charge to the Owner.

2.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products. Remove damaged products from project site.

2.04 MAINTENANCE

A. Extra Stock:
   1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures, flush valves, and trim to Owner’s Representative with receipt in a quantity of one device for each 10 fixtures.
   2. Furnish faucet repair kits complete with all necessary washers, springs, pins, retainers, packings, o-rings, sleeves, and seats in a quantity of one kit for each 10 faucets.

2.05 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 22 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide fixtures as specified. Fixtures in any secure or public areas shall be vandal proofed.

B. Architect/Engineer shall review and approve any substitution requested by Contractor prior to bid submittal.

C. Provide fixture as specified, acceptable manufacturers:
   1. Vitreous China or Cast Iron Fixtures: American Standard, Eljer, Zurn, Kohler, or equal.
   2. Stainless Steel Sinks: Elkay, Just, or equal.
      a. All stainless steel is minimum 18-gauge, type 304 unless otherwise specified.
   3. Drinking Fountains: Elkay, Haws, or equal.
   4. Terrazzo Service Sinks: Florestone, Stern Williams, or equal.
   5. Showers enclosures: Lasco, Fiber Fab, Aquaglass, Aqua Bath, or equal.

D. Provide faucet as specified. Acceptable manufacturers: Chicago Faucets, Zurn, Symmons, T and S, Delany, or equal.

E. Provide thermostatic mixing valves and fixtures conforming to ASSE 1070, ASSE 1069 and ASSE 1016. Limit the maximum water temperature to 110°F for all public lavatories and 120°F for all other public fixtures served with hot water. Handle position stops and temperature mixing valves shall be used as required to limit maximum temperature to prevent scalding. Water heater thermostats shall not be considered a suitable control.

F. Provide flush valve as specified. Manufacturers: Sloan, Hydrotek, Zurn, Delany, or equal.

G. Provide commercial grade toilet seat as specified. Manufacturers: Beneke, Bemis, Church, Olsonite, or equal.

H. Provide heavy-duty cast iron commercial grade carrier as specified. Provide compact carriers where space is limited. Comply with ASME A112.6.1M for Floor-Affixed Supports for Off-The-Floor Plumbing Fixtures for Public Use. Manufacturers: Jay R. Smith, Watts, Josam, Wade, Zurn, Mifab, or equal. No plastic parts on foundry items.
   1. Wall hung water closet with optional flush valve support where applicable: J.R. Smith Fig #0210 Series, #0240 Series, and #0410 Series.
   2. Wall hung urinal: J.R. Smith Fig #0634-M12 or Zurn #Z-1221-58.
   3. Wall hung lavatory with concealed arm carrier: J.R. Smith Fig #0700–M31.

I. Provide heavy duty commercial grade 17-gauge P-Trap and supplies with stops as specified. Provide heavy duty commercial grade lavatory supplies. Provide supplies meeting AB1953 no lead requirements. Supplies shall be 1/2"x 3/8" x 12" ground joint flexible riser with loose key angle stop with chrome plates IPS brass nipple. Sink supplies shall be ½" x 12" ground joint flexible riser with loose-key angle stop with chrome plated IPS brass nipple. Provide bell type escutcheons for both P-trap and supplies. Manufacturers: Zurn, Brasscraft, Chicago, McGuire, or equal.
   1. P-trap - Lav: McGuire C8902-DF or Zurn Z-8701.
   2. P-trap - Sink: McGuire C8912-DF or ZurnZ-8702.
   3. Supply for Lavatory: McGuire LFH2165LK or Zurn ZH88-XL-LK.
   4. Offset supply for barrier free lavatory: McGuire 158 WC.
   5. Supply for Sink: McGuire LFH2167LK or Zurn ZH8803-XL-LR.
   6. Supply for Water Closet: McGuire H2169LK or Zurn ZH-8807-CR.
   7. Escutcheons: McGuire WE00D Series, wrought brass, bell type.

8. Lavatory grid strainer: McGuire 155A or Zurn Z-8743.
9. Barrier-free lavatory offset grid strainer: McGuire 155WC or Zurn 8746.
10. Sink Strainer: Elkay LK-18B.

A. Provide standard grade P-Traps and supplies with stops as specified in residences. Provide supplies meeting AB1953 no lead requirements. Lavatory supplies shall be 1/2" x 3/8" x 12" ground joint flexible riser with round wheel handles and chrome plated IPS brass nipple. Sink supplies shall be 1/2" x 12" ground joint flexible riser with round wheel handle angle stop with chrome plated IPS brass nipple. Provide bell type chrome plated escutcheon for traps and supplies. Manufacturers: McGuire, Zurn, Chicago, Brasscraft, or equal.
1. P-Trap Lavatory: McGuire 8901-C or Zurn 8706.
2. P-Trap Sink: McGuire 8892-C or Zurn 8708.
3. Supply Lavatory: McGuire LF2165 or Zurn ZH8801-XL-LR.
4. Supply Sink: McGuire LF2167 or Zurn ZH8803-XL-LR.
5. Supply Water Closet: McGuire 2169 or Zurn Z8807CR.
6. Offset Supply for ADA Lavatory: McGuire 158W or Zurn Z-8855-WL.
7. Offset Trap Arm for ADA Lavatory: McGuire 155WC or Zurn Z-8746.
8. Offset Trap Arm for ADA Sink: McGuire 1151AWC or Zurn Z-8749.
9. Escutcheons: McGuire chrome plated WE125TR, WE150, WE125D and WE150D or Zurn.

B. Insulation: provide white molded closed cell vinyl pre-fab insulation on P-Trap and on both hot and cold water supply for barrier free lavatories and sinks. Bag type insulators are not acceptable. Manufacturers: Plumberex, True-Bro, Zurn, or equal.

2.02 LISTING

A. Refer to plumbing fixture schedule on drawings for manufacturers, model numbers and selection criteria.

PART 2 - EXECUTION

2.01 GENERAL

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.

D. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.

E. Comply with the installation requirements of ADA with respect to plumbing fixtures for the physically handicapped.

F. Fasten plumbing fixtures securely to supports behind wall or building structure. Secure supplies behind or within wall construction to provide rigid installation.

G. Install a stop valve in an accessible location in the water connection to each fixture.

H. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.

I. Seal fixtures to walls and floors using sealants as specified in Division 07. Match sealant color to fixture color.

J. Install P-Trap tight to outlets from lavatories and shower drains to minimize the vertical water drop and related drainage noise. Outlet drops longer than 7” to P-trap water level are not acceptable.

K. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.

L. Inspect each installed unit for damage. Replace damaged fixtures.

M. During construction cover all installed fixtures, sinks, and water coolers with cardboard boxes and wrap with water proof plastic sheeting.

N. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream.

O. Replace washers or cartridges of leaking or dripping faucets and stops.

P. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

END OF SECTION

SECTION 23 05 00

BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Mechanical Sections specified herein.

1.02 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:
   1. Compliance with all codes and standards applicable to this jurisdiction
   2. Shop Drawings for Equipment
   3. Coordination Documents
   4. Record Drawings
   5. Start-up Service and Building Commissioning
   6. Instruction, Maintenance, and O & M Manuals
   7. Work associated with Delivery, Storage, and Handling of products
   8. Work associated with provision of Temporary Facilities
   9. Preparation of Posted Operating Instructions
   10. Meeting Project Safety and Indemnity requirements
   11. Proper Cleaning and Closing
   12. Supplying proper Warranty information
   13. Supply specified Guarantee documentation
   14. Design and provision of Supports and Anchors
   15. Pipe Portals
   16. Pipe Supports
   17. Equipment Rails
   18. Access Panels and Doors
   19. Identification Markers
   20. Coordination of Electrical requirements for equipment provided

1.03 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to provide all material and labor to install complete heating, ventilating, air conditioning systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate this work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipe lines and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

D. Where project involves interface with existing building and site systems, every effort has been made to note existing utilities and services. However, the Contractor should thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

1.04 DESCRIPTION OF BID DOCUMENTS

A. Specifications:
   1. Specifications, in general, describe quality and character of materials and equipment.
   2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:
   1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation.
   2. Before proceeding with work check and verify all dimensions.
   3. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
   4. Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.
   5. Where existing pipes, conduits and/or ducts prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts. Verify exact location and elevation of existing piping prior to any construction.
   6. If any part of Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative interpretation and decision as early as possible, including during bidding period.

1.05 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Accessible": Ability to perform recommended maintenance without removal of services or equipment and requiring no special platforms.

C. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

D. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

E. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

F. "Connect": Complete hook-up of item with required service.

G. "Exposed": Not installed underground or "concealed."

H. "Furnish": To supply equipment and products as specified.

I. "Indicated," "Shown" or "Noted": As indicated, shown or noted on Drawings or Specifications.

J. "Install": To erect, mount and connect complete with related accessories.

K. “Motor Controllers”: Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

L. "Must": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

M. “NRTL”: Nationally Recognized Testing Laboratory, including UL and/or ETL.

N. “Piping”: Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

O. “Provide”: To supply, install and connect as specified for a complete, safe and operationally ready system.

P. “Reviewed,” “Satisfactory” or “Directed”: As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner’s Representative.

Q. “Rough-In”: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

R. “Shall”: An exhortation or command to complete the specified task.

S. “Similar” or “Equal”: Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

T. “Supply”: To purchase, procure, acquire and deliver complete with related accessories.

U. “Typical” or “Typ”: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

V. “Will”: A desire to complete the specified task. Allows some flexibility in application as opposed to “Shall”.

W. “Wiring”: Raceway, fittings, wire, boxes and related items.

X. “Work”: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.06 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 23 Mechanical sections included herein.

B. Division 33: Utility Site Work.
   1. Coordination of excavation of trenches and the installation of mechanical systems and piping on site.

C. Division 03: Concrete.
   1. All concrete work required for mechanical work shall be coordinated by Division 23 with Division 03 including:
      a. Concrete curbs and housekeeping pads for the mechanical equipment.
      b. Thrust blocks, pads, and boxes for mechanical equipment.

D. Division 07: Thermal and Moisture Protection.

1. Flashing and sheet metal
2. Sealants and caulking
3. Firestopping

E. Division 09: Painting:
   1. Division 23 shall coordinate with Division 09 to perform all painting, except where specifically stated otherwise in Division 09.
   2. Painting of all exposed steel, piping, ductwork, insulation, equipment and materials
   3. Paint all exposed gas piping, interior and exterior to the building, yellow.

F. Division 10: Miscellaneous Metals.
   1. Exterior louvers and grilles shall be included in this Section.

G. Division 26: Electrical is related to work of:
   1. Power connections to all mechanical equipment

H. Division 28: Electronic Safety and Security is related to work of:
   1. Fire protection alarms and relays
   2. Smoke detector and monitoring
   3. Life Safety Systems

1.07 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 23 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All accessible mechanical work shall comply with the minimum requirements of the Americans with Disabilities Act (ADA) and local amendments. Refer to Architectural drawings and specifications for additional ADA requirements. The following requirements are provided as consolidated list of minimum ADA requirements. Compliance requirements applicable to HVAC work includes, but is not limited to, the following:
   1. Section 309: Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds maximum.
   2. Section 308.3: Temperature control devices mounted on walls with operable buttons or switches shall be placed where clear floor or ground space allows a parallel approach and the side reach is unobstructed. Operable parts shall be located 48” maximum above finished floor.
   3. Section 308.3.2: Where a clear floor or ground space allows a parallel approach to an element and high reach is over an obstruction, the height of the obstruction shall be 34” maximum and depth of obstruction shall be 24” maximum.
   4. Section 404.2.9: Fire doors shall have a minimum opening force allowable by the applicable Building Code. The force for pushing or pulling open a door other than fire doors shall be 5 pounds maximum.

E. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

F. Provide in accordance with rules and regulations of the following:
   1. Building Codes enforced by the Authority Having Jurisdiction in California:
      a. 2016 Building Standards Administrative Code, Part 1, Title 24 California Code of Regulations (CCR).
      b. 2016 California Building Code (CBC), Part 2, Title 24 CCR (2015 International Building Code with California Amendments).
      c. 2016 California Electrical Code (CEC), Part 3, Title 24 CCR (2014 National Electrical Code with California Amendments).
      d. 2016 California Mechanical Code (CMC) Part 4, Title 24 CCR (2015 Uniform Mechanical Code with California Amendments).
      e. 2016 California Plumbing Code (CPC), Part 5, Title 24 CCR (2015 Uniform Plumbing Code with California Amendments).
      f. 2016 California Energy Code (CEC), Part 6, Title 24 CCR.
      g. 2016 California Fire Code, Part 9, Title 24 CCR (2015 International Fire Code with California Amendments).
      h. 2016 California Green Building Standards Code (CALGreen), Part 11, Title 24 CCR.
      i. 2016 California Referenced Standards, Part 12, Title 24 CCR.
      j. Title 19 CCR Public Safety, State Fire Marshal Regulations.
   2. Local, city, county and state codes and ordinances
   3. Local Bureau of Buildings
   4. Local Health Department
   5. Local and State Fire Prevention Districts
   6. State Administrative Codes

G. Provide in accordance with appropriate referenced standards of the following and as referenced in other specification sections:
   1. NFPA - National Fire Protection Association
   2. AABC - Associated Air Balance Council
   3. CSA - Canadian Standards Association
   4. ADC - Air Diffuser Council
   5. AMCA - Air Moving and Conditioning Association
   6. ANSI - American National Standards Institute
   7. ARI - Air Conditioning and Refrigeration Institute
   8. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
   9. ASME - American Society of Mechanical Engineers
   10. ASTM - American Society for Testing Materials
   11. AWS - American Welding Society
   12. FM - Factory Mutual
   13. International Building Code (IBC) Chapter 16.
   14. ASCE 7-10 – American Society of Civil Engineers – Minimum Design Loads for Buildings and Other Structures.
   15. ICC AC156 Seismic Certification by Shake-Table Testing of Nonstructural Components.
   16. MSS - Manufacturer's Standardization Society
   17. NEMA - National Electrical Manufacturer's Association
   18. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
   19. UL - Underwriter's Laboratories
   20. ADA - Americans with Disabilities Act
   21. ETL - Electrical Testing Laboratories.

H. Provide compliance in accordance with the following referenced standard which applies to general system compliance in contrast to specific equipment standards referenced elsewhere:

1. UL-2043: Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces. This is applicable to spaces above suspended ceilings and below raised floors.

1.08 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Owner's Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Owner's Representative for a decision before proceeding.

1.09 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be metallic riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data suitable for the ambient exposure.

B. All work shall include the following:
   1. Manufactured items and equipment shall be a current, cataloged product of the manufacturer.
   2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 23, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

D. Each product and/or equipment type shall be provided by one manufacturer. Mixtures of manufacturers for each product and/or equipment type are not acceptable. Example – all fire dampers shall be supplied by one manufacturer.

E. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

F. Welding Qualifications:
   1. Steel Support Welding: Qualify procedures and personnel according to American Welding Society AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."
      a. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation per pressure and temperature operating class.

b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.10 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Prepare a Construction IAQ Management Plan meeting the SMACNA IAQ guidelines. See Section 23 31 13 Air Distribution for a summary of requirements.

E. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

F. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications for rough-in requirements.

G. Coordinate mechanical equipment and materials installation with other building components.

H. Verify all dimensions by field measurements.

I. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

J. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

K. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

L. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor shall provide for all cutting and patching required for installation of this work unless otherwise noted.

M. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

N. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

O. Coordinate the installation of mechanical materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

P. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

Q. Coordinate with Owner's Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

R. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

S. Coordinate installation of floor drains and floor sinks with work of other trades, such that finished floor slopes to drains and floor sinks are flush with surrounding floor.

T. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

1.11 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all mechanical work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting their work. It is the specific intention of this section that the contractor's scope of work shall include:

C. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications

D. Minor deviations from the mechanical plans required by architectural and structural coordination.

E. The Contractor shall study the operational requirements of each system, and shall arrange work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work". Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

F. Minor deviations to avoid conflict shall be permitted where the design intent is not altered.

G. Advise the Owner's Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

1.12 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner's Representative for approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings:
   1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per Division. Multiple submissions will not be accepted without prior approval of the Owner's Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.
   2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.
   3. Paper submittals will only be acceptable if specifically required by Division 01.
   4. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.

1.13 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.
   1. The shop drawings shall serve to record the coordination of the installation and location of all HVAC equipment, ductwork, grilles, diffusers, piping, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances.
   2. The Drawings shall include all mechanical rooms and floor plans.
   3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.
   4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:
   1. Two dimensional AutoCAD / Revit based documents:
      a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.

b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the HVAC work.
c. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
d. Drawings shall incorporate all addenda items and change orders.
e. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

2. Three dimensional Revit / BIM based documents (if required for project):
a. Provide three dimensional Revit model and BIM input information locating all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
b. Contractor shall obtain Revit model and BIM input from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
c. Model shall indicate locations of all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
e. Model shall incorporate all addenda items and change orders.
f. Distribute Revit model and BIM input information to all other trades and provide additional coordination as needed to assure adequate space for equipment and piping and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner's Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner's Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

F. Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work.

1.14 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).
1. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
2. RFIs shall address single questions and related issues only.

3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner's Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect and/or Construction Manager.
   6. RFI number, numbered sequentially and unique.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
       a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Incomplete RFIs or inaccurately prepared RFIs.
      a. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.
      b. RFIs addressing multiple unrelated issues.
      c. Requests for approval of submittals.
      d. Requests for approval of substitutions.
      e. Requests for approval of Contractor's means and methods.
      f. Requests for information already indicated in the Contract Documents.
      g. Requests for adjustments in the Contract Time or the Contract Sum.
      h. Requests for interpretation of Engineer's actions on submittals.
   2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.15 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked "Record Set" at the job site at all times, and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves

and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.).

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. Provide copy of Record Documents to Testing and Balancing Contractor and Commissioning Agent for use when performing their work.

E. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record Documents and CD/DVD disks labeled with all drawings and specifications and other supporting documentation.

F. Refer also to Division 01 for full scope of requirements.

1.16 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of air conditioning units, temperature controls, chillers, boilers, pumps, and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Provide certificates of calibration for all sensors required for control and monitoring including temperature and pressure.

D. Refer to other Division 23 Sections for additional requirements.

1.17 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, and prior to training of Owner's personnel, the Contractor shall submit to the Owner’s Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. Contractor shall be responsible for providing proper instruction of the of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 23. Training is to be appropriate to the complexity of the equipment. The Contractor shall develop and submit training materials prior to this training. These materials shall include qualifications of the trainer, training agenda, learning objectives, and a written test to be administered at the end of the training session. Operation and Maintenance manuals must present, incorporated and referenced in the training sessions.

1.18 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment showing signs of rust shall be removed from site and replaced with new.

1.19 UNIT PRICING SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. Preliminary List of Materials and Unit Price Items: Within thirty (30) days after awarding of the Contract, submit to Owner's Representative for preliminary approval a complete list of manufacturer's names and model numbers of proposed materials and equipment. Also include proposed list of unit price items for review.
   1. Indicate substituted items.
   2. Identify test and balancing agency.
   3. Identify independent testing laboratory for water analysis.

C. The Contractor shall submit with preliminary list of materials a unit price list for each item furnished on this project. Included with price shall be labor cost index.

D. Submittals and Shop Drawings shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. Submit six (6) typed copies of submittals. Refer to Division 01 for additional requirements.

1.20 TEMPORARY FACILITIES

A. Refer to Division 01 for the requirements of temporary water and sewer for construction and safety. Provide temporary heating, air conditioning, ventilation, water, and sewer, etc. services as necessary during the construction period and as required to maintain operation of existing systems.

B. Temporary Heating for Commissioning Tests:
   1. Provide temporary heating where needed to provide false load for commissioning tests.
   2. Temporary heating may be from the permanent heating system of the project or from a dedicated temporary heating system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon what work in place or being installed.

C. Temporary Cooling for Commissioning Tests:
   1. Provide temporary cooling where needed to provide false load for commissioning tests.
   2. Temporary cooling may be from the permanent cooling system of the project or from a dedicated temporary cooling system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon the work in place or being installed.

1.21 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring

diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.22 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner's Representative, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner's Representative, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.23 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner's Representative.

1.24 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, or longer, as defined in each subsequent specification section. Warranty shall include all parts, material, labor and travel.

D. Warranty Start Date: The start date for all warranty periods shall be defined as starting from the date of Substantial Completion which shall include the Certificate of Occupancy from the Authority Having Jurisdiction.

E. Refer to individual Specification sections for additional extended warranty requirements.

F. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

G. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

H. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.25 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year, minimum, after Substantial Completion, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in this work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words “or approved equal” shall be considered to be subsequent to all manufacturers’ names used herein, unless specifically noted that substitutes are not allowed.

2.02 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:
   1. UL and FM Compliance: Provide products, which are UL listed and FM approved.
   2. ASCE 7 (Latest Edition): American Society of Civil Engineers-Minimum Design Loads for Buildings and Other Structures.
   3. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).
   4. SMACNA: Seismic Restraint Manual: Guidelines for Mechanical Systems.
   5. NFPA: Pamphlet number 13 and 14 for fire protection systems.

6. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.
7. Manufacturer: Hilti Inc., B-Line, Anvil International, Erico, Tolco, Kin-Line, Simpson Strong-Tie Co. Inc., Superstrut, or Powers Fasteners.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.
1. Adjustable Steel Clevis Hangers: MSS Type 1.
2. Adjustable Steel Swivel Band Hangers: MSS Type 10.
3. U-Bolts: MSS Type 24.
4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
   b. Plate: Unguided type.
   c. Plate: Guided type.
   d. Plate: Hold-down clamp type.
5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.
6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.
7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.
8. Upper Attachment Side Beam Bracket: MSS Type 34
9. Upper Attachment Side Beam Angle Bracket: MSS Type 34, UL listed and FM Approved.
10. Single Pipe Roller with Malleable Sockets: MSS Type 41.
11. Adjustable Roller Hangers: MSS Type 43.
12. Pipe Roll Stands: MSS Type 44.
13. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.
1. Steel Turnbuckles: MSS Type 13.
2. Steel Clevises: MSS Type 14.
3. Swivel Turnbuckles: MSS Type 15.
4. Malleable Iron Eye Sockets: MSS Type 16.
5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated by the Structural Engineering design, provide factory-fabricated building attachments of one of the following types listed.
1. Concrete Inserts: HCI-MD (for metal deck) or HCI-WF (for wood forms) cast-in anchors by Hilti Inc. or MSS Type 18, Blue Banger Hanger by Simpson Strong-Tie Co. Inc., or Bang-It (for metal deck) or Wood-Knocker (for wood forms) by Powers Fasteners.
2. Steel Brackets: One of the following for indicated loading:
   a. Light Duty: MSS Type 31.
   b. Medium Duty: MSS Type 32.
   c. Heavy Duty: MSS Type 33.

3. Horizontal Travelers: MSS Type 58.
4. Concrete Screw Anchors: KWIK HUS EZ-I by Hilti Inc., Titen HD (or Rod Hanger version) by Simpson Strong-Tie Co. Inc., Wedge-Bolt+ (Screw Anchor) by Powers Fasteners, or Vertigo+ (Rod Hanger) by Powers Fasteners, or Snake+ (Internally Threaded Screw Anchor) by Powers Fasteners, or equal.
5. Torque-Controlled Expansion Anchor: KWIK BOLT-TZ by Hilti Inc., Strong-Bolt 2 by Simpson Strong-Tit Co. Inc., Power-Stud+ SD1 and Power-Stud+ SD2 by Powers Fasteners, or equal.
6. Screws and Bolts: Bolt Depot, Fastenal, National Bolt & Nut, or equal.
7. Eye Bolts: Lawson Products, Sierra Pacific, US Cargo Control, or equal.

G. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
   1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
   2. Insulation Protection Shields: MSS Type 40, 18" minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.
   3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert. Alternately Polyisocyanurate Urethane with a minimum flexural strength of 60psi, fully encased in 360 PVC (1.524 mm thick) SNAPPITZ. Provide assembly of same thickness as adjoining insulation.
   4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:
   1. Metal Framing: Provide products complying with NEMA STD ML1.
   2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.
   3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of one part cement to three parts sand by volume, with minimum amount of water required for placement and hydration.
   4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.
   5. Pipe Brackets: “HoldRite” copper plated brackets. Insulate brackets attached to metal studs with felt.

2.03 PIPE PORTALS

A. Where pipe portals are not provided by other sections of Specification, provide prefabricated insulated pipe portals as required for piping penetrating through the roof where shown on plans. Field built pipe portals are acceptable alternatives - provide detail of construction for review.

B. Standard pipe portals, unless otherwise noted, shall be constructed as follows:
   1. Curb shall be constructed of heavy gauge galvanized steel with continuous welds on shell seams.
   2. Insulation to be 1-1/2" thick, 3 lb density rigid fiberglass.
   3. Curb to have a raised 3" (minimum), 45° cant.
   4. Curb to have 1-1/2" x 1-1/2" wood nailer (minimum).

5. Curb height to be 8" (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.
7. Cover or flashing to be constructed of galvanized steel or other suitable material to provide sturdy weather tight closure. Provide collars and rubber nipples with draw bands of sizes required by piping. Size curb, cover and nipples per manufacturer's recommendations.

C. Manufacturer: Roof Products Systems, Pate, or equal.

2.04 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping. Coordinate all pipe stands with structural design.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

G. Manufacturer: Pate, Roof Products Systems, Portable Pipe Hangers, Roof Top Blox, Erico Caddy Pyramid, or equal.

2.05 EQUIPMENT/PIPING RAILS

A. Where equipment/pipe rails are not provided by other sections of Specification, provide prefabricated reinforced equipment rails as required for support of equipment and piping. Field built curbs are acceptable alternatives - provide detail of construction for review.

B. Standard equipment rail, unless otherwise noted, shall be constructed as follows:
1. Construct of heavy gauge galvanized steel with continuous welds on shell seams.

2. Provide internal reinforcing supports welded as required to meet application requirements.
3. Equipment rails to have raised 3" (minimum), 45° cant.
4. Equipment rails to have 1 1/2" x 1 1/2" wood nailer (minimum) and counterflashing.
5. Equipment rail height to be 6" (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.

C. Equipment rails to be constructed to meet equipment size and weight requirements. Provide tapered rails to match roof pitch where required.

D. Manufacturer: Pate, Vent Products, Thy Curb, Roof Products Systems, or equal.

2.06 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20-gauge steel, 1" flange width, continuous piano hinge, key operated, prime coated. Refer to Division 01 Architectural specifications and drawings for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels are not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each trap primer or concealed valve, for fire and combination fire/smoke dampers, and for volume dampers. Use no panel smaller than 12" x 12" for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Owner’s Representative. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Owner’s Representative.

D. Manufacturers: Milcor, Karp, Nystrom, Elmdor/Stoneman, or equal.

2.07 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 23 Sections. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category. Stencils, hand printed, painted, and felt pen markers are not acceptable.

B. Plastic Pipe Markers:
1. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially or fully cover the circumference of pipe, or insulated pipe, and to attach to pipe without fasteners or adhesive complying with ANSI A13.1. Minimum letter size shall be 1/2” high.
2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape.

3. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
4. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
5. Nomenclature shall include service type and directional arrow as follows:
   a. Chilled Water Supply and Return: green background with white lettering.
   b. Heating Water Supply and Return: yellow background with black lettering.
   c. Condenser Water Supply and Return: green background with white lettering.
   d. Heat Pump Loop Supply and Return: green background with white lettering.
   e. Refrigerant: yellow background with black lettering.
   f. Exhaust air: blue background with white lettering.
   g. Other piping services: Comply with ANSI and ASME A13.1standards.
   h. Direction of water flow.

C. Plastic Duct Markers:
1. Provide duct labels to indicate the system and direction of flow. Submit a labeling product that is suitable for the surface to be labeled.
   a. Pressure sensitive, 16” long by 2-1/4” high (minimum), 3 mil thick high gloss adhesive backed vinyl, 1-1/2” high letters, and color coded per ducted service.
2. Nomenclature shall include service type and directional arrow as follows:
   a. Supply air (cold service): green background with white lettering.
   b. Supply air (hot service): yellow background with black lettering.
   c. Return air: blue background with white lettering.
   d. Relief air: blue background with white lettering.
   e. Outside air: blue background with white lettering.
   f. Exhaust air: blue background with white lettering.
   g. Other air services: Comply with ANSI and ASME A13.1standards.
   h. Direction of air flow.

D. Valve Tags:
1. Brass Valve Tags: Provide 1-1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Fill tag engraving with black enamel.
2. Plastic Laminate Valve Tags (indoors only): Provide 3/32” thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32” hole for fasteners.
3. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
4. Access Panel Markers: Provide 1/16" thick (minimum) engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or device.
5. Plastic Equipment Signs:
6. Provide 4-1/2” x 6” (minimum) plastic laminate sign, ANSI A.13 color coded with engraved white core lettering. Minimum letter size shall be 1/2” high.
7. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
8. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
   a. Tag number
   b. Equipment service.
   c. Design capacity.

d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

9. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2"x11" bond paper, tabulate each equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

E. Underground-Type Plastic Line Markers: Provide 6" wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

F. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Kolbi, or Brimar.

2.08 ACOUSTICAL BLANKET INSULATION

A. Application:
1. Wrap high noise producing equipment and ductwork where occupied room noise levels cannot be obtained by architectural room barrier construction alone.
a. Wrap variable air volume terminal where located above noise sensitive rooms such as conference rooms, lobbies and offices.
b. Wrap ductwork where located above noise sensitive rooms such as conference rooms, lobbies and offices.
c. Wrap fans where located above noise sensitive rooms such as conference rooms, lobbies and offices.

B. Manufacturers: Kinetics Noise Control #KNM-100ALQ, or equal by BRD Noise and Vibration Control, GLT Products #Vinaflex with Absorber/Decoupler, or Singer Safety Company, Quilted Fiberglass Panels.

C. Composite material, quilted, with reinforced aluminized-face, mass loaded limp vinyl bonded to scrim-face, quilted fiberglass absorber/decoupler.

D. The barrier shall be constructed of a 0.12" (3 mm), minimum, thick mass loaded, limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side. The barrier shall have a nominal density of 1.0 lbs./ft^2 (4.9-kg/m^2) and shall have a minimum STC rating of 28 as measured in an independent accredited acoustical laboratory in accordance with ASTM E90 and/or E413.

E. The decoupling layer shall be a combination of 1.0" (25 mm), minimum, fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together in a matrix of 4" (100 mm) diamond stitch pattern which encapsulates the glass fibers.

F. The composite material shall be fabricated to include a minimum 2" (50 mm) wide barrier overlap tab extending beyond the quilted fiberglass to facilitate a leak-tight seal around field joints.

G. The barrier shall have a Flame Spread Index of no more than 10 and a Smoke Development Index of no more than 40 when tested for Surface Burning Characteristic per ASTM E84.

2.09 ELECTRICAL

A. General:

1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
2. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.
3. Set and align all motors and drives in equipment specified herein.
4. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.
5. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted “U” cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.
6. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

B. Quality Assurance:
   1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:
   1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment Specifications.
   2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
   3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Unless otherwise noted on plans, all motors 1/2 HP or larger shall be rated for 208 or 460 volt, 3-phase, operation. Unless otherwise noted on plans, all motors less than 1/2 HP shall be rated for 120 volt, single phase operation.
   4. Temperature Rating: Motor meets class B rise with class F insulation.
   5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
   6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design “B”, except “C” where required for high starting torque.
      a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
      b. VFD driven motors to be provided as inverter ready and equipped with a shaft grounding device, or inverter duty complying with NEMA Standard MG-1, Part 31 as supplied by same manufacturer as VFD.
      c. Bearings:
         1) Ball or roller bearings with inner and outer shaft seals.
         2) Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
         3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.
         4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.
         5) Enclosure Type:
            a) Open drip-proof (ODP) motors for indoor use in clean air environments.
            b) Totally enclosed fan cooled (TEFC) motors for outdoor use and indoor application in dirty environments.
            c) Totally enclosed air over (TEAO) motors for motors in the airstream of cooling towers and fluid coolers.
            d) Guarded drip-proof motors where exposed to contact by employees or building occupants.
            e) Weather protected Type I for outdoor use, Type II where not housed.

d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
e. Noise Rating: "Quiet."
f. Efficiency:
   1) Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.
   2) And, motors shall meet the NEMA premium efficiency standard.
g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:
1. Motor Starter Characteristics:
   a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs.
   b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.
2. Manual switches shall have pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).
3. Magnetic Starters:
   a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
   b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).
   c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
   d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.
   e. Externally operated manual reset.
   f. Under-voltage release or protection for all motors over 20 hp.
4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:
1. General: 14-gauge, Type THHN, color coded, installed in conduit.
2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:
1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.
2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.01 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work unless so indicated on Drawings or approved by Owner's Representative.

3.02 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.
   1. If the contractor must deviate from the manufacturer's recommendations provide a letter from the manufacturer indicating the clearance to be provided is acceptable for scheduled performance and maintenance.

3.03 INSTALLATION

A. Coordinate the work between the various Mechanical Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Engineer and at the Contractor's cost. Coordinate wall and ceiling work with the General Contractor, and other trades in locating ceiling air outlets, wall registers, etc.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

3.04 SUPPORTS AND HANGERS

A. Prior to installation of hangers, supports, anchors, and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives, (if any), installers of other work with requirements specified.

B. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed. Fasten insert securely to forms. Where Gypcrete is indicated, install reinforcing bars through opening at top of inserts.

C. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

D. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate

supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

E. Install hangers within 12 inches of every change in piping direction, end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

G. Support sprinkler piping and gas independently of other piping.

H. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

I. Hanger Spacing in accordance with following minimum spans for support of individual pipes and a minimum of one hanger per elbow at each change of direction. Other spacing and rod sizes may be considered in compliance with Table 121.5 of ASME B31.1, but shall not exceed 20 feet for large size pipe

1. Steel Pipe (Water Filled):

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2” to 1”	7 feet	3/8”
1-1/4” to 2”	10 feet	3/8”
3” to 4”	12 feet	3/8”
5” to 8”	15 feet	1/2”
10” to 12”	20 feet	2@5/8”
14” to 16”	20 feet	2@3/4”

2. Steel Pipe (Gas/Air Filled):

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2" to 1-1/4"	6 feet	3/8"
1-1/2" and larger	10 feet	1/2"

3. Copper Pipe:

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2" to 2"	6 feet	3/8"
2-1/2" and larger	8 feet	1/2"

4. Plastic/Fiberglass Pipe:

Pipe Size	Max. Hanger/Support Spacing	Rod Size
1/2" to 2"	4 feet	3/8"
2-1/2" and larger	6 feet	1/2"

5. Caulked Bell and Spigot and Glass Pipe: Provide hanger for each section of pipe, located at shoulder of bell. Where an excessive number of fittings are installed between hangers, provide additional reinforcing.
6. Trapeze support: Provide details stamped by a Registered Structural Engineer for the project state indicating trapeze channels, support rod sizes, and spacing.

J. Provisions for Movement:
1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.
3. Insulated Piping: Comply with the following installation requirements:

a. Clamps: Attach clamps, including spacers, (if any), to piping with clamps projecting through insulation.
b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install shields or inserts.
c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

K. Installation of Anchors:
1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.
3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
4. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

L. Equipment Supports:
1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.
2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

M. Adjusting:
1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 WALL, FLOOR, AND ROOF PENETRATION SIZING

A. All pipe penetrations through rated and non-rated assemblies shall be sized to allow for compliance with structural integrity and fire ratings, as applicable. Where sleeves are required, the sleeve size shall be installed with the inside clear diameter providing clearances as required below. Coordinate the required opening sizes with the manufacturer of the fire protection products.
1. Uninsulated pipe penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each uninsulated pipe.
2. Insulated pipes penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each pipe, including insulation.
3. Uninsulated pipe penetrations through fire rated walls and floors, and through roof: penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside diameter of each uninsulated pipe to provide minimum 1/4” annular space between the outside of the pipe surface and assembly. Coordinate with specific manufacturer requirements and UL listing.
4. Insulated pipe penetrations through fire rated walls and floors, and through roof: pipe penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside

diameter of each insulated pipe to provide minimum 1/4" annular space between the outside of the insulation surface and assembly. Coordinate with specific manufacturer requirements and UL listing.

5. Uninsulated pipe penetrations through foundation and basement walls: penetration sizes shall be larger than the outside diameter of each uninsulated pipe to allow adequate space for installation of mechanical link seals. Coordinate with specific manufacturer requirements.

3.06 ROOF CURBS, EQUIPMENT RAILS, PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed, as applicable.

C. Verify roof insulation thickness and adjust raise of cant to match.

3.07 ELECTRICAL COORDINATION

A. Division 23 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

C. Division 23 has responsibilities for electrically powered mechanical equipment which is specified in Division 23 Specifications or scheduled on Division 23 Drawings as follows:
   1. Motors: Furnish and install all motors necessary for mechanical equipment.
   2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 23 equipment, also furnish and install the power wiring between starter and motor.
   3. Variable Frequency Drives: Provide all VFD's associated with mechanical equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.
   4. Disconnects: Provide the disconnects which are part of factory wired Division 23 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.
   5. Controls: Division 23 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:
      a. Control relays necessary for controlling Division 23 equipment.
      b. Control transformers necessary for providing power to controls for Division 23 equipment.
      c. Line voltage thermostats.
      d. Low or non-load voltage control components.
      e. Remote bulb thermostats.
      f. Non-life safety related valve or damper actuators.
      g. Float switches.
      h. Solenoid valves, EP and PE switches.

i. Refrigeration controls.
j. Communications wiring and conduit between control devices and mechanical equipment.
k. Raceway to support control cabling.

6. Fire/Smoke Dampers: Division 23 is responsible for providing and physically installing the damper and for installing any required control interface wiring to Division 23 controls.
   a. Where fire/smoke dampers are part of an integrated smoke control system, Division 23 is responsible for providing dampers with necessary end switches for use by Division 28 in providing proof of closure.
   b. Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct detector installed per the requirements of the building code. If not integral with the damper assembly, the detector is to be installed in ductwork by Division 23 but wired to the damper controller by Division 26.

D. Division 26 Electrical Responsibilities:
   1. Motors: Provide the power wiring for the motors from servicing panel to motor controller.
   2. Magnetic Starters: Except where magnetic starters are factory installed on Division 23 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 23 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring from source panel/disconnect to the starter.
   3. Variable Frequency Drives: Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 23.
   4. Disconnects: Provide all disconnects necessary for Division 23 mechanical equipment which are not provided as part of factory wired Division 23 equipment. Provide power wiring to all disconnects. In addition provide power wiring between motor and disconnect when the disconnect is not factory installed.
   5. Controls: Division 26 is responsible for providing power to mechanical control panels and provide final power connection to Division 23 provided control transformers.
   6. Fire/Smoke Dampers: Division 26 is responsible for power wiring to each damper and as follows:
      a. Where these dampers are part of an integrated smoke control system Division 28 is responsible for providing the detectors and for all fire/smoke detection system wiring necessary to integrate dampers and related end switches into the system.
      b. Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct smoke detector installed per the requirements of the building code. If not integral with the damper assembly, the detector is to be installed by Division 23, but wired for damper control by Division 26.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.08 PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Section 09 91 00: Painting and Coating. Painting schemes shall comply with ANSI A13.1. Paint all exposed materials such as piping, ductwork, equipment, insulation, steel, etc. The inside surface of visible ductwork above diffusers/grilles shall be painted flat black.

B. All exposed work under Division 23 shall receive either a factory finish or a field prime coat finish, except:
   1. Exposed copper piping.
   2. Aluminum jacketed outdoor insulated piping.

3.09 IDENTIFICATION MARKERS

A. General: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Piping System Identification:
   1. Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.
   2. Locate pipe markers as follows:
      a. Near each valve and control device.
      b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
      c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
      d. At access doors, manholes, and similar access points which permit view of concealed piping.
      e. Near major equipment items and other points of origination and termination.
      f. Spaced horizontally at maximum spacing of 30' along each piping run, with minimum of one in each room.
      g. Vertically spaced at each story transversed.

C. Ductwork Identification: A minimum of every 50' for all ductwork, 12" or more in diameter or width, where ducts are concealed above accessible ceilings.

D. Mechanical Equipment Identification: Locate engraved plastic laminate signs on or near each major item of mechanical equipment and each operational device. Provide signs for the following:
   1. Main control and operating valves, including safety devices.
   2. Meters, gauges, thermometers, and similar units.
   3. Pumps, compressors, chillers, and similar motor-driven units.
   4. Hot water system mixing valves and similar equipment.
   5. Boilers, heat exchangers and similar equipment.
   6. Fans, blowers, primary balancing dampers, and mixing boxes.
   7. Packaged HVAC central-station and zone-type units.
   8. Tanks and pressure vessels.
   9. Strainers, filters, treatment systems and similar equipment.

E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.

F. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

3.10 VIBRATION AND DYNAMIC BALANCING

A. All equipment submitted and installed by Division 23 shall not exceed maximum tolerances as specified by the “International Research and Development Corporation”, Worthington, Ohio, measured by the displacement, peak to peak, as follows:
   1. All Fans: Below severity chart labeled “FAIR”, maximum velocity of 0.0786 in/sec, peak.
   2. Pump and Electric Motors: Below severity chart labeled “SLIGHTLY ROUGH”, maximum vibration velocity of 0.157 in/sec, peak.
   3. Compressors: Same as pumps.

B. Where installed equipment noise or vibration is objectionable to the Owner’s Representative, it shall be responsibility of the contractor to conduct testing to confirm that the equipment does not exceed the standard.

C. Correction shall be made to all equipment, which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

3.11 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner’s Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Ductwork: Test all air quantities as specified in Section 23 05 93 - Testing, Adjusting and Balancing. Pressure tests per SMACNA.

C. Registers and Diffusers: Test for proper operation of manually operated control feature. Test all air quantities as specified in Section 23 05 93 – Testing, Adjusting and Balancing.

D. Ductwork Specialties: Test all operable ductwork specialties for proper operation. Check all fire, smoke and fire/smoke dampers to ensure that they are 100% open.

E. Temperature Control: Test all control functions to assure that all systems are controlling as specified or as otherwise necessary and that all controls are adjusted to maintain proper room temperatures. The manufacturer's representative shall perform all tests.

END OF SECTION

SECTION 23 05 49

SEISMIC RESTRAINT FOR PIPING, DUCTWORK, AND EQUIPMENT

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SUMMARY

A. This Section includes the following:
   1. Seismic restraint and support of piping, ductwork and mechanical equipment as required by code and as designed by a registered Professional Structural Engineer for each related nonstructural equipment restraint.
   2. Mechanical component supports and the means how they are attached to the mechanical component shall be designed for the forces and displacements determined in ASCE 7 Chapter 13. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.
   3. All ductwork designed to carry toxic, highly toxic, flammable gases or used for smoke control shall be seismically braced regardless of size or location.

1.03 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. ASCE: American Society of Civil Engineers

C. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers

D. IBC: International Building Code with Amendments

E. ICC-ES: ICC-Evaluation Service

F. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association

G. Mechanical Attachments: Means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

H. Mechanical Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

I. Mechanical Components: Elements, including, but not limited to, pumps, air handling units, boilers, chillers, pipes, ductwork, and exhaust fans.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 05 48: Vibration Isolation for Piping, Ductwork and Equipment

C. Section 23 21 13: Hydronic Piping, Valves and Specialties

D. Section 23 31 13: Air Distribution

E. Other Division 23 Sections

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Structural Performance: Restraint devices and systems shall withstand the effects of locally defined gravity loads, seismic loads, dead loads, live loads, winds loads and stresses within limits and under conditions indicated per the local Building Code and ASCE 7. Coordinate all support structures and restraint systems with project registered professional Structural Engineer.

C. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

D. Codes and Standards: Provide components conforming to the seismic load requirements of the latest addition of the local building code and the following:
   1. International Building Code with State Amendments.
   2. ASCE 7 (Latest Edition) - Minimum Design Loads for Buildings and Other Structures
      a. Ductwork and piping requirements defined in Chapter 13 Seismic Design Requirements for nonstructural Components.
      b. Seismic Design Categories, B through F, are defined in Chapter 12, Table 12.6-1. Seismic Design Category B and C apply to all structures. While Seismic Design Categories D, E and F may apply to Category I and II buildings not exceeding two stories, light frame construction and/or structures not exceeding 160 in height.
      c. Nonstructural components in Seismic Design Category A are exempt from seismic design requirements.
   3. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems (Latest Edition)
      a. Seismic guidelines for ductwork and piping bracing as adopted by Authority Having Jurisdiction.
   4. ASHRAE – Practical Guide to Seismic Restraint (Latest Edition)
   5. Mason West Inc. - Seismic Restraint Guidelines (Latest Edition)
      a. For all suspended piping, suspended ductwork and suspended electrical raceways.

1.06 APPLICABILITY

A. Seismic restraints are required for nonstructural mechanical systems, but may not be required for the following conditions related to nonstructural components per ASCE 7 Section 13.1.4:
   1. Mechanical components in Seismic Design Category B facilities.
   2. Mechanical components in Seismic Design Category C facility if the component Importance Factor, I_p, is equal to 1.0.
   3. Mechanical components in Seismic Design Categories D, E, or F facilities where all of the following apply:
      a. The component Importance Factor, I_p, is equal to 1.0;
      b. The component is positively attached to the structure;
      c. Flexible connections are provided between the component and associated ductwork, piping, and conduit; and any of the following applies:
         1) The component weighs 400 lbs. (1,780 N) or less and has a center of mass located four feet (1.22 m) or less above the adjacent floor level; or
         2) The component weighs 20 lbs. (89 N) or less; or
         3) The distributed ductwork or piping system weights 5 lbs./ft. (73 N/m) or less.

B. Provide seismic bracing at the following locations per SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems (Latest Edition):
   1. Piping:
      a. Transverse bracing shall be provided at 40 feet (12.2 m) maximum except where a lesser spacing is indicated in SMACNA tables.
      b. Longitudinal bracing shall be provided at 80 feet (24.4 m) maximum except where a lesser spacing is indicated in SMACNA tables. Anchor locations for thermal expansion may be used as longitudinal braces. Longitudinal braces must be capable of resisting the additional force induced by expansion and contraction.
   2. Ductwork:
      a. Transverse bracing shall be provided at 30 feet (9.2 m) maximum except where a lesser spacing is indicated in SMACNA tables.
      b. Longitudinal bracing shall be provided at 60 feet (18.4 m) maximum except where a lesser spacing is indicated in SMACNA tables.
   3. Equipment:
      a. All equipment weighing more than 400 lbs. (1,780 N) shall be seismically braced or attached directly to structure.
      b. All suspended mechanical components weighing more than 20 lbs. (89 N) shall be seismically braced, unless the following criteria applies for components up to 75 lbs.
      c. All equipment installed in-line with the duct system with a weight greater than 75 lbs. (334 N), such as fans, heat exchangers and humidifiers, must be supported and laterally braced independent of the duct system.

C. Seismic restraints may be omitted where the following conditions apply and as allowed by the local Authority Having Jurisdiction (AHJ):
   1. Ductwork supported by hangers and each hanger in the duct run is 12" (305 mm) or less in length from the duct support point to the supporting structure.
   2. Ductwork cross-sectional area is less than six (6) square feet (0.557 m^2), round ductwork is 32 inches (0.8 m) in diameter or less, or weighs 17 lbs./ft. (248 N/m) or less.
   3. Pipes suspended by hangers 12" (305 mm) or less in length from the top of the pipe to the bottom of the supporting structure for the hanger. Where pipes are supported by trapeze, the trapeze shall be supported by hangers having a length of 12” (305 mm) or less.
   4. Pipe bracing is not required where the following conditions apply:

a. For Seismic Design Category C where the Ip value is greater than 1.0 and pipe sizes are 2" (50 mm) in diameter or less, and piping weighs less than 10 lbs./ft. (146 N/m).
b. For Seismic Design Category D, E, or F where the Ip is greater than 1.0 and pipe sizes are 1" (25 mm) in diameter or less, and piping weighs less than 10 lbs./ft. (146 N/m).
c. For Seismic Design Category D, E, or F and where the Ip equals 1.0 and pipe sizes are 3" (80 mm) in diameter or less, and piping weighs less than 10 lbs./ft. (146 N/m).

D. Seismically restrained systems shall not move more than 2" when pushed and shall not impact other nonstructural components or building structure.

1.07 PERFORMANCE REQUIREMENTS

A. Component Importance Factor and Risk Category:
1. Ip=1.0: Standard Occupancies and components associated with Risk Category I, II, and III, including offices and schools.
2. Ip=1.5: Components associated with Risk Category IV Buildings (Essential Services); or for conditions outlined in ASCE 7 Section 13.1.3 regardless of Risk Category, or Hospitals and Correctional Treatment Centers. Components include, but are not limited to, the following:
a. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.
b. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the AHJ and is sufficient to pose a threat to the public if released.
3. Additions, alterations, and repairs involving nonstructural mechanical components in structures designed in accordance with pre-1973 building codes may have a Component Importance Factor of Ip=1.0. However, components required to operate for life-safety purposes after an earthquake, including emergency and standby power systems, mechanical smoke removal system, fire alarm panels and egress stairways shall have an Ip=1.5.

B. Building Seismic Design Category:
1. The directions of application of seismic forces used in the design shall be those which will produce the most critical load effects. Seismic Design Categories are classified as B, C, D, E or F. Refer to Architectural and Structural Designs for project specific classification.

C. Mechanical Seismic Coefficients for Mechanical Components:
1. Refer to ASCE 7 Table 13.6-1 for a_p factor (component amplification factor) and R_p factor (component response modification factor) as required for each unique mechanical component.

1.08 SUBMITTALS

A. Product Data:
1. Include rated load, rated deflection, and overload capacity for each device or system.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Submit seismic brace product details from the Mason West Seismic Restraint Guidelines detailing compliance with the specifications.
4. Where products from the Mason West Seismic Restraint Guidelines cannot be used, special details must be submitted for approval.

B. Seismic Restraint Calculations
1. Seismic restraint calculations must be provided for all connections to the structure.
2. Calculations must be stamped by a registered professional Structural Engineer.
3. Where seismic restraint sizes, spacing and anchorage are included in the Mason West Seismic Guidelines no further calculations are required.

1.09 ENGINEERED PIPING SYSTEMS

A. Where the piping system design indicated on the plans utilizes Mason Industries, Inc. - Mason West, Inc. seismic restraint components, vibration isolators, guides, anchors, expansion compensators and flexible connectors the following requirements apply:
1. Mason Industries, Inc. - Mason West, Inc. products must be installed as shown.
2. If product substitutions or design changes are made the contractor must provide certified design of the piping system and meet the following conditions:
a. Certification must be provided by a registered professional Structural Engineer.
b. Certification shall include a statement that all systems have been checked for loads and stresses and that no excessive loads or stresses exist.
c. Forces on all anchors, guides, supports, and restraints must not exceed those shown in the original design unless the structure is checked for the larger loads at no cost to the owner.

B. Where the piping system design is not indicated on the drawings the design is delegated to the contractor with the following requirements for piping certification and analysis:
1. The supports, anchors, guides and seismic braces for systems with significant thermal motion including steam, condensate, high temperature hot water and heating hot water systems must be designed for combined gravity, seismic, pressure and thermal loads.
2. Small diameter pipes (2” diameter and smaller) may not require analysis as determined by the project registered professional Structural Engineer.
3. The results of the analysis shall include reactions at restraints and anchors, maximum pipe displacements and a code compliant report indicating maximum pipe stresses.
4. Where required, seismic restraint components, vibration isolators, guides, anchors, expansion compensators and flexible connectors manufactured by Mason Industries, Inc. and Mason West, Inc. shall be incorporated into the design of the systems.
5. The analysis and design must be performed by a Structural Engineer with 5 years of experience in this field.

1.10 MANUFACTURER AND CONTRACTOR RESPONSIBILITIES

A. All seismic restraints shall be designed by a registered professional Structural Engineer.

B. Seismic restraint layouts for piping and ductwork shall be added to the contractor’s shop drawings and shall include:
1. The number, size and location of seismic braces.
2. Maximum support loads and seismic loads at the seismic brace locations.
3. Reference to specific details or pages from the Mason West Seismic Restraint Guidelines.

C. Submit seismic restraint layout drawings and special details for approval of the project registered professional Structural Engineer per the requirements listed in the Mason West Seismic Restraint Guidelines.

D. Seismic restraint layout drawings shall bear the stamp and signature of the registered professional Structural Engineer who designed the layout of the braces.

1.11 LOADS ON STRUCTURE

A. The responsibility of determining allowable loads on the structure is the sole responsibility of the project registered professional Structural Engineer.

B. Maximum support loads and seismic brace loads on the structure must be less than the maximum allowable loads defined by the project registered professional Structural Engineer, as shown on the plans.

C. Where maximum loads are not listed on the plans or the maximum allowable loads cannot be met, any additional support steel required to reduce support and seismic bracing loads on the structure shall be designed by the project registered professional Structural Engineer.

D. Mechanical component supports and the means how they are attached to the component shall be designed for the forces and displacements determined in ASCI 7 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.

E. Mechanical supports are those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Mechanical attachments are the means how components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

1.12 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 INTENT

A. All seismic restraints described in this section shall be the product of a single manufacturer.

B. Mason Industries products are the basis of these specifications; products of other manufacturers may be submitted for review provided their systems strictly comply with the specifications.

2.02 SEISMIC SWAY BRACING

A. Seismic sway braces shall consist of galvanized steel aircraft cables, steel angles or steel struts.

B. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads. Brace end connections shall be steel assemblies that swivel to the final installation angle.

C. Cable brace assemblies shall have published strength and stiffness ratings based on testing per FM-1950 standards.

D. Angle or strut bracket assemblies shall be FM Approved except as noted below.

E. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps.

F. Cable brace bracket assemblies shall be Type SCB or SCBH. Solid brace bracket assemblies shall be Type SSB-FM, SSBS-FM or SHB-FM. All bracket assemblies shall have published strength and stiffness values based on testing per FM-1950.

G. Rod clamps shall be Type SRC or UCC.

PART 3 - EXECUTION

A. Contractor's Statement of Responsibility: Each contractor responsible for installing a Designated Seismic System or any seismic resisting component must submit a statement of responsibility prior to the commencement of work to include acknowledgment of awareness of the need for Special Inspections.

B. All seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

C. Installation of seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

D. No connections between the piping or ductwork and the building structure shall be made that degrades the seismic restraint system herein specified.

E. Any conflicts with other trades due to inadequate space or other unforeseen conditions should be brought to the attention of the Owner's Representative prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 WORK RELATED IN OTHER SECTIONS

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 09 00: Building Automation System (BAS) Controls

C. Section 23 21 13: Hydronic Piping, Valves and Specialties

D. Section 23 31 13: Air Distribution

E. Division 26: Electrical.

1.03 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 23 05 00 - Basic Mechanical Requirements.

B. Systems: Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:
   1. Air handling systems including supply, return and exhaust.
   2. Air distribution ductwork including supply, return and exhaust.
   3. Dedicated exhaust systems.
   4. Hydronic system including condenser water.
   5. Instruction of Owner's personnel for future balancing of systems.

1.04 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Reference Standards
   1. ANSI/ASHRAE Standard 111 - Measurement, Testing, Adjusting and Balancing of Building HVAC Systems (current edition).
   2. ASHRAE - HVAC Applications Handbook: Chapter 38 - Testing, Adjusting and Balancing (current edition).
   3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings, Chapter 6 (current edition).
   4. AABC - National Standards for Total System Balance.

5. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
6. SMACNA - HVAC Systems-Testing, Adjusting and Balancing.
7. SMACNA - HVAC Air Duct Leakage Test Manual.
8. ANSI - American National Standards Institute. Comply with the following:
   a. S1.4: Specifications for Sound Level Meters.
   b. S1.11: Specifications for Electroacoustics - Octave-Band and Fractional-Octave-Band Filters
9. Building Code, with State Amendments, Chapter 9 Fire Protection Systems.
10. Mechanical Code, with State Amendments, Chapter 4 Ventilation Air Supply.
11. Local Nonresidential Energy Code.

1.05 QUALITY ASSURANCE

A. Contractor's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, is not the installer of the system to be tested and is otherwise independent of the project. Testing, adjusting, and balancing shall be performed by a certified NEBB technician or a certified AABC technician under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor. Testing and balancing agency must submit qualifications for review and approval prior to acceptance for work.
   1. Approved testing and balancing contractors are:
      a. Independent Air Group, Hesperia, CA
      b. Los Angeles Air Balance Co., Upland, CA
      c. Precision Air Balance, Brea, CA
      d. National Air Balance Company, Fremont, CA
      e. RSAnalysis, El Dorado Hills, CA
      f. Raglen System Balance, Reno, NV

B. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

C. Retainages: In addition to any other sums retained or withheld pursuant to the provisions of this Contract, the amount of dollars will be withheld from payments to the contractor until such time as the work has been completed and accepted. In no event will this amount be paid to the Contractor prior to 60 days following acceptance of the project; during such time, the Contractor shall investigate and correct any reported deficiencies unless such deficiencies are a result of unauthorized tampering by building occupants.

D. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months.

E. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer.

F. The testing and balancing agency shall provide with their bid a performance guarantee covering all phases of the work as herein specified.

G. The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:
   1. Provide sufficient time before final completion dates so that tests and balancing can be accomplished.
   2. The various system installers, suppliers and contractors shall provide all required materials, labor and tools to make corrections when required without undue delay. Install balancing dampers and valves as required by testing and balancing agency.
   3. The contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.
   4. Testing and balancing agency shall be kept informed of any major changes made to the system during construction, and shall be provided with a complete set of Record Drawings.
   5. The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work.

H. All air balancing work shall be coordinated with other disciplines to comply with the meet or exceed the minimum requirements of the Americans with Disabilities Act (ADA), Building Code, local amendments and State Energy Code.

1.06 SUBMITTALS

A. Conform to the Submittals requirements of Division 01.

B. Forms: The Contractor shall deliver a complete copy of either NEBB or AABC standard forms for testing and balancing work associated with the project. These forms shall serve as specific guidelines for producing final test report. Hybrid or non-standards forms are not acceptable.

C. Test Reports: Provide six (6) certified test reports, signed by the test and balance supervisor who performed the work. The final reports shall include key plans identifying all inlets and outlets. Final test reports shall be typed. Hand written reports are not acceptable.

D. Maintenance Data: Include, in maintenance manuals, copies of certified and approved test and balance reports and identification of instruments.

E. Qualifications: The Test and Balance Agency shall submit qualifications of all persons responsible for supervising and performing the on-site testing and balancing work and the name of the certifying agency, NEBB or AABC. Provide a reference list of five (5) similar size projects with contact person and telephone number.

F. LEED:
   1. Air-Balance Report for Prerequisite EQp1: Documentation of work performed per ASHRAE 2.1, Section 7.2.2 - "Air Balancing".
   2. TAB Report for Prerequisite EAc2: Documentation of work performed per ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing".

1.07 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating and cooling.
3. The agenda shall include a list of all air and water flows to be performed at all mechanical equipment.
4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas such as conference rooms.
5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.
6. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:
   a. Air terminal configuration.
   b. Flow direction (supply or exhaust).
   c. Velocity corrections.
   d. Effective area applicable to each size and type of air terminal.
   e. Density corrections.
7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.08 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.
   1. Installation and start-up work on equipment or systems to be tested has been completed and documented.
   2. Work area scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.
   3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested shall be in their completed normal positions and operation.
   4. All related mechanical systems which may affect the operation of the system to be tested shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.01 TEST HOLES

A. Test holes and ports shall be provided in ducts, housings and pipes as directed by the Balancing Agency. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.

2.02 PATCHING MATERIALS

A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.
   1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.
   2. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.03 TEST INSTRUMENTS

A. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. The Owner's Representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

B. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against Certified Calibrated instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.

C. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser/grille/register air flow measurements. The readout meters shall meet calibration requirements.

PART 3 - EXECUTION

3.01 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by approved project drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four-hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.
   1. All instruments shall be applied in accordance with the manufacturer's certified instructions.
   2. All labor, instruments, and appliances required shall be furnished by the Contractor. Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.

3.02 DUCT SMOKE DETECTORS

A. Duct smoke detectors shall be provided and located as required by these specifications and drawings and as required by the building codes and the following:
   1. Obtain information from the Contractor who is to furnish the smoke detectors on the proper device placement and installation limitations and on the proper differential pressure across the sampling tubes of the duct detectors and for required air velocity range requirements.
   2. Installing Contractor shall review the manufacturer's installation guidelines for proper mounting locations.
   3. The testing and balancing agency shall be engaged to confirm that proposed mounting locations will not be adversely impacted by airflows.

B. Duct smoke detectors shall be tested in collaboration with the installing Contractor and project Fire Alarm Contractor to ensure proper air flow sampling and differential pressure.

3.03 DUCTWORK AIR LEAKAGE TESTING

A. Editor-delete/edit this section for duct leakage testing as required. Active air leakage testing requires additional testing fees and can be expensive depending on construction phasing. This method is more definitive than calculation methods which assume the ductwork was properly installed. 5% leakage matches maximum allowable for smoke control systems per UBC-909. Glumac duct leakage requirements exceed the basic California code requirements and are alignment with proposed SMACNA testing guidelines. Completion of Glumac testing requirements will assure that the air distribution system can serve the design air flows and operating pressure. The California code requirement is an initial attempt at forcing the contractor to identify and seal ductwork to a minimal acceptance level.

B. Per California Nonresidential Energy Code Section for Prescriptive Requirements for Space Conditioning Systems ducts shall be sealed and testing. All new ductwork must be tested by a HERS certified agency to demonstrate a leakage rate of no more than 6% of nominal fan flow at 0.10" wg (25 Pascals). Certificate of Installation test forms must be completed by the installing contractor and HERS inspector. This is a requirement on the contractor to complete prior to certificate of occupancy. Duct leakage requirements

C. Test and balance agency shall perform active air flow testing of ductwork systems or sections of ductworks. Agency shall inspect and confirm that all ductwork is sealed per the specification requirements prior to performing any testing. Calculate maximum allowable air leakage by system based on total design air flow rate. Maximum allowable system leakage shall not exceed 5%. Test a random sample of 10% of the ductwork. If any ductwork within the sample fails to meet the criteria than an additional 10% (20% total) sample must be measured. If any ductwork within this second 10% sample fails than 100% of all ductwork must be tested and verified to have a leakage rate than does not exceed the maximum allowable limit.

D. Ductwork leakage testing may be required to meet local energy code requirements. Refer to local codes for applicability and requirements.

E. All California duct systems shall be sealed to a leakage rate not to exceed 6% of the fan flow if the duct systems are:
   1. Connect to a constant volume, single zone system, air conditioners, heat pumps or furnaces, and,
   2. Serve less than 5,000 square feet of floor area, and
   3. Have more than 25% duct surface area located in one or more of the following places:
      a. Outdoors, or,
      b. In a space directly under a floor where the U-factor of the roof is greater than the U-factor of the ceiling, or,
      c. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces, or,
      d. In an unconditioned crawlspace, or,
      e. In other unconditioned spaces.

F. Ductwork systems to be leakage tested shall include:
   1. Testing shall be performed at 1.5 times the peak design outlet static pressure (external static pressure) from the air handling unit/fan, but not greater than the maximum SMACNA pressure rating of the ductwork construction classification. Testing is not required of flexible ductwork or ductwork downstream of VAV terminal units.
   2. Leakage through manufactured products, such as dampers, fire smoke dampers and terminal units may be excluded from the leakage calculations based on manufacturer

stated values, at pressure, or these units may be temporarily sealed with painter's tape during testing to seal any openings and must be removed after testing.

3. Supply air ductwork from the outlet of the air handling unit/fan to inlet side of terminal units or connection to flexible ductwork. Duct leakage testing is not required downstream of terminal units.
4. All supply, return and exhaust air ductwork located outside the building envelope.
5. Return and exhaust air ductwork located in unconditioned spaces from inlet of the air handling unit/fan to the ductwork terminations upstream of each return air grille.
6. Laboratory and fume hood exhaust air ductwork from inlet of the air handling unit/fan to the connection at the remote exhaust air grille or fume hood connection.
7. Kitchen exhaust air ductwork from inlet of the exhaust fan to the connection at the remote exhaust hood.

G. Ductwork installer shall prepare ductwork for pressure testing as deemed appropriate to maintain construction schedule. Ductwork may be tested as total systems or in sections. Sectional testing will require documentation to prove the totalized system leakage is within allowable range of entire system. Ductwork inlets and outlets may be temporarily sealed airtight with plastic, or other means, to facilitate testing pressures.

H. Testing may occur through ductwork devices such as balancing dampers, smoke fire dampers and coils. Manufacturer provided air leakage allowances for such devices may be excluded from duct leakage measurement but must be documented in final report.

I. The leakage rate shall be confirmed through field verification and diagnostic testing in accordance with procedures defined by Oriflow Air Leakage Test, or equivalent procedure. Perform all testing utilizing a duct leakage testing system, Oriflow Duct Leakage Tester or equal, with calibrated fan, orifice, gauges, ductwork, pressure tips and tubing.

3.04 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant air conditions.

B. Equalizers: Equalizing devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.

C. Balance: Flow adjusting (volume control) devices shall be used to balance air quantities (i.e., proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e., in excess of specified limits).
1. Balancing between runs (submains, branch mains, and branches) generally shall be accomplished by flow regulating devices at, or in, the divided-flow fitting.
2. Restriction imposed by flow regulating devices in or at terminals shall be minimal.
3. Final measurements of air quality shall be made after the air terminal has been adjusted to provide the optimum air pattern of diffusion and as indicated on the air distribution drawings.

D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds or axial-flow fan wheel blade pitch. Damper restriction of a system's total flow may be used only for systems with direct-connected fans (without adjustable pitch blades), provided system pressure is less than 0.5" w.g. and sound level criteria are met.

E. Air Measurement: Where air quantity measuring devices are specified in other sections such systems shall be used as a cross-check of portable measuring equipment.

1. Except as specifically indicated herein, pitot tube traverses shall be made of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook Fundamentals Inch Pound Edition."
2. For ducts serving modular office areas with movable partitions, which are subject to change, pitot tube traverses may be omitted provided the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of pitot tube traverses, airflow in the duct shall be determined by totaling volume of individual terminals served, measured as described herein.
3. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

F. Test Holes: Test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

G. Air Terminal Balancing: Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda. Laboratory tests shall be conducted to prove accuracy of testing methodology and test data when so directed. Such tests shall be conducted in conformance with applicable ASHRAE or American Society of Mechanical Engineers (ASME) codes and shall be performed at no additional cost to Owner.

H. Air Motion: Air motion and distribution shall be as specified and indicated on drawings. The Contractor, at no additional cost to the Owner shall, in addition to air motion and direct measurements, perform smoke tests as requested to demonstrate the air distribution and pattern from air terminals and outlets.

I. Air system test and balance procedures shall include, but not be limited to the following requirements:
1. Test and adjust blower RPM to design requirements.
2. Test and record motor full load amperes.
3. Make pitot tube traverse of main supply ducts and obtain design CFM at fans.
4. Test and record system static pressures, suction pressure directly at system fan inlet, and outlet pressure directly at system fan outlet or discharge. Test and record static pressure across each component of air handling system (coils, filters, etc.).
5. Test and adjust system for design CFM recirculated air.
6. Test and adjust system for design CFM outside air.
7. Test and record entering air temperatures.
8. Test and record leaving air temperatures.
9. Adjust all supply, return and exhaust air ducts to proper design CFM.
10. Adjust all zones to proper design CFM, supply and return.
11. Test and adjust duct systems and each diffuser, grille, and/or register to within 10% of design requirements.
12. Each grille, diffuser and register shall be identified as to location and area.
13. Operate each variable frequency drive (VFD) and verify controls installation is complete.
14. Size, type and manufacturer of VAV boxes, diffusers, grilles, registers and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.
15. Readings and tests of diffusers, grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustment.
16. In cooperation with the control manufacturer's representative, setting adjustments of automatically operated dampers to operate as specified, indicated, and/or noted. Testing agency shall check all controls requiring adjustment by control installers. Room thermostats shall be checked for cooling and heating response.

17. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.
18. Adjust overall system balances to allow all self-closing exterior doors to close from any open position. Maximum interior air pressure in all operational modes shall not exceed 0.05" static pressure relative to the outside air pressure. Comply with chapter 10 of the Building Code to assure that self-closing doors will release with a maximum force of 15 pounds.
19. As part of the work of this contract, the HVAC contractor shall make any changes in the pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by air balance agency, at no additional cost to Owner.
20. After air balancing is completed and RPM determined, HVAC Contractor shall provide fixed pitch pulleys.
21. All mixing boxes, VAV air valves, control dampers, smoke dampers and similar devices which operate at 100% shut off shall be tested for leakage.
22. Variable Air Volume Fan Systems: The primary balancing mode is 100% outside air with all terminal boxes on a full call for cooling. Also check and record performance at minimum outside air with all terminal boxes on call for full cooling and at minimum outside air with all terminal boxes on call for full heating and at minimum outside air in the deadband range with no call for heating or cooling. Verify that the systems are operating on a stable part of the fan curves in each mode. Record final duct static controller settings.
23. Provide testing of underfloor air distribution plenum floor mock-ups and final floor installation to document that plenum does not exceed 5% air leakage rate at maximum 0.10” w.g. positive differential pressure.

3.05 ADA COMPLIANCE (NOTE TO EDITOR: ADA COMPLIANCE IS REQUIRED IN ALL BUILDING AND CRITICAL FOR TESTING IN ACTIVE SMOKE CONTROL SYSTEMS TO AVOID EXCEEDING MAXIMUM ALLOWABLE FORCES.)

A. All air balancing work shall be coordinated with other disciplines to comply with meeting or exceeding the minimum requirements of the Americans with Disabilities Act (ADA), Chapters 9 and 10 of the Building Code, local amendments and State Energy Code. Final air balancing for all systems in each space shall be verified and adjusted as necessary to meet the following requirements during peak ventilation, smoke control mode, partial ventilation and minimum ventilation modes during occupied and non-occupied hours. The following requirements are provided as consolidated list of minimum ADA requirements:
   1. The required force for pushing or pulling open a door other than fire doors shall not exceed 5 pounds.
   2. At fire doors the required opening force shall not exceed 15 pounds.
   3. At fire doors the doors shall be set in motion when subjected to a force not exceeding 30 pounds.
   4. At fire doors the doors shall swing to a full open position when subjected to a force not exceeding 15 pounds.
   5. The force to operate door latch releases shall not exceed 5 pounds.
   6. The differential pressure between the building lobby and outside shall remain positive between 0.01” w.g., minimum, and 0.05” w.g., maximum, during operational hours.

3.06 AIR SYSTEM DATA (NOTE TO EDITOR: MODIFY SCOPE ACCORDINGLY.)

A. Report: The certified report shall include for each air handling system the data listed below.
   1. Equipment (Fan or Factory Fabricated Station Unit):
      a. Installation data
         1) Manufacturer and model
         2) Size
         3) Arrangement, discharge and class
         4) Motor hp, voltage, phase, cycles, and full load amps

a) Location and local identification data
b. Design data
1) Data listed in schedules on drawings and specifications.
c. Fan recorded (test) data
1) CFM
2) Static pressure (suction and discharge, across each coil and filter set)
3) RPM
4) Motor operating amps
5) Motor operating bhp
2. Duct Systems:
a. Duct air quantities (maximum and minimum) - main, submains, branches, outdoor (outside) air, total air, and exhaust:
1) Duct size(s)
2) Number of pitot tube (pressure measurements)
3) Sum of velocity measurements (Note: Do not add pressure measurements)
4) Average velocity
5) Recorded (test) cfm
6) Design cfm
b. Individual air terminals
1) Terminal identification supply or exhaust, location and number designation
2) Type size, manufacturer and catalog identification applicable factor for application, velocity, area, etc., and designated area
3) Design and recorded velocities - fpm (state "core," "inlet," etc., as applicable)
4) Design and recorded quantities - cfm (deflector vane or diffusion cone settings)

3.07 WATER SYSTEM PROCEDURES

A. Preparation:
1. Open all valves to full open position. Close coil bypass stop valves. Set mixing valve to full coil flow.
2. Remove all strainers and clean same. Reinstall.
3. Examine water system and determine if water has been treated and cleaned.
4. Check expansion tank to determine they are not air bound and the system is completely full of water.
5. Check all air vents at high points of water systems and determine that all are installed and operating freely.
6. Check operation of automatic bypass valve.
7. Operate each variable frequency drive (VFD) and verify controls installation is complete.
8. Check and set operating temperatures of all equipment at design requirements.
9. Complete air balance must have been accomplished before actual water balance begins.

B. Adjustment: All heating, cooling and condensing water systems shall be adjusted to provide required quantity to or through each component.

C. Metering: Water quantities and pressures shall be measured with calibrated meters.
1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils except room units, converters, etc.) prior to the capacity testing.
2. Where flow metering fittings are not installed, in air/water type heat transfer equipment, flow balance shall be determined by measuring the air side energy differential across the heat transfer equipment. Measurement of water temperature differential shall be performed with the air system, adjusted as described herein, in operation.

D. Automatic Controls: Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests.

E. Flow: Flow through bypass circuits at three-way valves shall be adjusted to equal that through the supply circuit, when the valve is in the bypass position.

F. Distribution: Adjustment of distribution shall be effected by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided. Manual service valves shall not be used for balancing.
   1. Where automatic flow control valves are utilized in lieu of Venturi tubes, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

G. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

H. Water System Test and Balance Procedure: Perform the following tests, and balance each system in accordance with the following requirements:
   1. Test and record water temperatures at inlet and outlet side of each terminal unit. Note rise or drop of temperatures from source.
   2. Proceed to balance each terminal unit.
   3. Upon completion of flow readings and adjustments at coils, mark all settings and record data.
   4. Record and check the following items at each coil.
   5. Inlet water temperatures.
   6. Leaving water temperatures.
   7. Water pressure drop of each coil.
   8. Water metering device readings.

3.08 WATER SYSTEM DATA (NOTE TO EDITOR: EDIT SCOPE ACCORDINGLY.)

A. Report: The certified report for reach water system shall include the data listed below.
   1. Air Heating and Cooling Equipment: (Note to Editor: edit scope as required.)
      a. Design data
         1) Load in Btuh or MBh
         2) GPM
         3) Entering and leaving water temperature
         4) Entering and leaving air conditions (DB and WB)
         5) CFM
         6) Water pressure drop
         7) Entering steam pressure (Note to Editor: Remove if no steam coil.)
      b. Recorded data
         1) Type of equipment and identification (location or number designation)
         2) Entering and leaving air conditions (DB and WB)
         3) Entering and leaving water temperatures
         4) GPM
         5) Temperature rise or drop
         6) Entering steam pressure (Note to Editor: Remove if no steam coil.)

3.09 MEASUREMENT TOLERANCES

A. Set system air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Condenser Water Flow Rate: Plus or minus 10 percent.

3.10 CERTIFIED REPORTS

A. Submittals: Six (6) copies of the reports described herein, covering air and water system performance, air motion (fpm), and sound pressure levels, shall be submitted prior to final tests and inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious malfunction and design deficiencies.

D. Certification: Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.11 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.
   1. At the time of final inspection, the Contractor shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report. In addition, all courtrooms, auditoriums, and conference rooms shall be rechecked.
   2. Points and areas for recheck shall be selected by the commissioning team.
   3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.
   4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from design, or a sound level greater than 2 db or more than recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.

C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 23 05 00 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:
   1. Ductwork Insulation:
      a. Duct wrap insulation.
      b. Acoustic duct lining.
      c. Rigid board ductwork and plenum insulation.
      d. Fire Rated duct insulation systems.
      e. Field applied jackets, indoor and outdoor.
   2. Section Includes insulating the following duct services:
      a. All supply air ductwork, unless otherwise shown on drawings.
      b. Return air ductwork in unconditioned spaces and as shown on drawings.
      c. Acoustical duct lining, in vertical/horizontal supply and return ducts within twenty feet (20') of air handling equipment and where otherwise shown on drawings.
      d. Outside air ductwork in return plenums, mechanical rooms and in freezing climates.
      e. Vapor/moisture ductwork.
      f. Insulation to protect fire rated exhaust systems.
   3. Plenums and equipment rooms, as noted.

B. Types of mechanical insulation specified in this Section include the following:
   1. Duct wrap insulation: Glass Mineral Wool also known as fiberglass.
   2. Duct wrap insulation: Flexible elastomeric foam.
   3. Acoustic duct liner: Glass Mineral Wool also known as fiberglass.
   4. Acoustic duct liner: Flexible elastomeric foam.
   5. Acoustic duct liner: Polyimide foam.
   6. Rigid board duct and plenum insulation: Calcium silicate.
   7. Rigid board duct and plenum insulation: Glass Mineral Wool
   8. Fire-rated duct insulation: Calcium silicate.
   9. Fire-rated duct insulation: Kitchen hood exhaust.
   10. Fire-rated duct insulation: Fire-rated board.
   11. Fire-rated duct insulation: Fire rated blanket.
   12. Insulation jackets.
   13. Removable covers
   14. Insulation accessories.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods.

B. Section 23 31 13 Air Distribution

1.04 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room. Typically, between 70°F and 78°F.

B. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

C. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

D. Freezing Climate: Where outdoor design temperature is less than 33^{o} F, as stated in ASHRAE fundamentals under 99% column for winter design conditions.

E. Unconditioned Space: any space not directly conditioned by mechanical equipment or maintained to temperature by mechanical equipment.

1.05 INSULATION INDUSTRY DEFINITIONS

A. UL GREENGUARD: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.

B. EPA: Environmental Protection Agency.

C. WHO: World Health Organization.

D. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.

E. ASJ: All Service Jacket (no outer film).

F. SSL+: Self-Sealing Lap with Advanced Closure System.

G. SSL: Self-Sealing Lap.

H. FSK: Foil Scrim Kraft; jacketing.

I. FSP: Foil Scrim Polyethylene jacketing

J. PSK: Poly Scrim Kraft; jacketing.

K. PVC: Polyvinyl Chloride.

L. FHC: Fire Hazard Classification

M. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety risk of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.

N. ECOSE Technology: a proprietary binder system based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. ECOSE Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.

O. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

P. Recycled Content – Post-Consumer: materials such as bottled glass collected at curbside or other collection sites after consumer use and used in the manufacturing process to create a new product rather than being placed in a landfill or incinerated.

Q. Recycled Content – Pre-Consumer (aka Post-Industrial): materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.

R. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE and Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

S. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL classifies products to applicable UL requirements standards for safety and standards of other National and International organizations

T. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the “worst in class” materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.

U. Underwriter’s Laboratories Environment (UL Environment): offers independent green claims validation, product assessment and certification.

V. UL Environment Claims Validation (ECV): service and label tests a manufacturer’s product and validates that the environmental claims they make in their marketing and packaging materials are factual. This ECV service enables products to qualify for LEED® MR Credit 4 Recycled Content LEED-NC 2009 or New LEED V-4 Building product disclosure and optimization – sourcing of raw materials.

1.06 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:
   1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:
      a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.
      b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.
      c. C167 - Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
      d. C168 – Terminology for Thermal Insulation
      e. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission by Means of the Guarded Hot Plate Apparatus.

f. Properties by Means of the Guarded-Hot-Plate Apparatus.
g. C195 - Specification for Mineral Fiber Thermal Insulating Cement.
h. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
i. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.
j. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.
k. C305 - Test for Thermal Conductivity of Pipe Insulation.
l. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.
m. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.
n. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
o. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
p. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
q. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
r. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
s. C547 - Specification for Mineral Fiber Preformed Pipe Insulation.
t. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
u. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
v. C755 – Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
w. C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
x. C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
y. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
z. C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
aa. C1071 - Standard Specification for Thermal and Acoustical Insulation.
bb. C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
cc. C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
dd. C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
ee. E84 - Test Method for Surface Burning Characteristics of Building Materials.
ff. E119 - Test for Fire Resistance.
gg. G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
hh. G22 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.
ii. EE2336 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:
   a. 90 - Energy Conservation in New Building Design.
3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:
   a. 255 - Test Methods, Surface Burning Characteristics of Building Materials.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

D. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

E. Corrosiveness: Passes ASTM C1617-05, Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals.

F. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

G. Sustainable Project Requirements:
   1. Formaldehyde Free: Third party certified with UL Environment Validation or Scientific Certification Systems (SCS).
   2. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
   3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of GREENGUARD Certification.
   4. Note to Editor: If your project is Living Building Challenge, include this requirement: Living Building Challenge-Declare Red List Free.

1.07 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation. Also, furnish necessary test data certified by an independent testing laboratory. Submit samples.

B. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable when present in quantities greater than 0.1% by mass. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:
   1. Pentabrominated diphenyl ether (CAS#32534-81-9)
   2. Octabrominated diphenyl ether (CAS#32536-52-0)
   3. Decabrominated diphenyl ether (CAS#1163-19-5)

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.08 LEED ACTION SUBMITTALS:

A. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

B. Product Data for Credit MR 5 Regional Materials: For products and materials to comply with requirements for regional materials, provide documentation indicating location of product or material, manufacturing location and the point of extraction, harvest, or recovery for each raw material. Include distance to Project, contractor cost for each regional material, and percent by weight that is considered regional.

C. LEED v 4, Product Data for Credit EA 2: For products and materials significant to the energy performance of a structure, provide documentation that indicates that insulation levels are significant to increasing the level of energy performance beyond the prerequisite standard.

D. LEED v 4, Product Data for Credit MR 2: For products and materials to comply with Building Product Disclosure & Optimization, provide data/evidence that substantiates Environmental Product Declaration and Multi Attribute Optimization requirements.

E. LEED v 4: Product Data for Credit MR 3: For products and materials to comply with requirements for regional materials, provide documentation indicating location of product or material, manufacturing location and the point of extraction, harvest, or recovery for each raw material. Include distance to Project, contractor cost for each regional material, and percent by weight that is considered regional.

F. LEED v 4, Product Data for Credit MR 4: For products having recycled content documentation; indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.

G. LEED v 4, Product Data for Credit EQ 2: For products and materials to comply with low emittance standards, provide documentation substantiating that insulation products comply with requisite low emittance standards.

H. LEED v 4, Product Data for Credit EQ 5: For products and materials to meet the standard for both thermal comfort design and thermal comfort control, provide data to support that insulation products are significant to thermal comfort design and thermal comfort control.

I. LEED v 4, Product Data for Credit EQ 9: For products and materials that contribute to the design and performance of workspaces that promote occupants well-being, productivity, and communication, provide data/documentation supporting acoustical benefits of Glass Mineral Wool insulation products.

J. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.10 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design is insulation provided by Knauf, Johns Manville, Owens-Corning, Armstrong, Pittsburgh-Corning, Trymer, IIG, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.02 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds if possible. Products shall be certified UL GREENGUARD Gold or Indoor Advantage Gold if possible.

C. UL Environment or GREENGUARD Certification shall validate that each product is formaldehyde free.

D. Insulation materials for use on austenitic stainless steel shall be qualified per ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.03 DUCT WRAP INSULATION

A. Type DW-A Flexible Glass Mineral Wool Blanket bonded with a bio-based thermosetting resin. Comply with ASTM C553, Type I, II, and III and ASTM C1290, Type I. UL/ULC Classified per UL 723 for FSK; FHC 25/50 per ASTM E 84. UL GREENGUARD, UL Environment, or Scientific Certification Systems (SCS) validated as formaldehyde free, DecaBDP free. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Application: Insulation wrap for ductwork, or other HVAC systems.
   2. 'K' Value: ASTM C553-92, 0.27 Btu•in./(hr.•ft²•ºF) at 75°F installed full thickness.
   3. Density: 1.0 lb./cu ft.
   4. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with glass mineral wool yarn and laminated to fire-resistant Kraft.
   5. Manufacturers: Knauf Insulation #Atmosphere Duct Wrap with ECOSE Technology, Owens Corning #SOFTR Duct Wrap FRK, or equal.

B. Type DW-B Elastomeric Foam Flexible Insulation:
   1. Greenguard certified, low VOC.
   2. Elastomeric foam insulation with acrylic polymer airstream coating.
   3. K' Value: ASTM C518, 0.25 Btu•in./(hr.•ft²•ºF) at 75°F.
   4. R' value per inch thickness: ASTM C518, 4.0 (hr.•ft²•ºF) / Btu at 75°F.
   5. Density: ASTM D 1622, 3.0-6.0 lb./ft3.

6. Water vapor sorbtion: ASTM C 1104, less than 2% by weight.
7. Fungal and bacteria resistance: ASTM G 21/22, no growth.
8. Noise Reduction Coefficient: ASTM C 423, 0.49 or higher based on "Type A mounting."
9. Maximum Velocity on Mat or Coated Air Side: 5,000 ft./min.
10. Maximum operating temperature: 250 degrees F.
11. Flame spread index: ASTM E84, less than 25
12. Smoke developed index: ASTM E84, less than 50
13. Adhesive: UL listed waterproof type compliant with ASTM C916.
14. Manufacturers: Armacell Industries #AP Armaflex and AP Coilflex, or equal

2.04 ACOUSTIC DUCT LINER

A. Type ADL-A. Glass Mineral Wool Acoustic Duct Liner: Type ADL-A fiber glass acoustical duct liner bonded with a bio based thermosetting resin meeting ASTM C1071 and GREENGUARD certification Standard for Low-Emitting Products.
   1. Application: Duct lining for acoustic or thermal purposes.
   2. 'K' Value: ASTM 1071, 0.23 Btu•in./(hr•ft²•ºF) at 75°F.
   3. Water vapor absorption: ASTM C1104, less than 3% by weight.
   4. Noise Reduction Coefficient: 0.70 or higher based on ASTM C423 "Type A mounting."
   5. Maximum Velocity on Mat or Coated Air Side: 6,000 ft./min.
   6. Surface burning: NFPA 90 A and 90B
   7. Liner must pass both ASTM G21 and ASTM G22 or UL 2824 for microbial resistance.
   8. DecaBDP Free.
   9. UL Environment validated to be formaldehyde free.
   10. Adhesive: UL listed waterproof type compliant with ASTM C916 with a water repellency of greater than or equal to 3 per INDA IST-80.
   11. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
   12. Manufacturers: Knauf Insulation Atmosphere duct liner or rigid plenum liner with ECOSE Technology, Owens Corning QuietR Duct Liner Board, or equal.

B. Type ADL-B Flexible Elastomeric Foam Duct Liner:
   1. Elastomeric foam insulation with acrylic polymer airstream coating.
   2. K' Value: ASTM C518, 0.25 Btu•in./(hr•ft²•ºF) at 75°F.
   3. R' value per inch thickness: ASTM C518, 4.0 (hr•ft²•ºF) / Btu at 75°F.
   4. Density: ASTM D 1622, 3.0-6.0 lb/ft3.
   5. Water vapor absorption: ASTM C209, less than 2% by weight.
   6. Fungal and bacteria resistance: ASTM G21/22, no growth.
   7. Noise Reduction Coefficient: ASTM C 423, 0.49 or higher based on "Type A mounting". Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min.
   8. Maximum operating temperature: 250 degrees F.
   9. Flame spread index: ASTM E84, less than 25
   10. Smoke developed index: ASTM E84, less than 50
   11. Adhesive: UL listed waterproof type compliant with ASTM C916.
   12. Greenguard certified, low VOC.
   13. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
   14. Manufacturers: Armacell #AP Armaflex, Armacell #AP Coilflex, Armacell #AP Spiralflex, or equal.

C. Type ADL-C Polyimide Foam Acoustic Duct Liner:
   1. Greenguard certified, low VOC.
   2. Polyimide foam insulation with acrylic polymer airstream coating.
   3. K' Value: ASTM C518, 0.30 Btu•in./(hr•ft²•ºF) at 75°F.
   4. R' value per inch thickness: ASTM C518, 3.3 (hr•ft²•ºF) / Btu at 75°F.
   5. Density: ASTM D 3574, 0.80 lb/ft3.

6. Water vapor absorption: ASTM C1104, less than 2% by weight.
7. Fungal and bacteria resistance: ASTM G21/22, no growth.
8. Noise Reduction Coefficient: ASTM C423, 0.70 or higher based on "Type A mounting".
9. Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min.
10. Maximum operating temperature: 250 degrees F.
11. Flame spread index: ASTM E84, less than 25
12. Smoke developed index: ASTM E84, less than 50
13. Adhesive: UL listed waterproof type compliant with ASTM C916.
14. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
15. Manufacturers: Boyd Corporation #SOLCOUSTIC, or equal.

D. Type ADL-D Round Duct Liner:
1. Application: Round duct lining for acoustic or thermal purposes.
2. 'K' Value: ASTM C518, 0.23 Btu•in./(hr•ft²•ºF) at 75°F.
3. Noise Reduction Coefficient: 0.70 as per ASTM C427 based on “Type A mounting”.
4. Maximum Velocity: 6,000 ft/min.
5. Surface burning: NFPA 90 A and 90B
6. Liner must pass both ASTM G21 and ASTM G22 or UL 2824 for microbial resistance.
7. DecaBDP Free.
8. UL Environment validated to be formaldehyde free.
9. Factory-formed grooves at sufficient intervals to prevent air gaps between back of insulation and spiral duct surface.
10. Manufacturers: Johns Manville #Spiracoustic Plus, Owens Corning #QuietZone Spiral Duct Liner, or equal.

2.05 RIGID BOARD DUCTWORK AND PLENUM INSULATION

A. Type RB – A rigid fiber glass board bonded with a thermosetting resin meeting ASTM C612 Type IA or IB with factory-applied FSK jacket. UL/ULC Classified or FHC 25/50 per ASTM E84 and GREENGUARD Certification Standard for Low-Emitting Products.
1. Application: insulation for HVAC plenums and ductwork.
2. 'K' Value: ASTM C1071, 0.23 Btu•in./(hr•ft²•ºF) at 75°F.
3. Density: 3.0 lb./cu ft.
4. Vapor Barrier Jacket: ASJ (All Service Jacket) or FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with glass mineral wool yarn and laminated to fire-resistant Kraft paper.
5. Installation: See Part 3 below.
6. Manufacturers: Knauf #ECOSE, CertainTeed Corp, Johns Manville 800 Series Spin-Glas, Manson Insulation Inc., Owens Corning Type 703 Insulation Board, or equal.

2.06 FIRE-RATED INSULATION SYSTEMS

A. Type FRI-A. Hydrous Calcium Silicate: Johns Manville Industrial Insulation Group Thermo-12/Gold ASTM C533; Rigid Molded Block Insulation; Asbestos-Free Coded Throughout Material Thickness and Maintained Throughout Temperature Range:
1. “K” Value: 0.397 Btu•in./(hr.•ft²•ºF) at 300^{o}F.
2. Maximum Service Temperature: 1,200°F.
3. Compressive Strength (block): Minimum of 100 psi to produce 5% compression at 1½" thickness.
4. Tie Bands: Secure blocks in places with staggered joints using 3/8" or 1/2" stainless steel bands on 12” centers.

B. Type FRI-B. Insulation for Type I, commercial, kitchen hood exhaust ductwork. High-temperature, flexible, blanket insulation with FSK jacket that is NRTL (Nationally Recognized Test Lab) tested and certified to provide a 2-hour fire rating.

1. Manufacturers: Morgan #FireMaster FastWrap, Morgan #Pyroscat DuctWrap XL, 3M #Fire Barrier Duct Wrap 15A, Unifrax #FyreWrap Elite 1.5, or equal.

C. Type FRI-C. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700^0F (927^0C). Comply with ASTM C656, Type II, Grade 6. UL tested and certified to provide a 2-hour fire rating.

D. Manufacturers: Johns Manville #Super Firetemp M or equal.

E. Type FRI-D. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is NRTL (Nationally Recognized Test Lab) tested and certified to provide a 2-hour fire rating.
1. Manufacturers: Morgan #FireMaster FastWrap, Morgan #Pyroscat DuctWrap XL, 3M #Fire Barrier Duct Wrap 15A, Unifrax #FyreWrap Elite 1.5, or equal.

2.07 FIELD APPLIED DUCTWORK INSULATION JACKETS

A. Field Applied Jackets (For Exterior Applications):
1. Longitudinal seams shall not be located on top of ducts when exposed to outdoor environment.
2. Stainless Steel Jacket: Type 304 stainless steel, 0.010” minimum (smooth/corrugated) finish.
3. Aluminum Jacket: 0.016” aluminum with factory applied moisture barrier positioned such that the longitudinal overlap provides a watershed.
4. PVC Jacket: Johns Manville Zeston 300 30 mil thick white only.
5. Circumferential joints shall be wide enough to provide weather-proofing jacket.
6. Secure jacket with 3/8" or 1/2" stainless steel bands on 12” centers for round ductwork and objects.
7. Secure to rectangular sheet metal with sheet metal screws. Seal screw penetrations with silicone caulk.

B. Field Applied Jackets (For Interior Applications):
1. All longitudinal seams shall be located on bottom of ductwork
2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.

2.08 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Manufacturers: Aeroflex #Aeroseal, Armacell #Armaflex 520, H.B.Fuller #Foster 85-75, K-Flex #720-LVOC, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated per 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: H.B.Fuller #Childers Chil-Quik CP-127, H.B.Fuller #Foster 85-60 or 85-75, Mon-Eco Industries # 22 Series, or equal.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated per 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: H.B.Fuller #Childers Chil-Quik CP-127, H.B.Fuller #Foster 85-60 or 85-75, Mon-Eco Industries #22 Series, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Dow Corning #739 Plastic Adhesive, JohnsManville #Zeston Perma-Weld, Speedline #Polyco Adhesive Low VOC, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.09 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturers: H.B.Fuller #Foster 30-90, Vimasco #749 Vapor-Blok, or equal.
2. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: -20°F to +180°F (-29°C to +82°C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use.
1. Manufacturers: H.B.Fuller #Childers CP-30, H.B.Fuller #Foster 30-35, Mon-Eco Industries #55-10, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180°F (Minus 18 to plus 82°C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Manufacturers: H.B.Fuller #Foster 60-95/60-96, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220°F (Minus 46 to plus 104°C).

4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Manufacturers: H.B.Fuller #Childers CP-10, H.B.Fuller #Foster 46-50, Mon-Eco Industries #55-50, Vimasco #WC-1 or WC-5, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.10 LAGGING

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated per 40 CFR 59, Subpart D (EPA Method 24).
2. Manufacturers: H.B.Fuller #Childers CP-50, H.B.Fuller #Foster 30-36, Vimasco #713 or 714, or equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to +180°F (-18°C to +82°C).
5. Color: White.

2.11 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44, Mon-Eco Industries, Inc.; 44-05, or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 1241°C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 121°C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.12 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
   5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.13 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.
   1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5, or equal.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
   1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab, Vimasco Corporation; Elastafab 894, or equal.

2.14 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd. (271 g/sq. m).
   1. Products: Subject to compliance with requirements, provide one of the following: Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59, or equal.

2.15 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following: Johns Manville; Zeston, P.I.C. Plastics, Inc.; FG Series, Proto Corporation; LoSmoke, Speedline Corporation; SmokeSafe, or equal.
   2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

D. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems, ITW Insulation Systems; Aluminum and Stainless Steel Jacketing, RPR Products, Inc.; Insul-Mate, or equal.
   2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
   3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.
   1. Products: Subject to compliance with requirements provide one of the following: Polyguard Products, Inc.; Alumaguard 60, or equal.

2.16 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 428 AWF ASJ, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836, Compac Corporation; 104 and 105, Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ, or equal.
   2. Width: 3 inches (75 mm).
   3. Thickness: 11.5 mils (0.29 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf./inch (7.2 N/mm) in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 491 AWF FSK, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827, Compac Corporation; 110 and 111, Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ, or equal.
   2. Width: 3 inches (75 mm).
   3. Thickness: 6.5 mils (0.16 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf./inch (7.2 N/mm) in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Manufacturers: ABI, Ideal Tape Division #370 White PVC tape, Compac Corporation #130, Venture Tape #1506 CW NS, or equal.
   2. Width: 2 inches (50 mm).
   3. Thickness: 6 mils (0.15 mm).
   4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Manufacturers: ABI Ideal Tape Division #488 AWF, Avery Dennison Corporation #Specialty Tapes Division Fasson 0800, Compac Corporation #120, Venture Tape #3520 CW, or equal.
   2. Width: 2 inches (50 mm).
   3. Thickness: 3.7 mils (0.093 mm).
   4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.17 SECUREMENTS

A. Bands:
   1. Manufacturers: ITW Insulation Systems, Gerrard Strapping and Seals, RPR Products, Inc., Insul-Mate Strapping, Seals, and Springs, or equal
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304, 0.020 inch (0.50 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.
   3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.
   4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
      a. Manufacturers: AGM Industries, Inc. #CWP-1, GEMCO #CD, Midwest Fasteners #CD, Nelson Stud Welding #TPA/TPC/TPS, or equal.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
      a. Manufacturers: AGM Industries #CHP-1, GEMCO; Cupped Head Weld Pin, Midwest Fasteners, Inc.; Cupped Head, Nelson Stud Welding; CHP, or equal.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Subject to compliance with requirements, provide one of the following products: AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers, GEMCO; Perforated Base, Midwest Fasteners, Inc.; Spindle, or equal.
      b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel coordinated with application, fully annealed, 12 gauge, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following: GEMCO; Nylon Hangers, Midwest Fasteners, Inc.; Nylon Insulation Hangers, or equal.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
   c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, GEMCO; Peel & Press, Midwest Fasteners, Inc.; Self Stick, or equal.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, Stainless steel, fully annealed, as coordinated with application. 12 gauge, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.015-inch- (0.41-mm-) thick, galvanized-steel, aluminum, or stainless-steel sheet, as coordinated with application with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; RC-150, GEMCO; R-150, Midwest Fasteners, Inc.; WA-150, Nelson Stud Welding; Speed Clips, or equal.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: GEMCO, Midwest Fasteners, Inc, or equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: C & F Wire, or equal.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that ductwork has been tested for leakage in accordance with specifications before applying insulation materials. All ductwork shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.02 INSTALLATION

A. General:
   1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
   2. Remove and replace any insulation that has become wet or damaged during the construction process.
   3. Continue insulation and vapor barrier at penetrations and duct supports, except where prohibited by code. Instances where this is required include:
      a. Ductwork support angle or struts.
         1) To prevent crushing of low density insulation, provide separator or high density insulation at point of support. A 12 inch wide strip of 6pcf density, glass mineral wool board, or similar mfg/product, across the bottom side of the duct. Vapor barrier to continue unbroken at point of support.
         2) As an alternative method, where the duct sits directly on the Unistrut or similar support, install board material on either side of the support to allow duct wrap to be tented over the support, providing a smooth transition over the support and maintaining thickness. 3pcf board may be used in this method.

B. Insulation Applied over the Exterior of the Duct:
   1. Provide insulated ductwork conveying air below ambient temperature (below room temperature) with vapor retardant jacket.
   2. Seams/joints of duct wrap shall be secured with outward clinching galvanized staples spaced 4” O.C. Vapor barrier tape shall not be used as the sole means of securing the insulation facing.
   3. Seal all vapor retardant jacket seams and penetrations with 3” wide pressure-sensitive vapor barrier tape matching the insulation facing.
   4. Provide insulated ductwork conveying air above ambient temperature (above room temperature) with or without vapor retardant jacket. Where service access is required, bevel and seal ends of insulation.
   5. Continue insulation through walls, sleeves, hangers, and other duct penetrations except where prohibited by code.
   6. The insulation shall be firmly wrapped around the ducts with all joints lapped a minimum of 2" and secured with stapes spaced 4” O.C. The vapor barrier shall be sealed with FSK or metallic pressure sensitive tape. Installed thickness shall not exceed 25% compression. The underside of duct work 24” or greater in width shall be secured with mechanical fasteners and speed clips spaced approximately 18” on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.
   7. For ductwork exposed in mechanical equipment rooms below 7’ or in finished spaces, finish with Proto LoSmoke or Johns Manville Zeston PVC Jacket material.

8. For interior vapor/moisture conveying duct applications, install glass mineral wool insulation unless specifically indicated otherwise on drawings. Install to meet manufacturer's requirements and as required by local code authorities.
9. Ducts installed exposed outside the building:
    a. For exterior applications where insulation is on the outside of the duct, provide insulation with a weather protection jacket.
    b. All exposed to weather exterior metallic ductwork exposed or covered with cladding is to be built with a crown or reverse cross break to shed moisture.

C. Type I Kitchen Grease Exhaust Ducts:
1. For grease ducts inside the conditioned building envelope but not in rated enclosures, install two-hour fire rated blanket wrap or duct board system to meet manufacturer's requirements and as required by NFPA and local code authorities.
2. For grease duct outside the conditioned building envelope, install UL listed grease duct wrap insulation with weatherproofing jacket. Install to meet manufacturer's requirements and as required by local code authorities.

D. Duct Liner:
1. Adhere insulation to sheet metal with a UL listed adhesive. Adhesive shall be applied to the sheet metal with a minimum coverage of 90%.
2. Secure insulation with mechanical liner fasteners as indicated by SMACNA or manufacturer. Pin length should be as recommended by the liner manufacturer.
3. All exposed edges of the liner must be factory or field coated. Unless factory coated, all transverse edges and longitudinal joints of the duct liner shall be coated. For systems operating at 4,000 fpm or higher, a metal nosing must be installed in all liner facing fan discharge or upstream of the airflow.
4. Repair liner surface penetrations with UL listed adhesive.
5. Duct dimensions indicated on plans are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.
6. Liner shall be folded and compressed into corners of rectangular duct or cut and fitted to assure a lapped compressed joint. Longitudinal joints should not occur in rectangular duct except at corners.
7. Longitudinal joints shall be coated with adhesive.

3.03 DUCTWORK INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed ASHRAE 90.1 2013, IECC 2012, State and Local energy code and mechanical code requirements as noted below. Minimum thermal resistance in range of 4.2 to 4.6 per inch of thickness. Insulation thicknesses are based on glass mineral wool insulation and may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. The installed thickness of duct insulation used to determine its R-value shall be determined as follows:
1. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
2. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.
3. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.

C. All air distribution system ducts and plenums, but not limited to, building cavities, mechanical closets, air handler boxes, and support platforms used as ducts or plenums, shall be installed, sealed, and insulated to meet the requirements of the code. Portions of supply-air and return-

air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum level of R-8.

1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

D. TABLE 1: DUCT WRAP INSULATION SERVICE, THICKNESS, AND MATERIAL TYPE REQUIRED. Note to Editor - Designers should be aware the thicknesses below may need to be edited to comply with the specific requirements of the applicable energy code. For example, Climate Zone 2 in Oregon requires 3" (R12) insulation for exterior ductwork.

E. Flexible Duct wrap:

SYSTEM	THICKNESS (inches)	FINISH	REMARKS/MATERIAL OPTIONS
Supply ducts within building envelope	1-1/2	FSK	Type DW-A, B
Supply or return duct installed as exposed ductwork in the atmosphere controlled occupied space.	0		Except where noted on drawings for acoustical reasons.
Supply or return or outside air duct installed as exposed ductwork in the occupied clean rated space.	1-1/2	Mylar	Applies to ISO rated Cleanroom spaces. Type DW-A, B
Return ducts within building envelope	1-1/2	FSK	Type DW-A, B
Exterior/Outside supply and return ductwork	NA	NA	* duct wrap or blanket may not be used in this application.
Supply and return ductwork located outdoors and as described in 3.3.C above.	3		Type DW-A, B
Exhaust ducts within 10 ft. of exterior openings	2	FSK	Type DW-A, B

1. Thicknesses in the above table shall have insulation values as follows: 1-1/2" = R-4.2, 2" = R-5.6, 3" = R-8.3. Greater thicknesses are permitted to achieve identical values if space constraints allow.

F. TABLE 2: DUCTWORK RIGID INSULATION AND PLENUM INSULATION SERVICE, THICKNESS, AND INSULATION TYPE REQUIRED.
1. Rigid and Plenum Insulation:

SYSTEM	THICKNESS (inches)	FINISH	REMARKS/MATERIAL OPTIONS
Outside air intake ducts	2	FSK	Provide aluminum jacket over exterior installations. Type RB-A, B
Interior Plenums	2	FSK	Type RB-A
Exterior Plenums	2	FSK	Type RB-A

Supply, return and relief ducts in mechanical rooms and parking garages	2	FSK	Type RB-A
Vapor/moisture ducts installed exterior to the building envelope.	1-1/2	FSK	Provide jacketing on exterior ducts. Type RB-A
Exterior ductwork using rigid duct liner sandwiched between sheet metal layers	2	FSK	Type RB-A

2. Thicknesses in the above table shall have insulation values as follows: Interior plenums:1-1/2" = R-4.2, 2" = R-5.6. Plenums exposed to the exterior: 1-1/2" = R-6, 2" = R-8.

G. TABLE 3: ACOUSTIC DUCT LINER SERVICE, THICKNESS, AND INSULATION TYPE REQUIRED.
1. Acoustic Duct Liner (rectangular ductwork):

SYSTEM	THICKNESS (inches)	FINISH	REMARKS/MATERIAL OPTIONS
Where indicated	1" unless otherwise noted on plans	Air stream side-mat facing	Type ADL-A, B, C
Exterior ductwork where indicated in double wall sheet metal sandwich construction.	2	Air stream side-mat facing	Type ADL-A, B, C
Within 20' of Air Handling Unit in supply and return ducts	1	Air stream side mat facing	Type ADL-A, B, C

2. Acoustic Duct Liner (round ductwork):

SYSTEM	THICKNESS (inches)	FINISH	REMARKS/MATERIAL OPTION
Where indicated	1	Air stream side mat facing	Type ADL-D

3. Thicknesses in the above table shall have insulation values as follows: 1-1/2" = R-4.2, 2" = R-5.6, 3" = R-8.3. Greater thicknesses are permitted to achieve identical values if space constraints allow.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 23 05 00 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:
   1. Piping Insulation:
      a. Piping Insulation.
      b. Insulation Jackets.
      c. Removable Covers.
   2. Acoustic piping wrap
   3. Section includes the following HVAC piping systems:
      a. Condenser water supply and return piping.
      b. Heat recovery piping.
      c. Process piping.
      d. Valves, pumps, air separators, strainers and fittings in insulated piping systems.
      e. Refrigerant hot gas and suction piping.

B. Types of mechanical insulation specified in this Section include the following:
   1. Pipe insulation: Glass Mineral Wool.
   2. Pipe insulation: Closed cell phenolic.
   3. Pipe insulation: Polyisocyanurate.
   4. Pipe insulation: Calcium silicate.
   5. Pipe insulation: Cellular glass.
   6. Pipe insulation: Flexible elastomeric closed cell foam.
   7. Insulation jackets.
   8. Removable covers.
   9. Insulation accessories.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Division 22: Plumbing.

B. Section 23 05 00: Basic HVAC Materials and Methods.

C. Section 23 21 13: Hydronic Piping, Valves and Specialties.

1.04 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room. Typically, between 70°F and 78°F.

B. Insert: Spacer placed between the pipe support system and the piping to allow for the space required for insulation.

C. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

D. Insulation Shield: Buffer material placed between the pipe support system and the insulation to prevent the insulation material from crushing.

E. Jacket: Protective covering over the pipe insulation; may be factory applied such as “all service jacket” or field applied to provide additional protection; of such materials as canvas, PVC, aluminum or stainless steel.

F. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system.

G. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

H. Freezing Climate: Where outdoor design temperature is less than 34°F (1°C), as stated in ASHRAE Fundamentals under 99% column for winter design conditions.

I. Unconditioned Space: any space not directly conditioned by mechanical equipment or maintained to temperature by mechanical equipment.

1.05 INSULATION INDUSTRY DEFINITIONS

A. Third Party Independent Product sustainable certification: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.
   1. UL GREENGUARD:
   2. Scientific Certification Systems (SCS)

B. EPA: Environmental Protection Agency.

C. WHO: World Health Organization.

D. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.

E. ASJ: All Service Jacket (no outer film).

F. SSL+: Self-Sealing Lap with Advanced Closure System.

G. SSL: Self-Sealing Lap.

H. FSK: Foil Scrim Kraft; jacketing.

I. FSP: Foil Scrim Polyethylene jacketing

J. PSK: Poly Scrim Kraft; jacketing.

K. FHC: Fire Hazard Classification

L. PVC: Polyvinyl Chloride.

M. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety risk of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.

N. Bio based Binder Technology: binder systems based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. Biobased Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.

O. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

P. Recycled Content – Post-Consumer: materials such as bottled glass collected at curbside or other collection sites after consumer use and used in the manufacturing process to create a new product rather than being placed in a landfill or incinerated.

Q. Recycled Content – Pre-Consumer (aka Post-Industrial): materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.

R. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE and Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

S. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL classifies products to applicable UL requirements standards for safety and standards of other National and International organizations

T. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the “worst in class” materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.

U. Underwriter’s Laboratories Environment (UL Environment): offers independent green claims validation, product assessment and certification.

V. UL Environment Claims Validation (ECV): service and label tests a manufacturer’s product and validates that the environmental claims they make in their marketing and packaging materials are factual. This ECV service enables products to qualify for LEED® MR Credit 4 Recycled Content LEED-NC 2009 or New LEED V-4 Building product disclosure and optimization – sourcing of raw materials.

1.06 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:
   1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:
      a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.

b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.
c. C168 - Provides standard terminology for thermal insulation.
d. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
e. C195 - Specification for Mineral Fiber Thermal Insulating Cement.
f. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
g. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.
h. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.
i. C305 - Test for Thermal Conductivity of Pipe Insulation.
j. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.
k. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.
l. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
m. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
n. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
o. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
p. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
q. C547 - Specification for Mineral Fiber Pipe Insulation.
r. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
s. C553 - Specification for Mineral Fiber Blanket-Type Pipe Insulation (Industrial Type).
t. C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered).
u. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
v. C755 – Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
w. C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
x. C916 – Standard Specification for Adhesives for Duct Thermal Insulation.
y. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
z. C1071 - Standard Specification for Thermal and Acoustical Insulation.
aa. C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
bb. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
cc. C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
dd. C1393 – Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.
ee. C1617-05, Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
ff. E84 - Test Method for Surface Burning Characteristics of Building Materials.
gg. E119 - Test for Fire Resistance.
hh. G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
ii. G22 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:
   a. 90 - Energy Conservation in New Building Design.
3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:
   a. 255 - Test Methods, Surface Burning Characteristics of Building Materials.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

D. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

E. Corrosiveness: Passes ASTM C1617-05, Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals.

F. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

G. Sustainable Project Requirements:
1. Formaldehyde Free: Third party certified with UL Environment or Scientific Certification Systems (SCS) Validation.
2. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of GREENGUARD Certification.
4. Living Building Challenge-Declare Red List Free.

1.07 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable when present in quantities greater than 0.1% by mass. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:

1. Pentabrominated diphenyl ether (CAS#32534-81-9)
2. Octabrominated diphenyl ether (CAS#32536-52-0)
3. Decabrominated diphenyl ether (CAS#1163-19-50)

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.08 LEED ACTION SUBMITTALS:

A. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

B. Product Data for Credit MR 5 Regional Materials: For products and materials to comply with requirements for regional materials, provide documentation indicating location of product or material, manufacturing location and the point of extraction, harvest, or recovery for each raw material. Include distance to Project, contractor cost for each regional material, and percent by weight that is considered regional.

C. LEED v 4, Product Data for Credit EA 2: For products and materials significant to the energy performance of a structure, provide documentation that indicates that insulation levels are significant to increasing the level of energy performance beyond the prerequisite standard.

D. LEED v 4, Product Data for Credit MR 2: For products and materials to comply with Building Product Disclosure & Optimization, provide data/evidence that substantiates Environmental Product Declaration and Multi Attribute Optimization requirements.

E. LEED v 4: Product Data for Credit MR 3: For products and materials to comply with requirements for regional materials, provide documentation indicating location of product or material, manufacturing location and the point of extraction, harvest, or recovery for each raw material. Include distance to Project, contractor cost for each regional material, and percent by weight that is considered regional.

F. LEED v 4, Product Data for Credit MR 4: For products having recycled content documentation; indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.

G. LEED v 4, Product Data for Credit EQ 2: For products and materials to comply with low emittance standards, provide documentation substantiating that insulation products comply with requisite low emittance standards.

H. LEED v 4, Product Data for Credit EQ 5: For products and materials to meet the standard for both thermal comfort design and thermal comfort control, provide data to support that insulation products are significant to thermal comfort design and thermal comfort control.

I. LEED v 4, Product Data for Credit EQ 9: For products and materials that contribute to the design and performance of workspaces that promote occupants well-being, productivity, and communication, provide data/documentation supporting acoustical benefits of Glass Mineral Wool insulation products.

J. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.10 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - **PRODUCTS**

2.01 MANUFACTURERS

A. Acceptable manufacturers include KNAUF Insulation, Johns Manville, Owens-Corning, Armstrong, Pittsburgh-Corning, Trymer, IIG, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Aeroflex, Armacell, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.02 PIPE INSULATIONS

A. Type PI-A: Molded glass mineral wool pipe insulation meeting ASTM C547 Type I, 850°F or Type IV, 1000°F Materials: Glass mineral wool bonded with a bio-based thermosetting resin. FHC 25/50 per ASTM E 84 for Redi-Klad Pipe. Product to be validated formaldehyde free. In addition, pipe insulation to have a validated EPD from UL Environment or Scientific Certification Systems. Comply with ASTM C 585, ASTM C 411, ASTM C 795, and ASTM C 547, Type I, and Type IV, with factory-applied ASJ+ or ASJ interior and with factory-applied ASJ+-SSL+ or ASJ-SSL for exterior. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article
   1. Applications: Insulation of piping up to 3” thick insulation.
   2. Semi rigid board material with factory-applied ASJ or FRK/FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB.
   3. Nominal density is 2.5 lb/cu. ft. unjacketed or more.
   4. Thermal conductivity (k-value) per ASTM C547 at 100°F is 0.29 Btu in./h sq. ft. °F or less.
   5. Basis-of-Design Product: Subject to compliance with requirements, provide pipe Insulation or comparable product by one of the following: Knauf ECOSE, Owens Corning, CertainTeed Corp., Johns Manville Miro-Lok, Micro-Lok HP, Manson Insulation Inc, or equal.
   6. Maximum Service Temperature per ASTM 547: 850°F to 1000°F.
   7. Vapor Retarder Jacket: ASJ+ SSL+ outer film layer, white kraft paper interleaving reinforced with glass fiber scrim yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips.

B. Type PI- B: Closed cell phenolic foam: Trymer Supercel, Kingspan Koolphen K, Resolco Insulphen, or approved equal meeting ASTM C 1126.
   1. ‘K’ Value: 0.16 at 75°F (24°C)
   2. Maximum Continuous Service Temperature: 300°F.

3. Vapor Retarder Jacket – straight sections: Saran 540/SSL or Mylar laminate, factory applied with self-sealing lap.
4. Vapor Retarder Jacket - fittings: Saran 540/SSL spiral wrapped in field for fittings.

C. Type PI-C: Rigid polyisocyanurate foam: Trymer 2000 XP, HiTHERM HT-300, Duna Corafoam, Dyplast ISO-25, or approved equal meeting ASTM C 591.
1. 'K' Value: 0.19 at 75°F (24°C)
2. Maximum Continuous Service Temperature: 300°F.
3. Vapor Retarder Jacket: Saran 540/SSL or Mylar laminate.

D. Type PI-D: Hydrous Calcium Silicate: Johns Manville Industrial Insulation Group Thermo-12 Gold, ASTM C533; Rigid Molded Pipe or equal.
1. 'K' Value: 0.397 at 300°F.
2. Maximum Service Temperature: 1,200°F.
3. Compressive Strength (block): Minimum of 200 psi to produce 5% compression at 1½" thickness.
4. Tie Wire: 16-gauge stainless steel with twisted ends on maximum 12" centers.
5. Product must contain corrosion inhibiting chemistry.

E. Type PI-E: Cellular Glass: Pittsburgh-Corning Foamglas or equal Meeting ASTM C522: Cellular Glass Thermal Insulation:
1. 'K' Value: 0.35 at 75°F.
2. Density: 8.0 lbs./cu. ft.
3. Maximum Service Temperature: 900°F.
4. Vapor Retarder Jacket – straight sections: Saran 540/SSL or Mylar laminate, factory applied with self-sealing lap.
5. Vapor Retarder Jacket - fittings: Saran 540/SSL spiral wrapped in field for fittings.

F. Type PI-F: Flexible Elastomeric Closed Cell Thermal Insulation: Armacel AP Armaflex, Rubatex K-Flex ECO, Aeroflex Aerocel, closed-cell, halogen free, elastomeric insulation. Comply with ASTM-C177, ASTM E 84 and UL 181.
1. 'K' Value: 0.27 at 75°F.
2. Density: 3.0 to 6.0 lbs./cu.ft.
3. Maximum Service Temperature: 260°F.
4. Seal all seams and joints with contact adhesive.

G. Field Applied Jackets (For Interior Applications):
1. All longitudinal seams shall be located on bottom of pipes.
2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.
3. Canvas Jacket: UL listed fabric, 6 oz./sq. yd. plain weave cotton, treated with dilute fire retardant lagging adhesive.
4. Aluminum Jacket: 0.016" thick sheet, smooth or embossed finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.
5. Secure aluminum jackets with 3/8" or 1/2" stainless steel bands on 12" centers.

H. Field Applied Jackets (For Exterior Applications):
1. All longitudinal seams, on horizontal pipe runs, shall be installed on the bottom of pipes.
2. Aluminum Jacket: 0.016" (minimum) thick sheet, smooth or embossed finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.
3. Stainless Steel Jacket: Type 304 stainless steel, 0.010" minimum (smooth/corrugated) finish.

4. Secure stainless steel or aluminum jackets with 3/8” or 1/2” stainless steel bands on 12” centers.
5. Manufacturers: Pabco, Childers, RPR, or equal.

I. Removable Covers:
1. Provide removable covers on pumps, valves, air separators, air vent fittings, flanges, strainers, steam traps, etc., where periodic maintenance or removal of insulation may is required.
2. Use of pre-molded fittings with PVC covers is acceptable, unless noted otherwise.
   a. Cold systems: Provide PVC covers on elbows.
   b. Cold systems: Provide Armaflex elastomeric foam for flanges, valves, pumps and strainers.
   c. Hot systems: provide PVC covers on elbows and flanges.
   d. Hot Systems: provide removable blanket covers on valves, pumps, and strainers.
3. Removable- type silicon cloth glass mineral wool filled insulating blankets:
   a. Fit Tight Covers, by GLT products, or equal custom fabrication by Insulation Contractor, for 0-350°F service operating temperature:
      1) Jacket: silicon impregnated glass mineral wool cloth
      2) Liner: silicon impregnated glass mineral wool cloth
      3) Liner reinforcement: stainless steel mesh cloth
      4) Insulation: 1” type E glass matt
      5) Fastening: 2” Nomex Velcro
      6) Fastening: 1” straps and stainless steel D-rings
      7) Fastening: 12 gage stainless steel hooks and stainless steel wire
      8) Thread: Kevlar/stainless steel thread

2.03 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds if possible. Products shall meet UL GREENGUARD certification standards for low-emitting products.

C. UL Environment shall validate that each product is formaldehyde free.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.04 ACOUSTICAL PIPE WRAP

A. Barrier material shall meet the sound transmission loss and physical properties performance requirements as follows:
1. Barrier material shall have a minimum continuous operating temperature range from -40°F to 180°F, be resistant to water, oils, weak acids, alkalies, and fungi.
2. Physical Properties:
   a. One pound per square foot
   b. Tensile Strength: 300 lbs. per inch
   c. Tear Strength: 100 lbs. per inch
   d. Flammability: Flameout and afterglow in zero seconds
3. Sound Transmission Loss dB

125 hz	250 hz	500 hz	1000 hz	2000 hz	4000 hz	STC
15	19	21	28	33	37	26

B. Products: Subject to compliance with performance requirements, provide one of the following: Sound Seal B-20 LAG/QFA-9 or Kinetics KNM-100aiq.

2.05 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 1200°F (10 to 649°C).
   1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97, Johns Manville Industrial Insulation Group CalBond Gold, Marathon Industries; 290, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27, Mon-Eco Industries, Inc.; 22-30, Vimasco Corporation; 760, or equal.
   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200°F (minus 73 to plus 93°C).
   1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84, or equal.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 °F (minus 59 to plus 149°C).
   1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33, or equal.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following: Aeroflex USA, Inc.; Aeroseal, Armacell LLC; Armaflex 520 Adhesive, Foster Brand, Specialty

Construction Brands, Inc., a business of HB Fuller Company; 85-75. K-Flex USA; R-373 Contact Adhesive, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company, CP-127.Eagle Bridges - Marathon Industries; 225, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70. Mon-Eco Industries, Inc.; 22-25, or equal.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82, Eagle Bridges - Marathon Industries; 225, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50. Mon-Eco Industries, Inc.; 22-25, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following: Dow Corning Corporation; 739, Dow Silicone, Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive, P.I.C. Plastics, Inc.; Welding Adhesive, Speedline Corporation; Polyco VP Adhesive, or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90, Vimasco Corporation; 749, or equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30, Eagle Bridges - Marathon Industries; 501, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35, Mon-Eco Industries, Inc.; 55-10, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180°F (Minus 18 to plus 82°C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements,provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel, Eagle Bridges - Marathon Industries; 570, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220°F (Minus 46 to plus 104°C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10, Eagle Bridges - Marathon Industries; 550, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50, Mon-Eco Industries, Inc.; 55-50, Vimasco Corporation; WC-1/WC-5, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180°F (Minus 29 to plus 82°C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.07 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company, CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36, Vimasco Corporation; 713 and 714, or equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180°F (Minus 18 to plus 82°C).
5. Color: White.

2.08 SEALANTS

A. Joint Sealants:
   1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45, Mon-Eco Industries, Inc.; 44-05, Pittsburgh Corning Corporation; Pittseal 444, or equal.
   2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70, Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45, Mon-Eco Industries, Inc.; 44-05, or equal.
   3. Materials shall be compatible with insulation materials, jackets, and substrates.
   4. Permanently flexible, elastomeric sealant.
   5. Service Temperature Range: Minus 100 to plus 300°F (Minus 73 to plus 149°C).
   6. Color: White or gray.
   7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of HB Fuller Company; CP-76. Eagle Bridges - Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of HB Fuller Company; 95-44, Mon-Eco Industries, Inc.; 44-05, or equal.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 121°C).
   5. Color: Aluminum.
   6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, or equal.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250°F (Minus 40 to plus 121°C).
   5. Color: White.
   6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.09 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.
   1. Products: Subject to compliance with requirements, provide one of the following; Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5, or equal.
   2. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
   3. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab, Vimasco Corporation; Elastafab 894, or equal.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
   1. Products: Subject to compliance with requirements, provide one of the following: Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59, or equal.

2.12 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following: Johns Manville; Zeston, P.I.C. Plastics, Inc.; FG Series, Proto Corporation; LoSmoke, Speedline Corporation; SmokeSafe, or equal.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White jackets based on system.

D. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems, ITW Insulation Systems; Aluminum and Stainless Steel Jacketing, RPR Products, Inc.; Insul-Mate, or equal.
   2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.

b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
   a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
   b. Material, finish, and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
   d. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered withstucco-embossed aluminum-foil facing.
   1. Products: Subject to compliance with requirements, provide one of the following: Polyguard Products, Inc, Alumaguard 60, or equal.

2.13 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 428 AWF ASJ, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836, Compac Corporation; 104 and 105, Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ, or equal.
   2. Width: 3 inches (75 mm).
   3. Thickness: 11.5 mils (0.29 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 491 AWF FSK, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827, Compac Corporation; 110 and 111, Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ, or equal.
   2. Width: 3 inches (75 mm).
   3. Thickness: 6.5 mils (0.16 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 370 White PVC tape, Compac Corporation; 130, Venture Tape; 1506 CW NS, or equal.
   2. Width: 2 inches (50 mm).
   3. Thickness: 6 mils (0.15 mm).
   4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, provide one of the following: ABI, Ideal Tape Division; 488 AWF, Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800, Compac Corporation; 120, Venture Tape; 3520 CW, or equal.
   2. Width: 2 inches (50 mm).
   3. Thickness: 3.7 mils (0.093 mm).
   4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.14 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following: ITW Insulation Systems, Gerrard Strapping and Seals, RPR Products, Inc., Insul-Mate Strapping, Seals, and Springs, or equal.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304, 0.020 inch (0.50 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.
   3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) or 3/4 inch (19 mm) wide with wing seal.
   4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
      a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; CWP-1, GEMCO; CD, Midwest Fasteners, Inc.; CD, Nelson Stud Welding; TPA, TPC, and TPS, or equal.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
      a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; CHP-1, GEMCO; Cupped Head Weld Pin, Midwest Fasteners, Inc.; Cupped Head, Nelson Stud Welding; CHP, or equal.
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers, GEMCO; Perforated Base, Midwest Fasteners, Inc.; Spindle, or equal.
      b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
      c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel coordinated with application, fully annealed, 12 gauge, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
      d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
   4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely

in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following: GEMCO; Nylon Hangers, Midwest Fasteners, Inc.; Nylon Insulation Hangers, or equal.
b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, GEMCO; Peel & Press, Midwest Fasteners, Inc.; Self Stick, or equal.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, Stainless steel, fully annealed, as coordinated with application. 12 gauge, 0.106-inch - (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.015-inch- (0.41-mm-) thick, galvanized-steel, aluminum, or stainless-steel sheet, as coordinated with application with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following: AGM Industries, Inc.; RC-150, GEMCO; R-150, Midwest Fasteners, Inc.; WA-150, Nelson Stud Welding; Speed Clips, or equal.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: GEMCO, Midwest Fasteners, Inc, or equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: C & F Wire, or equal.

PART 3 - **EXECUTION**

3.01 EXAMINATION AND PREPARATION

A. Verify that piping has been tested for leakage in accordance with specifications before applying insulation materials. All piping and ductwork shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection

shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.02 INSTALLATION

A. General:
1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
2. Remove and replace any insulation that has become wet or damaged during the construction process.

B. Piping Insulation:
1. Locate insulation and cover seams in least visible locations unless otherwise specified.
2. Neatly finish insulation at supports, protrusions, and interruptions.
3. Provide insulated dual temperature pipes and cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Insulate complete system. Note that staples used on pipes conveying fluids below ambient temperatures (cold systems) must be covered with approved mastic.
4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self-sealing lap or outward clinched, expanded staples. Seal ends of insulation at equipment, flanges, and unions.
5. Provide insert between support shield and piping on piping 1½" diameter or larger. Fabricate of Johns Manville Thermo-12, or other heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:
   a. 1½" to 2½" pipe size: 10" long
   b. 3" to 6" pipe size: 12" long
   c. 8" to 10" pipe size: 16" long
   d. 12" and over: 22" long
6. Use of metal saddles is acceptable as specified in Section 23 05 00. Fill interior voids with segments of insulation matching adjoining pipe insulation.
7. Use of pipe hangers designed as an insulation coupling is acceptable in lieu of saddles and other devices. Klo-Shure coupling or equal.
8. For pipe exposed in mechanical equipment rooms or in finished spaces below 7 feet above finished floor, finish with Proto LoSmoke PVC jacket and fitting covers or Johns Manville Zeston PVC jacket.
9. Where pumps, valves (manual and control types), strainers, etc., with insulation require periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.
   a. Cold Systems: Provide Armaflex elastomeric foam for pumps and strainers.
   b. Hot Systems: Provide removable blanket covers on valves, pumps, and strainers.
10. For exterior applications:
   a. Provide weather protection jacket. Insulated pipe lengths, pumps, fittings, joints, and valves shall be covered with aluminum jacket or stainless steel jacket. Jacket seams shall be located on bottom side of horizontal piping. All lateral joints shall be caulked with a minimum 20-year silicone sealant (clear). All longitudinal joints, except those at the bottom of a horizontal pipe run, shall be caulked with a minimum 20-year silicone sealant (clear).
   b. Apply weather-resistant protective finish such as WB Armaflex to flexible elastomeric insulation. Insulation seams shall be located on the bottom side of horizontal piping. All lateral and longitudinal joints to be sealed with low V.O.C., UV inhibitive adhesive, such as Armaflex 520 BLV adhesive.
11. For underground installations, install per manufacturer's written instructions and recommendations.

12. When maintenance or service access for equipment will result in foot traffic over floor mounted insulated piping the contractor is to fabricate a permanent removable walkway to prevent damage to the piping and insulation.

3.03 ACOUSTIC PIPE WRAP

A. Acoustic pipe wrap is to be used in piping system which occur over occupied spaces for the following:
   1. Horizontal condenser water riser offsets.
   2. Pipe, valves and fittings where water velocity exceeds 6 feet per second.

3.04 PIPING INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed state energy code requirements as noted below. Increase thickness by 1/2" (minimum) where insulated pipe is exposed to exterior ambient air. Minimum thermal resistance shall comply with building code minimum ranges and may exceed those minimum levels. Insulation thicknesses may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. TABLE 1: PIPING SERVICES, FLUID TEMPERATURE, AND INSULATION TYPE REQUIRED

INSULATION TYPE	INSULATION SUMMARY	
PI-A	Molded glass mineral wool	
PI-B	Closed cell phenolic foam	
PI-C	Rigid polyisocyanurate foam. Limited to non-plenum rated applications.	
PI-D	Hydrous Calcium Silicate	
PI-E	Cellular Glass	
PI-F	Flexible Elastomeric Closed Cell	
SERVICE	INSULATION TYPE / ALLOWED OPTIONS	REMARKS
Cooling Coil Condensate drain piping (40°F -60°F)	Type PI-F	Provide 1/2" thickness insulation, all pipe sizes, except where piping is located exterior to the building or at floor level routed adjacent to air handling equipment in mechanical rooms. Refer to Division 22.
Refrigerant suction and hot-gas piping	Type PI-F	Provide 3/4" insulation for all hot gas piping in close proximity to likely human contact
Refrigerant liquid piping	Type PI-F	Provide 3/4" thickness insulation. Provide aluminum jacket on exterior insulated suction piping / uninsulated liquid piping bundled together.
Exterior Condenser water supply and return systems and fittings. (55°F-105°F)	Type PI-A, B, C, E	Exterior installation where exposed to freezing conditions provide 1" thickness all pipe sizes.
Interior Condenser water supply and return systems and fittings. (55°F-105°F)	N/A	
(Interior and Exterior Geothermal Condenser water supply and return systems and fittings. (54°F and below)	Type PI-A, B, C, E	Above grade piping only. Below grade not insulated.
Electric Heat Traced systems	Per fluid type	Provide aluminum jacket on exterior insulated piping

C. TABLE 2: MINIMUM PIPING INSULATION THICKNESS BASED ON FLUID TEMPERATURE AND PIPING SIZE.
1. California

Insulation Based on California T-24 Energy Code Table 120.3-A Minimum Pipe Insulation Thicknesses or Greater							
FLUID TEMPERATURE RANGE (°F)	**CONDUCTIVITY RANGE (in Btu-inch per hour per square foot °F)**	**INSULATION MEAN RATING TEMPERATURE (°F)**	**NOMINAL PIPE DIAMETER (in inches)**				
			<1	**1 and 1-1/4**	**1-1/2 to <4**	**4 to <8**	**8 and larger**
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating systems (steam, steam condensate and hot water) and Domestic Services Water Heating Systems							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.31	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
40-60 residential	0.21-0.27	75	0.75 for residential		1.0	1.0	1.0
Below 40	0.20-0.27	75	1.0	1.5	1.5	1.5	1.5

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING SYSTEMS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. Includes, but not limited to:
   1. Furnish and install piping and piping specialties for refrigeration systems serving split system air conditioning units.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 07 19: HVAC Piping Insulation

C. Section 23 81 30: Split System Air Conditioning Units

D. Division 26: Electrical

1.04 QUALITY ASSURANCE

A. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:
   1. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications" latest edition.
   2. Comply with ASHRAE 15: Safety Code for Refrigeration Systems.
   3. Comply with ASME B31.5: Refrigeration Piping and Heat Transfer Components.
   4. Comply with ASTM B 280-88: Specification for Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.

B. Contractor Qualifications: A refrigeration contractor licensed by the State shall install refrigerant piping.

C. Manufacturer Qualifications:
   1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
   2. Replacement parts shall be readily available and stocked in the USA.
   3. Manufacturer shall have a minimum of five years of manufacturing products related to refrigerant piping and/or fittings.
   4. Products shall have an installation history of no less than five years of field operation with reliable maintenance track record.
   5. Alternate system and material must be submitted with historical supporting documentation and reliability report before approval is allowed.

D. Codes and Standards:
   1. All work shall be in full accordance with all applicable codes, ordinances and code rulings.
   2. The Contractor shall furnish without any extra charge the labor and material required for compliance of codes for work required, but not specifically shown in Drawings.

3. Perform all tests required by governing authorities and as required under all Division 23 Sections. Provide written reports on all tests.
4. Electrical devices and wiring shall confirm to the latest standards of NEC; all devices shall be UL listed and so identified.

E. Product Control
1. Protection: Use all means necessary to protect materials before, during, and after installation and to protect the installed work and materials of all other trades.
2. The general arrangement and locations of piping are shown on the Drawings. Changes may be necessary to accommodate work. Should it be necessary to deviate from arrangement or location indicated in order to meet existing conditions or due to interference with work of other trades, such deviations as offsets, pipe sizes, fittings sizes, rises and drops in piping that may be necessary, whether shown or not, shall be made without extra expense. Accuracy of data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for assistance and guidance, and exact locations, distances, and elevations will be governed by actual site conditions.
3. All work shall be in accordance with the applicable codes listed in Division 01. No extra charge will be paid for furnishing items required by the regulations but not specified herein or shown on the Drawings. Should there be any direct conflict between the Drawings and/or Specifications and the above rules and regulations, the rules and regulations shall take precedence.
4. All work shall be completely coordinated, and all lines, grades, slopes and vertical and horizontal locations of pipes shall be exactly determined in the field and cleared with the Owner's Representative before the installation of these items is begun. No extra compensation shall be made for failure to observe this clause.
5. The Drawings and Specifications do not undertake to list every item that will be installed. When an item is necessary for the satisfactory operation of the system, it shall be furnished without extra cost. Work called for in the Specifications, but not on the Drawings, or vice versa, shall be done as though required by both. Lack of specific mention of any work necessary for proper completion of the work in the Specifications and/or Drawings, shall not lessen the Contractor's responsibility.
6. Obtain Owner's Representative's approval prior to rerouting of existing services. Refer to Division 01 sections for alterations, shutdown and temporary construction for existing services.
7. Pipe spaces provided in the design shall be utilized and the work shall be kept within the spaces established on the Drawings.
8. Manufacturers' directions shall be followed in all cases where manufacturers of articles used in this Contract furnish directions covering points not shown on the Drawings or specified herein. Manufacturers' directions do not take precedence over the Drawings and Specifications. Where manufacturers' directions are in conflict with the Drawings and Specifications, submit these conflicts to the Owner’s Representative and receive clarification before installing the work.
9. Do not permit or cause any work to be covered or enclosed until it has been inspected, tested, and approved. Should any of the work be enclosed or covered before inspection and test, Contractor shall, at his/her own expense, uncover the work; and, after it has been inspected, tested and approved, make all repairs with such materials as may be required. Restore all work to its original and proper condition.
10. Be responsible for damage to any of this work before acceptance. Securely cover all openings, both before and after setting into place, to prevent obstructions in the pipes and breakage.
11. Repair all damage to the premises occasioned by the work. All damage to any part of the premises caused by leaks or breaks in the pipe installed under this Section of the work for a period of one (1) year after date of final acceptance of the work, shall be repaired.

F. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less,

and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for all refrigerant piping, valves and specialties indicating dimensions, flow capacity, pressure setting, tolerances etc.

B. Shop Drawings:
   1. Submit shop drawings including plans, schematics, and riser diagrams of refrigerant piping, including dimensions of all piping.
   2. Reference to associated insulation systems submitted in compliance with Section 23 07 00 HVAC Insulation.
   3. Provide all details of suspension and support for ceiling hung equipment.

C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, valve replacement, and spare parts lists. Include this data, product data, and shop drawings in operating and maintenance manuals.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver unit to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect equipment and products against dirt, water, chemical, and mechanical damage. Do not install damaged unit - remove from project site.

1.07 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

C. Provide the following additional extended warranty requirements that apply to piping with mechanical type joints and fittings, such as grooved or pressed/compression type fittings.
   1. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.
   2. Contractor and Manufacturer warrant that, for a period of ten (10) years from the date of Substantial Completion, the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.
   3. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).
2. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).
3. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).

B. Line Test Pressure for Refrigerant R-407C:
1. Suction Lines for Air-Conditioning Applications: 230 psig (1586 kPa).
2. Suction Lines for Heat-Pump Applications: 380 psig (2620 kPa).
3. Hot-Gas and Liquid Lines: 380 psig (2620 kPa).

C. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

D. Do not use pre-charged refrigerant lines more than 50 feet in length.

2.02 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B88, Type K or L; or ASTM B280, Type ACR.

B. Wrought-Copper Fittings and Unions: ASME B16.22.

C. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe. Flux: Stay-Silv white brazing flux by J.W. Harris Co or silver solder flux by Handy & Harmon.

D. Brazing Filler Metals: AWS A5.8.
1. Copper to Copper Connections:
   a. AWS Classification BCuP-4 Copper Phosphorus (6% silver).
   b. AWS Classification BCuP-5 Copper Phosphorus (15% silver).
2. Copper to Brass or Copper to Steel Connections
   a. AWS Classification BAg-5 Silver (45% silver)
3. Do not use rods containing Cadmium.

E. Flexible Connectors:
1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch (180-mm-) long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250°F (121°C).

F. Manufacturers: Mueller Streamline, Nibco, Grinnell, Elkhart, or equal.

2.03 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.

B. Wrought-Steel Fittings: ASTM A234, for welded joints.

C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Flanged Unions:
1. Body: Forged-steel flanges for NPS 1” to NPS 1-1/2” (DN 25 to DN 40) and ductile iron for NPS 2” to NPS 3” (DN 50 to DN 80). Apply rust-resistant finish at factory.

2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch (180-mm) long assembly.
6. Pressure Rating: Factory test at minimum 400 psig (2760 kPa).
7. Maximum Operating Temperature: 330°F (165 C).

F. Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket.
2. End Connections:
a. NPS 2” (DN 50) and Smaller: With threaded-end connections.
b. NPS 2-1/2” (DN 65) and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch (180-mm) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250°F (121°C).

G. Manufacturers:
1. Anaconda "Vibration Eliminators" by Anamet
2. Vibration Absorber Model VAF by Packless Industries
3. Vibration Absorbers by Superior Valve Co.
4. Style "BF" Spring-flex refrigerant connectors by Vibration Mountings.
5. Or equal.

2.04 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 F (135 C).

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 F (135 C).

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).

8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 F (135 C).

D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Manufacturers: Apollo Valves (Conbraco), Henry, Mueller, Superior, Virginia, or equal.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24/115/208-volt ac coil as required.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 F (116 C).

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 F (116 C).

G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Reverse-flow option (for heat-pump applications).
6. End Connections: Socket, flare, or threaded union.
7. Manufacturers: Alco, Henry, Mueller, Parker, Singer, Sporlan, or equal.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter and 24/115/208-volt AC coil as required.
7. End Connections: Socket.
8. Throttling Range: Maximum 5 psig (34 kPa).
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 F (116 C).

I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).

5. Maximum Operating Temperature: 275 F (135 C).

J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 F (135 C).
   a. Moisture/Liquid Indicators:
7. Body: Forged brass.
8. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
9. Indicator: Color coded to show moisture content in parts per million (ppm).
10. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
11. End Connections: Socket or flare.
12. Working Pressure Rating: 500 psig (3450 kPa).
13. Maximum Operating Temperature: 240 F (116 C).

K. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10-micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. End Connections: Socket.
5. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement for suction-line filter dryers.
6. Maximum Pressure Loss: **2 psig (14 kPa)**.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 240 F (116 C).

L. Permanent Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell.
2. Filter Media: 10-micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. End Connections: Socket.
5. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: **2 psig (14 kPa)**.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 240 F (116 C).
9. Manufacturers: Alco, Mueller, Parker, Sporlan, Virginia, or equal.

M. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 F (135 C).

N. Receivers: Comply with AHRI 495.
1. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL for receivers larger than 6 inches (150 mm).
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).

7. Maximum Operating Temperature: 275 F (135 C).

O. Liquid Accumulators: Comply with AHRI 495.
   1. Body: Welded steel with corrosion-resistant coating.
   2. End Connections: Socket or threaded.
   3. Working Pressure Rating: 500 psig (3450 kPa).
   4. Maximum Operating Temperature: 275 F (135 C).

P. Sight Glass
   1. Combination moisture and liquid indicator with protection cap.
   2. Sight glass shall be full line size.
   3. Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.
   4. Manufacturers: Alco, Asco, Mueller, Parker, Sporlan, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide and install refrigerant piping, fittings, valves and devices as required by equipment manufacturer and as shown on the Drawings.

B. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary.
   1. No soft solder (tin, lead, antimony) connections will be allowed in system.
   2. Braze valve, sight glass, and flexible connections.
   3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Insulate all suction and hot gas lines. Insulate liquid lines where pipe may be in close contact to humans.

3.02 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.
      a. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
      b. Install receivers sized to accommodate pump-down charge.
      c. Install flexible connectors at compressors.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective chaseway where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
   1. Shot blast the interior of piping.
   2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
   3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
   4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
   5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
   6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Install sleeves and escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Steel pipe: Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.05 HANGERS AND SUPPORTS

A. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.

2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

B. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
1. NPS 1/2-inch (DN 15): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
2. NPS 5/8-inch (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
3. NPS 1” inch (DN 25): Maximum span, 72 inches (1800 mm); minimum rod, 1/4 inch (6.4 mm).
4. NPS 1-1/4” (DN 32): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
5. NPS 1-1/2” (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
6. NPS 2” (DN50): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
7. NPS 2-1/2” (DN 65): Maximum span, 108 inches (2700 mm); minimum rod, 3/8 inch (9.5 mm).
8. NPS 3” (DN 80): Maximum span, 10 feet (3 m); minimum rod, 3/8 inch (9.5 mm).
9. NPS 4” (DN 100): Maximum span, 12 feet (3.7 m); minimum rod, 1/2 inch (13 mm).

C. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2” (DN 50): Maximum span, 10 feet (3 m); minimum rod, 3/8 inch (9.5 mm).
2. NPS 2-1/2” (DN 65): Maximum span, 11 feet (3.4 m); minimum rod, 3/8 inch (9.5 mm).
3. NPS 3” (DN 80): Maximum span, 12 feet (3.7 m); minimum rod, 3/8 inch (9.5 mm).
4. NPS 4” (DN 100): Maximum span, 14 feet (4.3 m); minimum rod, 1/2 inch (13 mm).

D. Support multifloor vertical runs at least at each floor.

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
4. Prepare test and inspection reports.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13
AIR DISTRIBUTION

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this Section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 23 05 00 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:
   1. Ductwork - Rigid, Flexible and Fabric
   2. Diffusers, Grilles, and Registers
   3. Ductwork Specialties
   4. Flexible Connections
   5. Sealants, Adhesives and Tapes
   6. Duct Access Panels and Doors
   7. Backdraft and Relief Dampers
   8. Combination Fire and Smoke Dampers
   9. Fire Dampers
   10. Smoke Dampers
   11. Chimneys, Stacks and Flue Vents
   12. Flashings
   13. Bird Screens

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic Materials and Methods

B. Section 23 05 93: Testing, Adjusting and Balancing

C. Section 23 07 13: Duct Insulation

D. Section 23 09 00: Building Automation System (BAS) Control

E. Division 26: Electrical

1.04 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:
   1. ARI 885-98 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminal and Air Outlets
   2. AMCA-210 - Laboratory Methods of Testing Fans for Rating Purposes
   3. ANSI S12.23 - Designation of Sound Power Emitted by Machinery and Equipment
   4. ASC-A7001 - Standard for Duct Sealants

5. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip. Type 304 or 304 stainless steel
6. ASTM A525 - Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) Hot-Dip Process. G60 and G90 zinc-coated
7. ASTM A527/A527M - Standard Specification for Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
8. UL 181/ANSI 181 - Factory-Made Air Ducts and Connections, Class 1
9. ASHRAE Standard 130-2008 Methods of Testing Air Terminal Units
10. AHRI Standard 885-2008 - Procedures for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
11. NFPA 90A - Standards for the Installation of Air Conditioning and Ventilating Systems
12. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

B. Provide and construct ductwork systems in conformance with the latest editions of the following documents:
   1. SMACNA - HVAC Duct Construction Standards-Metal and Flexible – 2005.
   2. SMACNA - HVAC Phenolic Duct Construction Standards - 2015.
   3. SMACNA - Accepted Industry Practice for Industrial Duct Construction" for duct pressures above +5" wg positive pressure or below -5" wg negative pressure. Where differences exist between SMACNA and the prevailing building code, the gauge or construction method of the submitted ductwork shall be the more stringent of the two standards.
   4. ASHRAE Systems and Equipment Handbook "Duct Construction" chapter.
   5. ASHRAE Fundamentals Handbook "Duct Design" chapter.

C. Alternatives: The SMACNA standards and publications referenced in this Section of the specifications establish ductwork construction requirements.
   1. Alternatives to these standards and publications may be submitted. Approval will be based on demonstration that such alternatives are equivalent and satisfy the functional requirements described in the referenced standards.
   2. Such demonstration shall include evidence that the alternatives proposed were tested in accordance with SMACNA procedures and with test results certified by an independent testing laboratory.

D. All ductwork and equipment shall be seismically supported and braced per the SMACNA “Seismic Restraint Manual: Guidelines for Mechanical Systems”.

E. Flame/Smoke Rating: All materials, including sealants and adhesives, exposed within plenum shall have a flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

1.05 DEFINITIONS

A. Class 0: Factory-made air ducts and connectors, compliant with ANSI/UL 181, having a surface burning characteristic of zero. Typically constructed of semi-rigid corrugated aluminum. This does not include sheet metal ductwork constructed per SMACNA Standards.

B. Class 1: Factory-made air ducts and connectors, compliant with ANSI/UL 181, having a flame spread index of not over 25 and a smoke developed index of not more than 50. Typically constructed of flexible ductwork, rigid fiberglass ductwork and plastic ductwork. This does not include sheet metal ductwork constructed per SMACNA Standards.

C. Flexible Air Duct (Factory-Made): Class 0 or Class 1 air ducts tested in accordance with 15 tests per ANSI/UL 181 and installed in conformance with the conditions of the listing and NFPA 90A/90B. Flexible ducts shall not be installed to serve more than two stories and shall not penetrate a fire-resistance rated assembly or construction. Maximum lengths of flexible ductwork shall not exceed lengths identified in this section or as limited by the AHJ, whichever is shorter.

D. Flexible Duct Connector (Factory-Made): Class 0 or Class 1 connectors tested in accordance with 12 of 15 tests per ANSI/UL 181 and installed in conformance with the conditions of the listing and NFPA 90A/90B. Connectors include, but are not limited to, short flexible connections between air handlers and ductwork systems, uninsulated transition fittings, specialty shapes for diffuser connections, etc. Connectors shall not penetrate a wall, floor, or ceiling. Maximum lengths of flexible ductwork shall not exceed five foot (5') lengths or as limited by the AHJ, whichever is shorter.

1.06 SUBMITTALS

A. Prior to construction, submit for approval on all materials and equipment:
1. Ductwork - Rigid, Flexible and Fabric
2. Ductwork Specialties
3. Flexible Connections
4. Sealants, Adhesives and Tapes
5. Flashings
6. Bird Screens
7. Duct Access Panels and Doors
8. Backdraft Dampers
9. Control Dampers
10. Diffusers, Grilles, and Registers
11. Fire/Smoke Dampers - Schedule of selected dampers must include the location, nominal size, free area velocity, and static pressure drop at free area velocity for each damper.
12. SMACNA "HVAC Duct Construction Standards - Metal and Flexible"

A. Shop Drawings: Provide shop drawings of sheet metal ductwork and plenums as follows:
1. Draw to a scale not less than 1/8" to one foot, with sheet sizes equal to Contract Drawings.
2. Show duct sizes, where possible use even duct sizes.
3. Show fitting details.
4. Show coordination with lighting fixtures, fire dampers, fire/smoke dampers, piping, diffusers, grilles, registers, fans, major electrical runs, cable trays and bus ducts.

B. Shop Drawings: Provide shop drawings for field erected mechanical equipment:
1. Draw to a scale of 1/2" to one foot, with sheet sizes equal to Contract Drawings.
2. Show plan, sections, elevations and details of all joints and enclosures.
3. Detail access doors and hardware.
4. Detail coil, damper, humidifier, filter and fan installations.
5. Show access space for electrical components that are part of the equipment provided and/or installed such as power and control panels on humidifiers. This shall be coordinated with Division 26 and NEC.

C. Certifications: Provide a duct schedule, certified by an officer of the sheet metal fabrication subcontractor, that the ductwork conforms to SMACNA standards, and for each sheet metal system furnished on the project include:
1. System name.
2. Duct material.

3. Duct gauge.
4. SMACNA rectangular reinforcement number.
5. SMACNA intermediate reinforcement number.
6. SMACNA transverse reinforcement number.
7. Rod diameter and type.
8. Sealant type.
9. Attachment method.
10. Duct system design pressure.

D. Construction IAQ Management Plan: Collaborate with the general contractor to submit and implement an IAQ Management Plan for the construction process meeting the requirements of the SMACNA IAQ Guidelines. This plan should address the protection of the ventilation system components during construction and cleanup of contaminated components after construction is complete. SMACNA IAQ Guideline recommends control measures in five areas. The IAQ Management Plan should address how compliance has been achieved in these required five areas as follows:
   1. HVAC Protection
      a. Shutdown of return side of existing HVAC system in areas affected by heavy construction.
      b. Provision of temporary filters if existing or new systems must remain operational during construction.
      c. Close supply, return and exhaust dampers and seal duct openings in areas subject to construction dust.
   2. Source Control
      a. How will reduction of contaminants be reduced at the source?
      b. What steps will be taken to employ low emitting products and sealants.
      c. How will air handling equipment be cycled off when not needed?
   3. Pathway Interruption
      a. Describe how the construction space will be ventilated as required to dilute contaminants.
      b. Describe how occupied spaces adjacent to construction areas will be kept at positive pressure relative to spaces under construction.
   4. Housekeeping: Describe how the following housekeeping objectives will be implemented:
      a. Reduction of dust generated by work will be suppressed.
      b. Maintaining a frequent cleaning frequency for dust and particulates.
      c. Remove spills or excess applications of solvent-containing products as soon as possible.
      d. Remove accumulated water and keep work areas as dry as possible.
      e. Protect insulation materials from exposure to moisture.
   5. Scheduling: Describe how overlap of construction activity and ongoing building occupancy activities will be minimized.

E. Field Manual: Submit one copy of the SMACNA "HVAC Duct Construction Standards - Metal and Flexible". Maintain a second copy on the project site.

F. Any ductwork installed without prior approval by the specifier, shall be replaced at the expense of the contractor.

G. The contractor must comply with the enclosed specification in its entirety. If on inspections, the specifier finds changes have been made without prior approval, the contractor will make the applicable changes to comply with this specification, at the contractor’s expense.

H. At the discretion of the specifier, sheet metal gauges and reinforcing may be checked at various times to verify all duct construction is compliant.

2.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged components. Remove damaged products from project site.

2.03 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 DUCTWORK

A. Construct all ducts and plenum of gauges, and with joints, bracing, reinforcing, and other construction details in accordance with the latest construction standards previously listed. Metals shall be manufactured by United States Steel, Kaiser, Rolok or equal.

B. Duct dimensions indicated on drawings are net, inside, clear dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions.

C. Ducts shall be constructed of material gauges and reinforcement Class per SMACNA pressurization classifications to meet 150% of the pressure requirements for external static pressure scheduled on drawings for the fans serving each system. Where differences exist between SMACNA and the prevailing building code, the gauge or construction method of the submitted ductwork shall be the more stringent of the code or standard. Refer to Part III - Execution for matrix of pressure and leakage requirements.

2.02 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
   1. Galvanized Coating Designation: G60 (Z180) for ductwork inside the building envelope in non-corrosive environments. G90 (Z275) for ductwork installed external to the building and may be installed inside the building as an alternate to G60.

	(inches)	Gauge Decimal (inches)	Weight (lb/ft2)	Gauge Decimal (inches)	Weight (lb/ft2)	Gauge Decimal (inches)	Weight (lb/ft2)	Gauge Decimal (inches)	Weight (lb/ft2)
28	0.0156	0.0149	0.625	0.019	0.781	0.0156		0.0126	0.178
27	0.0172	0.0164	0.688	0.02	0.844	0.0172		0.0142	0.2
26	0.0188	0.0179	0.75	0.022	0.906	0.0187	0.756	0.0159	0.224
25	0.0219	0.0209	0.875	0.025	1.031	0.0219		0.0179	0.253
24	0.025	0.0239	1	0.028	1.156	0.025	1.008	0.0201	0.284
23	0.0281	0.0269	1.125	0.031	1.281	0.0281		0.0226	0.319
22	0.0313	0.0299	1.25	0.034	1.406	0.0312	1.26	0.0253	0.357
21	0.0344	0.0329	1.375	0.037	1.531	0.0344		0.0285	0.402
20	0.0375	0.0359	1.5	0.04	1.656	0.0375	1.512	0.032	0.452
19	0.0438	0.0418	1.75	0.046	1.906	0.0437		0.0359	0.507
18	0.05	0.0478	2	0.052	2.156	0.05	2.016	0.0403	0.569
17	0.0563	0.0538	2.25	0.058	2.406	0.0562		0.0453	0.639
16	0.0625	0.0598	2.5	0.064	2.656	0.0625	2.52	0.0508	0.717
15	0.0703	0.0673	2.813	0.071	2.969	0.0703		0.0571	0.806
14	0.0781	0.0747	3.125	0.079	3.281	0.0781	3.15	0.0641	0.905
13	0.0938	0.0897	3.75	0.093	3.906	0.0937		0.072	1.016
12	0.1094	0.1046	4.375	0.108	4.531	0.1094	4.41	0.0808	1.14
11	0.125	0.1196	5	0.123	5.156	0.125	5.04	0.0907	1.28
10	0.1406	0.1345	5.625	0.138	5.781	0.1406	5.67	0.1019	1.438

A. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.
   1. Galvanized Coating Designation: G60 (Z180) for ductwork inside the building envelope in non-corrosive environments. G90 (Z275) for ductwork installed external to the building and may be installed inside the building as an alternate to G60.
   2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick. On sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface].
   3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL181, Class 1.

B. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

G. Factory- or Shop-Applied Antimicrobial Coating:
   1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
   2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D3363.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   5. Shop-Applied Coating Color: Black in concealed areas and white for ductwork in exposed spaces.
   6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

2.02 DUCTWORK FABRICATION

A. Joints – Rectangular Ducts
   1. Slip drive joints, standard seams, flanges or welding as required by SMACNA HVAC Duct Construction Standards for system static pressure. Flanged and gasketed joint fittings, such as Ductmate 25/35/45, Carlisle, MEZ Industries, or equal, are acceptable joint methods, but must be sealed as described previously. Transverse duct joints shall be constructed per Figure 1-4 for types T-8 through T-25. T-1 and T-5 slip joints are NOT allowed. Joint T-2, T-3, T-6 and T-7 reinforced slip joints are allowed below 2” static pressures.

B. Joints - Round
   2. Exposed Ductwork: Slip drive and sheet metal screws.
   3. Concealed Ductwork: Sheet metal screws.

C. Elbows
   1. Construct long radius elbows with centerline not less than 1.5 times the duct width. Shorter radius elbows may be used where required to fit in restricted spaces, or as shown. Provide single thickness turning vanes on all short rectangular elbows less than 25" wide. Provide double thickness turning vanes for short rectangular elbows 25" wide and greater. Number of vanes per SMACNA. Elbows with square throat and radius heel are NOT allowed.

D. Transitions
   1. Construct transitions to meet the meet, or be less than slopes identified per SMACNA HVAC Duct Construction Standards-Metal and Flexible. Slopes shall generally be no greater than 15%, and no greater than 30% where shown on the drawings.

E. Branch Connections
   2. Provide 45°entry boots or radius taps for rectangular duct take-offs. Provide conical, bellmouth or 45° lo-loss boot taps for round duct take-offs. Straight 90° taps and spin-in taps are not allowed, except where round take-off duct size equals height of branch duct size. Provide volume dampers at each duct take-off for balancing. Provide insulation guards at transitions to lined ductwork.

F. Manufactured Joints
   3. 316 stainless steel adjustable clamps with gaskets for connecting welded laterals, branches, and Y fittings. Manufacturer: CECO Environmental #KB Duct or equal.

2.03 RECTANGULAR DUCTWORK

A. Construct rectangular ductwork to meet all functional criteria defined in of the SMACNA HVAC Duct Construction Standards-Metal and Flexible. All ductwork must comply with all local, code requirements. Ductwork shall be constructed of galvanized steel. Diagonally cross break all panels on ducts 30 inches wide and larger, or bead using automatic bead machine with beads at 12 inches on center or less. All connections shall utilize 45° boot take-offs. Bullhead tees and straight taps are not permitted.
   1. Listed manufactured ductwork system are allowed where they are installed per the manufacturer's installation instructions and meet or exceed the requirements of the design requirements.

2.04 ROUND AND OVAL DUCTWORK

A. Round and oval ductwork shall be constructed to SMACNA round ductwork requirements of galvanized sheet steel. Comply with SMACNA HVAC Duct Construction Standards-Metal and Flexible, based on indicated static-pressure class unless otherwise indicated. Longitudinal seams shall be spiral lock seams or continuous welded. Flat oval may be utilized in space-restricted areas. Elbows shall be 5-piece mitered and welded. All elbows shall be long radius type with centerline radius to duct diameter of 1.5, exceptions will only be allowed at restricted space locations.

B. Round or oval duct and fitting manufacturers:
   1. McGill Airflow Corporation
   2. Lindab
   3. Semco
   4. Sheet Metal Connectors
   5. Spiral Manufacturing
   6. Or equal.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. Transverse Joints: Fabricate according to SMACNA HVAC Duct Construction Standards-Metal and Flexible, for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions. All transverse joints, including mechanical flange type fittings, to be externally sealed at all joints.
   1. Exception: internal manufactured single or dual EPDM rubber gasket fittings do not require external sealant.
   2. Transverse joints in ducts larger than 50" diameter require flanged joints.
   3. Lap or snap lock seams are not permitted for round ductwork of any size.

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA HVAC Duct Construction Standards-Metal and Flexible. All longitudinal joints shall be sealed air tight with sealant or continuous welding.
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

F. Tees and Laterals: Select types and fabricate compliant with SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-5, "45 Degree Tees and Laterals", and Figure 3-6, "Conical Tees" and "45 Degree Boot Tees" for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions.
   1. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted.

2.05 DIFFUSERS, GRILLES AND REGISTERS

A. All diffusers, grilles, and registers shall be selected to provide proper air distribution for the intended occupant application. All supply air devices shall be selected to provide a maximum air velocity of 50 fpm at three feet above the floor, unless otherwise noted. Manufacturer's representative shall carefully review Architectural and Mechanical drawings and ensure diffuser/grille/register selections will provide proper air distribution at NC 25 or less. Manufacturer at no additional expense to the Owner shall replace diffusers, grilles, and registers not providing proper distribution or excessive noise at scheduled airflow.

B. All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper where individual duct mounted balancing dampers are not provided.

C. Refer to schedule on drawings for sizes, capacities and patterns.

D. Manufacturers: Titus, Krueger, Price, Metal Aire, Nailor, Anemostat, Carnes, Tuttle&Bailey, or equal.

2.06 DUCTWORK SEALANT

A. Duct tape is not allowed.

B. Rolled elastomeric duct sealants are not allowed.

C. Solvent-based and oil-based sealants are not allowed indoors.

D. Seal all transverse joints, including mechanical joint flanges, similar to Ductmate, on all supply, return, exhaust, and outside air intake ducts.

E. All sealant systems for outdoor application to be suitable for use in exposure to water, sunlight, temperatures extremes associated with project location.

F. All sealant systems for indoor application to be meet VOC limits as specified in South Coast Air Quality Management District (SCAQMD) Rule #1168 limiting VOC's to 80 grams/liter for duct liner adhesives and 250 grams/liter for duct sealants.

G. Indoor Application Water-Based Joint and Seam Sealant:
   1. Flexible, adhesive sealant, suitable for high velocity and high pressure applications, UL 181B-M listed, UL 723 classified, and complying with NFPA requirements for Class 1 ducts.
      a. Sealant shall be water based latex UL 181 B-M non-reinforced sealant.
      b. Sealant shall meet flame spread rating of 0 and smoke developed rating of 0.
      c. Flexibility on 1/4" mandrel.
      d. Freeze/thaw stability - 5 cycles.
      e. Service temperature: -20°F to +200°F (-29°F to +93°C).
      f. ASTM 5590; Resistance to mold, mildew and water.
      g. Meet all SMACNA seal classes.
      h. Meet all SMACNA pressure classes (+/-): 1/2, 1, 2, 3, 4, 6, and 10" water gauge.

   2. Manufacturer: Carlisle (Hardcast) #Iron Grip 601 or #Flex-Grip 550 or #Spray-Seal, Ductmate #PROseal, Design Polymerics #DP1010 or #DP1020 or #DP 1010 Spray, or equal.

H. Indoor Application Water-Based Joint and Seam Sealant with Extended Material Warranty:
   1. Flexible, adhesive sealant, suitable for high velocity and high pressure applications, UL 181B-M listed, UL 723 classified, and complying with NFPA requirements for Class 1 ducts.
      a. Sealant shall be water based latex UL 181 B-M non-reinforced sealant.
      b. Sealant shall meet flame spread rating of 0 and smoke developed rating of 0.
      c. Flexibility on 1/4" mandrel.
      d. Freeze/thaw stability - 5 cycles.
      e. Service temperature: -20°F to +200°F (-29°F to +93°C).
      f. ASTM 5590; Resistance to mold, mildew and water.
      g. Meet all SMACNA seal classes.
      h. Meet all SMACNA pressure classes (+/-): 1/2, 1, 2, 3, 4, 6, and 10" water gauge.
      i. Manufacturer: Carlisle (Hardcast) #Iron Grip 601 or #Flex-Grip 550 or #Spray-Seal and #Aluma-Grip AFT-701 rolled sealant, or equal.

   2. And, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed by a 30-mil rolled sealant. Rolled sealant shall be comprised of a 2-mil foil faced with 28 mils of butyl adhesive/sealant conforming to the product specifications. Rolled sealant shall have the following physical properties:
      a. Peel Strength: 16 lbs. per linear inch.
      b. Tensile strength: 955 psi
      c. Elongation: 560%
      d. Bonding time: Instant with full bond in 24 hours.
      e. Resistance to mold, mildew and water.
      f. Weather Resistance per ASTM G-53 @ 2000 hours QUV.
      g. Service temperature: -20°F to +200°F (-29°F to +93°C).
      h. Surface burning characteristics: Flame spread/smoke developed rating of 20/40, tested in accordance with UL 723.
      i. VOC: 0 g/l
      j. Meet all SMACNA seal classes.
      k. Meet all SMACNA pressure classes (+/-): 1/2, 1, 2, 3, 4, and 6" water gauge.
      l. Manufacturer: Carlisle (Hardcast) #Aluma-Grip AFT-701 rolled sealant, or equal.

I. Outdoor Application Two-Part Tape Sealing System:
   1. Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermally with tape to form hard, durable airtight seal.
   2. Manufacturer: Carlisle (Hardcast) #Two Part II, McGill Uni-Cast, or equal.

J. Rolled Mastic Sealant for indoor and outdoor application on flat sheet metal duct joints. Aluminum substrate with modified butyl sealant. Compliant with UL 181B-FX. Rolled sealant shall have the following physical properties:
   a. Peel Strength: >10 lbs. per linear inch.
   b. Bonding time: Instant tack with full bond in 24 hours.
   c. Resistance to mold, mildew and water.
   d. Weather Resistance per ASTM G-53 @ 2000 hours QUV.
   e. Service temperature: -20°F to +180°F (-29°F to +82°C).
   f. Surface burning characteristics: Flame spread/smoke developed rating of 5/25, tested in accordance with UL 723.
   g. VOC: 0 g/l
   h. Meet all SMACNA seal classes.
   i. Meet all SMACNA pressure classes (+/-): 1/2, 1, 2, 3, 4, 6" and 10" water gauge.
   j. Roll width as required to maintain minimum 3/4" adhesion width on each side of joint.
   k. City of Los Angeles RR#8069 approved.
   l. Manufacturer: Carlisle (Hardcast) #Foil-Grip 1404-181BFX rolled sealant, or equal.

K. Manufacturers of duct sealant systems for various ductwork applications: Design Polymerics, Tremco, Dure Dyne, Carlisle Hardcast, Ductmate, Mon-Eco Industries, and McGill AirSeal LLC.

2.07 FLEXIBLE DUCTWORK

A. Flexible one-inch thick insulated round ductwork, Class 0 or Class 1, may be utilized for final connections to each air outlet and inlet, unless shown otherwise on the plans. Maximum length of flexible ductwork in each low pressure branch shall not exceed five (5') feet and maximum flexible connector lengths shall not exceed five (5') feet.

B. See Part III Execution for installation requirements. All connections shall utilize welded conical tees, aluminum conical fitting, Flexmaster #CBD, or 45° boot take-offs by Flexmaster #STO. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted. Dampers regulators shall include end bearings as manufactured by DuraDyne, Ventlok or equal.

C. Flexible ductwork for low pressure systems with positive static pressure at or below 2" wg positive pressure suitable for both terminal unit connection and diffuser/grilles shall be a trilaminate of aluminized polyester, fiberglass insulation, and polyester, mechanically locked to galvanized steel helix without adhesives, exterior 1" fiberglass insulation and fire retardant polyester outer jacket. Flexmaster #Type 5B, Thermaflex Model M-KE or approved equal.

D. Flexible aluminum ductwork for use in magnetic/electrically sensitive room environments, such as MRI rooms, in low pressure systems with static pressure at or below 2" wg positive pressure shall be a trilaminate of aluminized foil with aluminum helix with exterior 1" aluminum jacket fiberglass insulation. Flexmaster #TL-B or approved equal.

2.08 DUCTWORK SPECIALTIES

A. General: Where specifically called for, materials for use in fabricating ductwork specialties shall be identical to that used to fabricate ductwork. See drawings and Part 3, Execution for schedule.

B. Volume and Splitter Dampers: Galvanized sheet metal blade and frame with Ventfabrics Inc., Ventlok operating hardware. For accessible dampers, provide #641 self -locking dial

regulators and #644 self-locking dial regulators for insulated ductwork, #637 square end bearing, and #635 spring end bearing, as applicable. For inaccessible dampers, provide #666 or #677 concealed locking damper regulator with bearings as above. For static pressures above 3"wg, provide #640 HiVel dial regulator and #609 HiVel end bearing for accessible dampers. Regulators shall extend to and through ceiling with neatly installed hardware at the finished ceiling. For inaccessible dampers requiring adjustment through diffusers use Young Regulator, Bowden cable control system.

C. Multi-louver Volume Dampers: 16-gauge galvanized steel frame. Opposed, 6" wide, 16-gauge galvanized steel blades. Concealed linkage in frame. Ruskin #CD35/OBD or equal.

D. Flexible Connections: Provide flexible connectors at the discharge and inlet of fans, air handlers, rotating mechanical equipment, and where shown on the Drawings for proper vibration isolation. Neoprene impregnated glass cloth with 24-gauge galvanized metal frame. Neoprene-only connectors are not allowed. Minimum dimensions - 3" metal, 3" fabric, 3" metal. Ventfabrics #Ventglas or approved equal by Duro Dyne, Q Industries, consolidated Kinetics, Ductmate Proflex or Elgen.

E. Ducts through roof shall be 16-gauge (or minimum of 2 gauges heavier than attaching ductwork), flashed and counterflashed, and provided with storm collars to secure a watertight construction.

F. Bird Screens: 14-gauge, 1/2", galvanized wire mesh, set in a galvanized steel frame, screw set.

2.09 DUCT ACCESS PANELS AND DOORS

A. In sheet metal work, hollow core double construction of same or heavier gauge material as duct in which installed. Use no door smaller than 12" by 12" for simple manual access or smaller than 24" by 24" where personnel must pass through infrequently. Use 24" by 60" minimum for filters and more frequent maintenance. Use Ventlok or approved hinges and latches on all doors; 100 Series hinges and latches on low pressure system doors up to 18 " maximum dimension, 200 Series on larger low pressure system doors and 333 Series on high pressure systems. Construct doors up to 18 " maximum dimension with one-inch overlap fit and gasket with 3/4" by 1/8" sponge rubber, fit larger doors against 1-1/2" by 1/8" flat stock or angle frame and gasket with 3/4" by 1/8" sponge rubber or felt. Door swing to be opposite airflow. CESCO, Pottorff, Vent Products, Air Balance, Ductmate Sandwich or equal. Access doors smaller than 12" x 12" can be used for visual inspection of dampers, etc. on small ductwork less than 12" wide but must be of maximum size that will fit on duct with 6" x 6" as minimum size. All access doors smaller than 12" x 12" must be approved by the Owner's Representative for the specific application prior to ordering.

2.010 CONTROL DAMPERS

A. General: Low leakage dampers shall be Class 1A with a maximum leakage rate of 3 cfm/ft^2 at 1.0 in wg pressure difference when tested to AMCA Standard 500.

B. Damper Type One: Airfoil Low Leakage Dampers (Galvanized Steel or Aluminum)
   1. Application: Commercial supply, return, and general exhaust air systems up to 3,000 fpm velocity. Damper shall be rated for -22°F to 122°F (-30°C to 50°C) minimum operating range.
   2. Frames to be 5" x 1"x 16-gauge galvanized steel hat-shaped channel or 5" x 1" x 0.125 anodized extruded aluminum hat channel with corner reinforcement.

3. Blades: Airfoil shaped, single piece, 6" wide (maximum), 14-gauge galvanized steel or 6063-T5 anodized aluminum.
    a. Action:
        1) Parallel blade for open and closed control, and economizer dampers.
        2) Opposed blade for modulating and air flow measurement control.
4. Seals: Silicone rubber or EPDM blade and jam seals.
5. Axles: 7/16" diameter steel (minimum), hex-shaped, mechanically attached to blade.
6. Bearings: Self-lubricating stainless steel or molded synthetic sleeve.
7. Linkage to be concealed in frame
8. Crank lever for operator to be provided.
9. Provide with mill finish on blades and frame.
10. Damper position indicator switch(es) as required by control sequence.
11. Manufacturer: Ruskin #CD60 or #CD50, Swartout, NCA PBD/OPD-AF-101, American Warming, Tamco, Air Balance, Greenheck, Pottorff, Nailor or equal.

C. Damper Type Two: Airfoil Low Leakage for Coastal and High Moisture Environments (Aluminum)
1. Application: Commercial supply, return, and general exhaust air systems where damper will be exposed to damp marine air and where velocity is less than 3,000 fpm. Damper shall be rated for -22°F to 122°F (-30°C to 50°C) minimum operating range.
2. Frame to be 5" x 1" x 0.125 anodized extruded aluminum hat channel with silicon side seals and corner reinforcement.
3. Blades: Airfoil shaped, single piece, 6" wide (maximum), 6063-T5 anodized aluminum.
    a. Action:
        1) Parallel blade for open and closed control, and economizer dampers.
        2) Opposed blade for modulating and air flow measurement control.
4. Seals: Silicone rubber or EPDM blade and jam seals.
5. Axles: 1/2" diameter steel, hex-shaped, mechanically attached to blade.
6. Bearings: Self-lubricating stainless steel sleeve or molded synthetic sleeve.
7. Linkage to be concealed in frame.
8. Stainless steel hardware.
9. Damper position indicator switch(es) as required by control sequence.
10. Manufacturer: Tamco #SW Series, Ruskin #CD50, Swartout, NCA, Pottorff, American Warming, Air Balance, Greenheck or equal.

D. Damper Type Three: Heavy Duty Fan Discharge Control
1. Application: Velocity over 3,000 fpm as fan outlet damper.
2. Frames to be 8" x 2" x 12-gauge steel channel (minimum).
3. Blades to be 8" wide (maximum), 0.080 thick extruded aluminum airfoil design.
4. Seals: Silicone rubber or EPDM blade and jam seals.
5. Axles: 3/4" diameter steel, hex-shaped, mechanically attached to blade.
6. Bearings: Stainless steel sleeve type pressed into frame.
7. Linkage to be out of airstream with 10-gauge galvanized steel clevis type arms with crank lever operator.
8. Provide with mill finish on blades and frame.
9. Maximum temperature rating to be 300°F.
10. Manufacturer: Ruskin #CD102, Nailor, Swartout, Pottorff, American Warming, Air Balance, Greenheck or equal.

E. Damper Type Four: Low Leakage Airfoil Insulated Dampers
1. Application: Air handler intake and exhaust. Damper shall be rated for -25°F to 180°F (32°C to 83°C) minimum operating range.
2. Frames to be 5" x 1"x 16-gauge galvanized steel hat-shaped channel or 5" x 1" x 0.125 anodized extruded aluminum hat channel with corner reinforcement.

3. Blades: Insulated, single piece, 6" wide (maximum), 14-gauge galvanized steel or 6063-T5 anodized aluminum, R-3.3.
    a. Action:
        1) Parallel blade for open and closed control.
4. Seals: Silicone rubber or EPDM blade and jam seals.
5. Axles: 7/16" diameter steel (minimum), hex-shaped, mechanically attached to blade.
6. Bearings: Self-lubricating stainless steel or molded synthetic sleeve.
7. Linkage to be concealed in frame
8. Crank lever for operator to be provided.
9. Provide with mill finish on blades and frame.
10. Damper position indicator switch(es) as required by control sequence.
11. Manufacturer: Ruskin #IL35, Greenheck, Pottorff, Tamco, or equal.

F. Damper Type Five: Ultra Low Leakage Airfoil, Double Row Dampers
1. Application: Natural ventilation wall inlets and outlets with parallel (double row) damper blades. Damper shall be rated for -72°F to 275°F (-58°C to 135°C) minimum operating range.
2. Frames to be 8” x 1” steel or aluminum channel thermally broken with insulation within frame channels.
3. Blades: Airfoil shaped, single piece, 4" wide (maximum), 14-gauge galvanized steel or 6063-T5 anodized aluminum.
    a. Action:
        1) Parallel blade for open and closed control.
4. Seals: Silicone rubber or EPDM blade and jam seals.
5. Axles: 7/16" diameter steel (minimum), hex-shaped, mechanically attached to blade.
6. Bearings: Self-lubricating stainless steel or molded synthetic sleeve.
7. Linkage to be concealed in frame
8. Crank lever for operator to be provided.
9. Provide with mill finish on blades and frame.
10. Damper position indicator switch(es) as required by control sequence.
11. Manufacturer: Ruskin #CD40x2, Greenheck, Pottorff, Tamco, or equal.

2.011 BACKDRAFT AND RELIEF DAMPERS

A. Light Duty Counterbalanced Backdraft Damper
1. Applications: Low pressure ductwork systems, including outside air intake and exhaust locations.
2. Frame: Extruded aluminum channel frame with flanges to match ductwork requirements.
3. Blades: Parallel blades, horizontal orientation, 0.025” (0.6 mm) minimum formed aluminum. Maximum 6” wide blades. Extruded vinyl blade seals mechanically attached to blade edge.
4. Counterbalance: Adjustable steel weights mechanically attached to blade.
5. Mounting: Vertically or horizontally oriented as shown on the drawings.
6. Sized for maximum velocity of 1,500 fpm (7.6 m/s).
7. Maximum back pressure of 2.0” wg (1.1 kPa).
8. Maximum Pressure Drop Fully Open: 0.06” wg (15 Pa).
9. Manufacturer: Ruskin #CBD2, Greenheck #WD Series, or equal.

B. Heavy Duty Counterbalanced Backdraft Damper
1. Application: Medium pressure air ductwork and generator exhaust.
2. Frame: Galvanized steel, 16 gage (1.5 mm) wall thickness minimum with flanges to match ductwork requirements.
3. Blades: Parallel blades, horizontal orientation, 0.05” (1.2 mm) minimum formed aluminum. Maximum 6” wide blades. Extruded vinyl blade seals mechanically attached to blade edge.

4. Counterbalance: Adjustable steel weights mechanically attached to blade.
5. Mounting: Vertically or horizontally oriented as shown on the drawings.
6. Sized for maximum velocity of 2,500 fpm (12.7 m/s).
7. Maximum back pressure of 4.5" wg (1.1 kPa).
8. Maximum Pressure Drop Fully Open: 0.20" wg (50 Pa).
9. Manufacturer: Ruskin #BD6, Greenheck #HB Series, Nailor #1380, or equal.

C. Barometric Relief Damper
1. Applications: Gravity hood exhaust, room pressurization control and stairwell pressurization relief.
2. Frame: Extruded aluminum channel frame, 0.090" (2.3 mm) wall thickness minimum with flanges to match ductwork requirements.
3. Blades: Parallel blades, horizontal orientation, 0.063" (1.6 mm) minimum formed aluminum. Maximum 6" wide blades. Extruded vinyl blade seals mechanically attached to blade edge.
4. Counterbalance: Adjustable on-blade counterweights for tuning of start-to-open and full open blade operation.
5. Axle: 3/8" (9.5 mm) galvanized steel rod with roller bearings.
6. Mounting: Vertically or horizontally oriented as shown on the drawings.
7. Sized for maximum velocity of 1,000 fpm (5.1 m/s).
8. Maximum back pressure of 2.0" wg (0.5 kPa).
9. Start-Open Pressure: 0.05" wg (12.5 Pa).
10. Manufacturer: Greenheck #BR-30 for vertical mounting, Greenheck #BD-10 for horizontal mounting, or equal.

D. Round Counterbalanced Backdraft Damper
1. Dampers shall be of the two-blade design with separate axles. Blades shall be retained in closed position with tensioned spring and field adjustable for required opening pressure. Not allowed for installation in dryer exhaust, kitchen exhaust or bypass air applications.
2. Frame: 20 gage (1.0 mm) minimum galvanized steel.
3. Blade: 0.016" thick (0.40 mm) minimum aluminum.
4. Blade Seals: Vinyl foam.
5. Axle: 3/16" (4.8 mm) minimum steel.
6. Maximum Velocity: 1,000 fpm (7.6 m/s).
7. Maximum Pressure Drop Fully Open: 0.06" wg (125 kPA).
8. Manufacturer: Ruskin #BDR2, Greenheck #WDR-53 or equal.

E. Light Duty Non-Counterbalanced Neoprene Backdraft Damper
1. Applications: Low pressure exhaust from small mechanical equipment less than 2,500 cfm.
2. Frame: 16 gage galvanized steel with flanges to match ductwork requirements.
3. Blades: Neoprene coated fiberglass. Maximum 6" wide blades.
4. Mounting: Vertically or horizontally oriented as shown on the drawings.
5. Sized for maximum velocity of 1,000 fpm (5.1 m/s).
6. Manufacturer: Ruskin #NMW2 or equal.

2.012 DUCT SMOKE DETECTORS (DSD)

A. Duct mounted photoelectric smoke detector. One required for each heating or cooling system supplying air in excess of 2,000 cfm, for systems serving more than one occupancy type, and for control of each combination fire/smoke damper when not controlled by Division 26 area wide detection system.

B. Coordinate with Division 26 work and electrical installer for power to smoke detector. Detector shall be installed in the system in compliance with Chapter 6 of the Mechanical Code and NFPA-72. Provide 24-volt power supply option and/or 24-volt transformer as required to coordinate with Division 26.

C. Coordinate with control installer to assure that detector shall shut down the air-moving equipment when smoke is detected and close associated damper actuator(s). Sensor shall be selected to operate with air velocity rating from 100 to 4000 fpm. Provide with metal sampling tube. Provide remote test and reset station at ceiling or as otherwise indicated. Duct smoke detector shall be installed in the supply or return in compliance with the applicable mechanical or building code. Coordinate with Section 23 09 00 and 23 05 93 work.

D. Provide additional duct smoke detectors per requirements of Section 6.4 of NFPA-90A. Provide one duct smoke detector at each story to the connection to a common supply and/or return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 15,000 cfm and serving more than one story.

E. Provide additional duct smoke detectors in high rise buildings and I-2 Occupancies per the Section 907.2 of the Building Code with duct smoke detectors in the main return and exhaust air plenums of each air-conditioning system having a capacity greater than 2,000 cfm.

F. Manufacturer: System Sensor #D2 series or equal.

2.013 FIRE, SMOKE AND COMBINATION FIRE/SMOKE DAMPERS

A. General:
1. Provide UL labeled 3 hour rated fire dampers at 3-hour and greater penetrations.
2. Provide UL labeled 1-1/2 hour rated fire dampers at less than 3-hour penetrations.
3. All dampers to be certified under the latest UL Standard. Certification based on former non-current standards is unacceptable.
4. All damper installations to conform with NFPA 90A and manufacturer's installation instructions. Details on drawings are shown for reference only.
5. Install in ducts passing through walls, floors, and ceilings as required by code. Refer to Architectural and Mechanical plans for damper locations.
6. Provide fire, smoke and fire/smoke dampers in locations as required by local code and NFPA-90A and 92A.
7. Provide sleeves, slip joints, retaining angles, duct access doors, ceiling access panels, etc., as required to check and service the fire dampers. Slip or break away joints are not allowed to be taped or sealed. Access doors shall be tight fitting hinged or sliding and shall have 1" high label reading "FIRE DAMPER", “SMOKE DAMPER”, or “FIRE/SMOKE DAMPER”.
8. All dampers to be designed for use in dynamic systems.
9. Dampers shall be rated for Leakage Class I. Leakage Class II may be used if damper size is smaller than available Leakage Class I dampers.
10. Dampers shall be certified for use by State and local authorities.
11. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress doe to twisting, racking, bowing, or other installation error. Do not install actuators in area where moisture can penetrate actuator or where temperature exceeds 120□F.
12. All fire dampers shall be sized to provide equivalent free area through the damper equal to, or greater than, the free area of the connecting ductwork. Upsize fire dampers as required to minimize pressure drops. In no case is the damper pressure drop to exceed 0.20” wg, but ideally less than 0.10” wg for low velocity dampers, as designed for total

system static pressure allowance. Refer to submittal requirements in Part One of this section and requirements on the drawings.

B. Radiation Ceiling Fire Dampers:
   1. Bladed ceiling fire damper constructed and tested in conformance with UL-555C (dynamic rating).
   2. Fire damper shall have a fusible link that opens at 165°F (74°C) or 212°F (100°C) for high temperature duct applications. Installation shall be in accordance with damper manufacturer's instructions.
   3. Provide fire blanket where required to obtain listed fire rating.
   4. Manufacturer: Ruskin #CFD Series, Greenheck #CRD Series, or equal by Pottorff, Cesco, Nailor, or Air Balance.

C. Dynamic Fire Dampers (FD):
   1. Curtain fire damper constructed and tested in conformance with UL-555C.
   2. Fire damper shall have a fusible link that opens at 165°F (74°C) or 212°F (100°C) for high temperature duct applications. Fire damper shall be equipped for vertical penetrations with manufacturer supplied sleeve. Installation shall be in accordance with damper manufacturer's instructions.
   3. Curtain damper shall not be located in air stream during system operation, Style B or C. Clear inside opening through fire damper is to match clear inside opening of duct. Fire dampers in lined ducts are to match size of sheet metal duct.
   4. Provide duct and ceiling access panel as required.
   5. Manufacturer: Ruskin #DIBD Series, Greenheck #DFD Series, or equal by Pottorff, Air Balance, Nailor or CESCO.

D. Combination Fire and Smoke Dampers (FSD):
   1. Required Locations:
      a. Install at ducted penetrations through rated fire barriers, fire walls, rated ceilings, rated corridor ceilings, shaft enclosures, and smoke barriers and partitions as defined on Architectural drawings and Chapter 7 of the Building Code.
      b. Per NFPA-90A install smoke dampers or combination fire/smoke dampers in systems with a capacity greater than 15,000 cfm to isolate the air handling equipment from the remainder of the system on the building supply and return side. Air handling units located on the floor they serve and only serving that floor are exempt. Air handling units located on the roof and serving only the floor immediately below the roof shall be exempt.
   2. General Requirements:
      a. Dampers shall be Low Leakage Class 1 in accordance with UL 555S.
      b. Dampers shall be provided as a manufactured UL listed device with electric actuator. Actuator shall be attached to sleeve outside of air stream.
      c. Temperature Rating: 165°F (74°C) or 212°F (100°C) for high temperature duct applications.
      d. Mounting: Vertical or horizontal
      e. Frame: 5” wide by 16-gauge roll formed, galvanized steel hat-channel, minimum.
      f. Sleeve: Minimum 20-gauge thickness and minimum 16” long.
      g. Bearings: Stainless steel, permanently lubricated sleeve type.
      h. Each damper shall be equipped with a controlled 15 second electric heat-actuated release device. This device is to be equipped with a push-button reset. No manual fusible links are permitted. Installation shall be in accordance with damper manufacturer's instructions. Coordinate power and smoke detector connections with electrical installer. Integral smoke detection and actuating devices may be used if listed and approved for such service. Comply with building code requirements. All combination fire and smoke dampers shall automatically reset

from closed to open position upon the reapplication of power to actuators, if temperature switch is not tripped.

i. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error.

j. Voltage: Coordinate with Division 26 work and electrical installer for power to damper actuator. Provide 24 VAC, 120 VAC or 230 VAC power option to match power supply provided by Division 26. Prior to purchase and installation coordinate with Division 26 to align power requirements at no additional cost to Owner.

k. Electric Actuators: All gear and housing shall be steel. The actuator shall be direct coupled and employ a steel toothed cold-weld clamp for connecting to damper shafts. Aluminum clamps or set-screw attachments are not acceptable. Actuator shall be UL listed and manufactured under ISO 9001 quality control.
   1) Actuator shall carry a manufacturer's 5-year warranty.
   2) Damper position shall fail closed on loss of power.
   3) Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible. Actuator shall be incapable of burning out if stalled before full rotation is reached.
   4) Actuator shall have UL555S Listing by the damper manufacturer and be rated for 20,000 cycles minimum. Actuator shall draw no more than 0.23 amps at 120-volt running, or 0.11 amps holding at 120-volt (27 VA and 10 VA respectively for 24-volt power) for 70 in-lb torque.
   5) Stall and instantaneous type actuators are not acceptable.
   6) Do not install in areas where moisture can penetrate damper or actuator, nor where actuator temperature exceeds 122□F (50°C).
   7) Manufacturer: Belimo #FS Series or equal by Siemens, Johnson Controls, or Honeywell.

3. Required Options:
   a. Provide open or closed indicator assembly consisting of a single pole, double throw switch used to indicate damper blade position. Include switch mounting bracket, crank arm, blade bracket and linkage from blade to the switch. Or, provide optional actuator end switches to indicate damper open and damper closed positions. Coordinate with fire alarm system and FireFighter's Smoke Control Panel for remote indication and damper override control.
   b. Provide a damper mounted testing module to permit test cycling of the damper actuator assembly as required for start-up testing and maintenance.
   c. Provide integral duct smoke detector and coordinate with Division 26 for area smoke detection and comply with NFPA-90A and NFPA-72. All wiring to be provided by Division 26 installers. In buildings not equipped with an approved fire alarm system the smoke detection activation shall cause a visual signal and audible signal in a normally occupied area and be identified as air duct detector trouble.For exposed wall applications provide matching wall grille to maintain appearance and fire rating.
   e. Temperature limited override: Provide a two-temperature electronic high temperature limit. A primary sensor at 165□F (or higher temperature as dictated by AHJ or Building Code) can be bypassed by an external electrical signal allowing the damper to reopen and remain open until the temperature reaches the setting of the secondary sensor at 350□F at which point the damper is closed and remains closed. Both sensors are to be equipped with manual resets.
4. Low Velocity Applications (1500 fpm or below):
   a. Maximum Rate Velocity: 1500 fpm.
   b. Style: 3V grooved blades or airfoil-shaped, single piece, double skin with mechanically fastened silicone edge seals.

c. Allowable Pressure Drop: size damper as shown on drawings and as required to not exceed maximum allowable pressure drop of 0.10" sp wg at full air flow.
d. Pressure rating: 4" wg
e. Manufacturer: Ruskin #FSD37 or #FSD60 or #FSD60-3, Ruskin #FSDR25 or #FSDR60 round style, Greenheck #FSD-211 or #FSD-231 or #FSD-311 or #FSD-311M, or equal by Pottorff, Nailor, Cesco or Air Balance.

5. High Velocity Applications (Greater than 1500 fpm):
   a. Maximum Rate Velocity: 4000 fpm.
   b. Style: True airfoil-shaped, extruded aluminum blades with silicone edge seals.
   c. Allowable Pressure Drop: size damper as shown on drawings and as required to not exceed maximum allowable pressure drop of 0.20" sp wg at full air flow.
   d. Pressure rating: 4" wg
   e. Manufacturer: Ruskin #FSD60 or #FSD60-3, Greenheck #FSD-211 or #FSD-231 or #FSD-311 or #FSD-331, or equal by Pottorff, Nailor, Cesco or Air Balance.
6. Low and Medium Velocity Round Applications (3000 fpm or below):
   a. Maximum Rate Velocity: 3000 fpm.
   b. Style: Two piece 14 gage thickness galvanized steel with mechanically fastened silicone edge seals
   c. Allowable Pressure Drop: size damper as shown on drawings and as required to not exceed maximum allowable pressure drop of 0.15" sp wg at full air flow.
   d. Pressure rating: 4" wg.
   e. Manufacturer: Ruskin #FSDR25 or #FSDR60, Greenheck #FSDR-511, or equal by Pottorff, Nailor, Cesco or Air Balance.
7. Corridor Ceiling Application:
   a. Maximum Rate Velocity: 1500 fpm.
   b. Style: 3V grooved blades or airfoil-shaped, single piece, double skin with mechanically fastened silicone edge seals.
   c. Allowable Pressure Drop: size damper as shown on drawings and as required to not exceed maximum allowable pressure drop of 0.10" sp wg at full air flow.
   d. Pressure rating: 4" wg.
   e. Manufacturer: Ruskin #FSD60-C, Greenheck #CFSD-211, or equal by Pottorff, Nailor, Cesco or Air Balance.

E. Smoke Dampers (SD):
8. Required Locations:
   a. Install at rated smoke barriers and partitions as defined on Architectural drawings and Chapter 7 of the Building Code.
   b. Per NFPA-90A install smoke dampers in systems with a capacity greater than 15,000 cfm to isolate the air handling equipment from the remainder of the system on the building supply and return side. Air handling units located on the floor they serve and only serving that floor are exempt. Air handling units located on the roof and serving only the floor immediately below the roof shall be exempt.
9. General Requirements:
   a. Dampers shall be Low Leakage Class 1 in accordance with UL 555S.
   b. Dampers shall be provided as a manufactured UL listed device with electric actuator. Actuator shall be attached to sleeve outside of air stream.
   c. Temperature Rating: 165°F (74°C) or 212°F (100°C) for high temperature duct applications.
   d. Mounting: Vertical or horizontal
   e. Frame: 5" wide by 16-gauge roll formed, galvanized steel hat-channel, minimum.
   f. Sleeve: Minimum 20-gauge thickness and minimum 12" long.
   g. Bearings: Stainless steel, permanently lubricated sleeve type.
   h. Smoke damper shall be equipped for vertical wall penetrations with manufacturer supplied sleeve and fail closed on loss of power. Each damper shall be equipped with a controlled 15 second electric heat-actuated release device. This device is to

be equipped with a push-button reset. No manual fusible links are permitted. Installation shall be in accordance with damper manufacturer's instructions. Coordinate power and smoke detector connections with electrical installer. Integral smoke detection and actuating devices may be used if listed and approved for such service. Comply with building code requirements. All combination smoke and fire dampers shall automatically reset from closed to open position upon the reapplication of power to actuators, if temperature switch is not tripped.

i. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error.

j. Voltage: Coordinate with Division 26 work and electrical installer for power to damper actuator. Provide 24 VAC, 120 VAC or 230 VAC power option to match power supply provided by Division 26. Prior to purchase and installation coordinate with Division 26 to align power requirements at no additional cost to Owner.

k. Electric Actuators: All gear and housing shall be steel. The actuator shall be direct coupled and employ a steel toothed cold-weld clamp for connecting to damper shafts. Aluminum clamps or set-screw attachments are not acceptable. Actuator shall be UL listed and manufactured under ISO 9001 quality control.
   1) Actuator shall carry a manufacturer's 5-year warranty.
   2) Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible. Actuator shall be incapable of burning out if stalled before full rotation is reached.
   3) Actuator shall have UL555S Listing by the damper manufacturer and be rated for 20,000 cycles minimum. Actuator shall draw no more than 0.23 amps at 120-volt running, or 0.11 amps holding at 120-volt (27 VA and 10 VA respectively for 24-volt power) for 70 in-lb torque.
   4) Stall and instantaneous type actuators are not acceptable.
   5) Do not install in areas where moisture can penetrate damper or actuator nor where actuator temperature exceeds 122□F (50°C).
   6) Manufacturer: Belimo #FS Series or equal by Siemens, Johnson Controls, or Honeywell.

10. Required Options:
    a. Provide open or closed indicator option assembly consisting of a single pole and a double throw switch used to indicate damper blade position. Output from switch to position indicator light (LED, provided by Division 26) is by automatic temperature control contractor. Include switch mounting bracket, crank arm, blade bracket and linkage from blade to the switch.
    b. Provide a test module to permit test cycling of the damper/actuator in the field
    c. Provide integral duct smoke detector or coordinate with Division 26 for area smoke detection. Division 26 to provide all wiring.For exposed wall applications provide matching wall grille to maintain appearance and fire rating.
11. Low Velocity Applications (1500 fpm or below):
    a. Maximum Rate Velocity: 1500 fpm.
    b. Style: 3V grooved blades or airfoil-shaped, single piece, double skin with mechanically fastened silicone edge seals.
    c. Allowable Pressure Drop: size damper as shown on drawings and as required to not exceed maximum allowable pressure drop of 0.10" sp wg at full air flow.
    d. Pressure rating: 4" wg.
    e. Manufacturer: Ruskin #SD-37, Ruskin #SD-60, Greenheck #SMD-201, Pottorff #SD-141, Pottorff #SD-151, or equal by Nailor, Cesco or Air Balance.
12. High Velocity Applications (Greater than 1500 fpm):
    a. Maximum Rate Velocity: 4000 fpm.
    b. Style: True airfoil-shaped, extruded aluminum blades with silicone edge seals.

c. Allowable Pressure Drop: size damper as shown on drawings and as required to not exceed maximum allowable pressure drop of 0.20" sp wg at full air flow.
d. Pressure rating: 4" wg.
e. Manufacturer: Ruskin #SD-50, Greenheck #SMD-401, or equal by Pottorff, Nailor, Cesco or Air Balance.

PART 3 - EXECUTION

3.01 DUCTWORK MATERIAL APPLICATION SCHEDULE

A. Fabricate ducts with galvanized sheet steel, except as otherwise indicated and as follows:
1. All duct system appurtenances are to be the same material as ductwork including volume dampers and access panels.
2. Environmental exhaust ductwork serving domestic clothes dryers shall be constructed of metal and shall have smooth interior surface. Provide backdraft damper at discharge to atmosphere.
3. Non-toxic and non-hazardous wet vapor exhaust, such as dishwasher, sterilizers, cart washers, and shower exhaust systems:
a. Material: Type 304 or 316L stainless steel, minimum 24-gauge spiral or sheet metal ductwork with G90 zinc coating. Type 304 or 316L stainless steel fittings.
b. Joints: welded, or swaged lap-joint with silicon caulk and stainless steel sheet metal screws.
c. All accessories shall be stainless steel including dampers, damper hardware and turning vanes.

3.02 COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Grease exhaust ducts for Type I hoods shall be constructed of 16-gauge steel or 0.044" stainless steel with liquid tight welded or brazed joints in accordance with the mechanical code, and/or manufactured grease duct assemblies may be utilized. Do not use turning vanes or dampers. Grease exhaust ducts located outside the building envelope may utilize mechanical fittings. Coordinate with architectural design for shaft enclosures.

B. As an alternate method to enclosing the duct in a rated shaft enclosure - furnish and install on the exhaust duct, a 2-hour fire rated board or blanket wrap. See Section 23 07 13 HVAC Insulation for specification. Coordinate with local AHJ and Fire Marshal requirements.

C. As an alternate method to enclosing the duct in a rated shaft enclosure - furnish and install fire resistive coated ductwork. Refer to Section 23 36 33 Fire Resistive Ductwork and Accessories. Coordinate with local AHJ and Fire Marshal requirements.

D. As an alternate method to enclosing the duct in a rated shaft enclosure. Furnish manufactured double wall, factory built grease duct assembly for use with Type I kitchen hoods, which conforms to the requirements of NFPA-96. Products shall be ETL listed to UL-1978 and UL-2221 for venting air and grease vapors from commercial cooking operation. Double wall grease ducts shall be listed for a continuous internal temperature of 500°F and intermittent temperatures of 2000°F. The duct sections shall be constructed of an inner duct wall and an outer wall with insulation in between. The inner duct wall shall be constructed of .036-inch-thick (minimum), 430 type stainless steel and be available in diameters 8" through 24". The outer wall shall be constructed of stainless steel at a minimum of 0.024-inch thickness (minimum). The duct shall include layers of insulation between the inner and outer wall. Grease duct joints shall be held together by means of formed clamps and sealed with

fire caulking. Ductwork Manufacturer: Captive Aire #DW Series or equal. Fire Caulking Manufacturer: 3M Fire Barrier 2000+ or equal.

E. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

F. Provide bolted access doors at each elbow and at the base of each riser sized to allow proper cleaning. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet (3.7 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

G. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and AHJ.

3.03 DUCTWORK AND SPECIALTIES INSTALLATION

A. Ductwork is generally diagrammatically indicated and shall be generally installed as indicated. Do not scale Drawings for exact location of ducts. Install ducts to best suit field conditions and cooperate with other trades. Do not penetrate Structural members without consent of Architect or Structural Engineer. Check with Structural drawings prior to locating any penetrations. Duct sizes are indicated as net inside dimensions on the Drawings. The indicated dimensions shall be altered at the job site for the purpose of avoiding interferences and clearance difficulties to other dimensions producing the same air handling characteristics, provided such altered dimensions are approved by the Architect. Ducts shall be constructed in accordance with the latest edition of codes and standards identified in Part 1 and as shown on the Drawings.
   1. Grilles, Registers and Diffusers: Install flush, squared, tightly sealed, and entirely covering sheet metal ductwork and gaskets. Thread sheet metal mounting screws tightly into sheet metal. All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper only where individual duct mounted balancing dampers are specifically noted as not provided. Duct connections shall fit securely to necks or collars behind face area. Provide all necessary transition pieces and duct collars to make connections from ductwork to neck sizes. Where ducts connect directly to necks or collars provide a minimum straight duct section of two times the duct diameter to the last elbow. Where minimum straight duct sections are not physically possible provide sheet metal plenum sized for approximately 500 fpm air velocity with duct tapped directly to side of plenum. Where building walls, floors and ceilings form portions of duct or plenum, provide gasketed angles or channels at junction points, securely bolted and sealed to building structure.
   2. Install turning vanes in all mitered elbows in all ducts, so that tips are parallel with the sides of the ducts. Vanes shall be single thickness type. Tips of acoustical turning vanes on outside radius shall be flush with acoustical lining.
   3. Provide flexible connections to completely isolate fans from direct contact with all sheet metal work.
   4. Provide access panels or doors, as required, for access to valves, controllers, fire dampers and humidifier dispersion tubes. Access doors required in Product Conveying Vapor/Moisture Ductwork (see applicable paragraph above) shall not be installed in the bottom of the duct or in a manner to allow leaks.
   5. Volume Dampers: Provide manual volume dampers in all supply, return and exhaust branch and run-out ductwork to grilles, diffusers, registers, and other inlet and outlet openings to facilitate balancing of air distribution systems. These are to be provided as part of contract whether shown on plans or not. Where ceilings are not accessible,

provide access door or remote damper regulator. Volume dampers must be installed immediately downstream of each duct takeoff.

6. Multi-Blade Control Dampers: Provide control dampers as shown on drawings. Coordinate with BAS system provider for control actuators.
7. Splitters and splitter dampers shall not be installed in medium or low pressure supply ductwork to VAV systems.
8. Clean and pretreat surfaces before application of sealant. Conform to the manufacturer's cleaning procedures. Install sealants in conformance with manufacturer's instructions.
9. Except where noted, vertical ducts or horizontal ductwork penetrating fire rated ceilings, roofs, walls and floors shall be fire separated with UL listed and labeled fire dampers installed per UL tested assembly including sleeves and retaining angles. Provide additional fire dampers indicated on the Drawings and as otherwise required by the IBC and building inspector. Provide approved firestopping between damper frames and firewalls. Install fire dampers in accordance with NFPA Standards, requirements of the State Fire Marshal, and applicable codes. Ensure that fire dampers are installed in the open position.
10. For penetration of fire rated partitions which meet the IBC Chapter Seven requirements of non-Group H occupancy penetration of tenant separation and corridor walls in buildings with fire sprinklers provide metal sleeves as follows: A minimum 12 inch-long (0.30 m) by 0.060-inch-thick (1.52 mm) steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 1-1/2" by 1-1/2” by 0.060-inch steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 screws. The annular space between the steel sleeve and wall opening shall be filled with rock wool batting on all sides.

B. Hangers and Supports: Securely fasten all ductwork to the building construction by means of hangers, supports, guides, anchors, and sway braces to maintain duct alignment, to prevent sagging, and to prevent noise and excessive strain on ductwork due to movement under operating conditions.
   1. Maximum spacing between hangers shall not exceed ten (10) feet for rectangular sheet metal ductwork and twelve (12) feet for spiral round sheet metal ductwork. Provide hanger at each change in direction and at each branch takeoff. Refer to “SMACNA HVAC Duct Construction Standards Metal and Flexible” for requirements.
   2. Adequately mount and anchor all material and equipment as required. Include lateral bracing as required to prevent horizontal, seismic movement. Refer to IBC and architectural Drawings for seismic requirements.
   3. Do not support ductwork from fans or any other pieces of equipment.
   4. Powder driver fasteners shall not be used to support rectangular ducts of 40" maximum dimension. Powder driven fasteners shall not be allowed in existing facilities where electronic equipment is located.
   5. Support round duct, larger than 36", shall have two hangers at each support point.
   6. Hangers and supports shall conform to SMACNA section "Hangers and Supports". Nail inserts, hangers and supports to formwork before slabs are poured. Cut off or remove nails, strap-ends and other projections, flush with concrete after forms are removed.
   7. Support vertical ducts, passing through floors with two continuous angles screwed to the duct and bearing to the floor and conforming to SMACNA section "Riser Support-From Floor". Blocking or shimming ducts will not be permitted.

C. Other:
   1. Fans: Align fans, motors, and drives. Install fans to render bearings accessible for lubrication without dismantling fans or ducts. Provide extended bearing oilers as required. Mount all fans on vibration isolators as specified.
   2. Insulation: Properly and neatly apply insulation on all material and equipment and apparatus, as specified, including all fittings. Apply insulation over clean, dry surfaces, with adjoining sections firmly butted together and canvas smoothly pasted over. When

vapor barriers are specified, install continuous overall external surfaces of the entire system.

3. Duct Sizing: Where duct sizes are not specifically shown on the plans or must be modified due to physical limitations, supply ducts may be sized at a maximum velocity of 1,500 fpm or 0.08" sp friction per 100 feet, whichever provides the larger duct, and return/exhaust/intake ducts may be sized at a maximum velocity of 1,000 fpm or 0.06" sp friction per 100 feet, whichever provides the larger duct. Refer to Basis of Design for further duct sizing criteria.

3.04 FLEXIBLE DUCTWORK INSTALLATION

A. Flexible insulated round ductwork connectors may be utilized where shown on the Drawings and for transitions between air handling equipment and rigid ductwork. A five (5) foot (maximum) length of flexible air duct shall be allowed to be used as an elbow at a terminal devices or air outlet/inlet, unless shown otherwise on the Drawings. No intermediate joints are allowed. Seal each end using two wraps of tape listed in accordance with UL 181B and marked 181B-FX, followed by a mechanical stainless steel screw operated drawband. Support duct to maintain smooth shape without sagging. All connections shall utilize welded conical tees, aluminum conical fitting, Flexmaster #CBD, or 45° boot take-offs by Flexmaster #STO. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted. Damper regulators shall include end bearings as manufactured by DuraDyne, Ventlok or equal.

B. Flexible duct runouts to diffusers and grilles is limited to the following sizes:
   1. 6” diameter: Up to 100 cfm
   2. 8” diameter: Up to 200 cfm.
   3. 10” diameter: Up to 360 cfm.
   4. 12” diameter: Up to 600 cfm.
   5. 14” diameter: Up to 900 cfm.

3.05 STAINLESS STEEL DUCTWORK

A. For installations serving moisture, vapor, or fume exhaust.
   1. For connections to hoods or equipment provide minimum 12” length flanged and bolted stainless steel spool piece connection.
   2. All fittings shall be long radius. Round elbows shall be minimum 5-gore.
   3. Slope horizontal ductwork back toward source connected equipment minimum 1% slope so that moisture and liquids may drain back toward equipment.
   4. Low point “traps” in the ductwork shall be fitted with a low point drain valve, 1/2” welded connection, stainless steel piping and valve.
   5. All welding to be completed by certified welders experienced in 316 grade stainless.

3.06 CONSTRUCTION AND SEALING CRITERIA

A. Leakage classification of ductwork conforms to requirements of SMACNA Air Duct Leakage Test Manual as follows:

SMACNA Leakage Classes Table 4-1

Duct Class	1/2" to 2” wg	3” wg	4” to 10” wg
Seal Class	C	B	A
Sealing Application	Transverse Joints Only	Transverse Joints and Seams	Joints, Seams and All Wall Penetrations.

D. Unless called out otherwise on drawings the pressure classification of ductwork shall be as follows:

Duct system:	**Location**	**Working Pressure**	**Build to SMACNA Pressure Class**	**Build to SMACNA Seal Class:**
Outdoor air intake	From ambient intake to AHU	-1” wc	-2” wc	B
Low press Supply Air	Downstream of air terminal units to grilles, registers or diffusers.	Low pressure	+1” wc	B
Low press Supply Air	From AHU to grilles, registers or diffusers.	Low pressure	+1” wc	B
Low press Return air	From return grilles to AHU	Low pressure	-1” wc	B
Transfer air	From grille to grille, or acoustic boots or “z” bends	Low pressure	+0.5” wc	C
Med press Supply Air	From AHU to air terminal units	+6” wc	+10” wc	A
Med press Supply Air	From AHU to air terminal units	+4” wc	+6” wc	A
Med press Supply Air	From AHU to air terminal units	+2” wc	+3” wc	A
Med. Press Return air	From air terminal units to AHU	-3” wc	-4” wc	A
Med. Press Return air	From air terminal units to AHU	-2” wc	-3” wc	B
Med. Press Return air	From air terminal units to AHU	-1” wc	-2” wc	B
Relief air	From AHU to discharge at ambient	+1” wc	+2” wc	B

Duct system:	Location	Working Pressure	Build to SMACNA Pressure Class	Build to SMACNA Seal Class:
General exhaust	From grille to exhaust fan	-1” wc	-2” wc	B
General exhaust	From exhaust fan to discharge at ambient	+1” wc	+2” wc	B
Washroom exhaust	From grille to exhaust fan	-1” wc	-2” wc	B
Washroom exhaust	From exhaust fan to discharge at ambient	+1” wc	+2” wc	B
Type II Kitchen Hood vapor/ low temp, and dishwash exhaust	From Hood or equipment to exhaust fan	-2” wc	-3” wc	A, or welded. Refer to specification
Type I Kitchen Hood medium/high heat, grease exhaust	From Hood to exhaust fan	-3” wc	-4” wc	A, or welded. Refer to specification

D. The default leakage classification of ductwork is as follows:

Duct working press. class:	Low pressure less than +/-0.5”wc	+/-0.5” to +/-2.99”	+/-3” to +/-10” wc
SMACNA Seal Class	C	B	A
Sealing Applicable	Transverse joints only	Transverse and longitudinal Joints	Joints, seams, and all wall penetrations
Rectangular sheet metal SMACNA Leakage Class	24	12	6
Round sheet metal SMACNA Leakage Class	12	6	3

3.07 DUCTWORK SEALANT METHODS

A. General
1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
2. All installation shall be in accordance with manufacturer’s published recommendations.

3. Cleanliness:
    a. Before installing sealant, Surface must be dry and be free of dirt, oil, grease, and loose or foreign matter that could impair adhesion wipe ductwork to a visibly clean condition.
    b. During construction, provide temporary closures of metal or taped polyethylene on open ductwork and duct taps to prevent construction dust or contaminants from entering ductwork system. Seal ends of ductwork prior to installation to keep ductwork interior clean. Remove closures only for installation of the next duct section.
    c. During duration of construction, maintain the integrity of all temporary closures until air systems are activated.
    d. Follow the Advanced Level requirements as found in the SMACNA Duct Cleanliness for New Construction Guidelines.

B. Installation of Mastic/Sealant Duct System
1. One Part Sealant System:
    a. Apply one-part sealant system at a 20 to 30 wet mil thickness with a brush, putty knife; caulk gun or spray to duct joints, fasteners and seams. Tool, if necessary, caulk bead with putty knife or brush. Let dry per manufacturer data sheet of a minimum of 48 hours.
2. Or, One Part Spray Applied Sealant System:
    a. Use a manufacturer approved airless sprayer capable of application pressure up 2,000 psi spraying through a minimum 0.111 tip. Apply in a smooth application perpendicular to the substrate at a rate of 20 to 30 wet mils to joints, seams and duct wall penetrations per manufacturer's technical data sheet. Let dry per manufacturer data sheet of a minimum of 48 hours.

C. Installation of Mastic/Sealant Duct System with 10-Year Warranty
1. Installation of Rolled Sealant Tape over Mastic/Sealant:
    a. Cut desired length for each side of the ductwork; peel off release liner and center over joint, seam or penetration. The rolled sealant should completely cover the sealant. Use hand pressure to place the rolled sealant followed by a squeegee application. Lap tape end 2 inches (50 mm minimum). Squeegee rolled sealant to insure bond and complete adhesion to the duct. Instant adhesion requires precise positioning. Not re-positional. Four-Bolt flange requires applying corner pieces prior to applying the edge strips.

D. Field Quality Control
1. Allow duct sealant system to cure minimum 48 hours before pressure testing for the fluid applied Sealants. Rolled sealants can be tested immediately with duct leakage tester.
2. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.
3. Notify Owner's Representative a minimum of seven (7) calendar days in advance of leakage testing.
4. Leaks identified during ductwork air leakage testing shall be repaired by:
    a. Complete removal of the sealing materials.
    b. Thorough cleaning of the joint surfaces.
    c. Installation of multiple layers of sealing materials.
5. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.

3.08 DUCTWORK LEAKAGE TESTING

A. Refer to Section 23 05 93 Testing, Adjusting and Balancing for air leakage testing requirements and procedures.

B. Ductwork leakage testing may be required to meet local energy code requirements. Refer to local codes for applicability.

3.09 DUCT SEALING ALTERNATIVE

A. Occasionally a ducted system will experience leaks after the ductwork has been installed and sealed per one of the SMACNA duct sealant classifications. These leaks may not be identifiable until after ductwork has been installed and system air balancing and leakage testing has been engaged. At the contractor's option an alternative solution to sealing such leaks may include the use of a water based sealing agent that is introduced to the interior of the duct system.
   1. Manufacturer: Aeroseal LLC or approved equal. Application must be performed by manufacturer approved provider.
   2. Sealant must be UL 723 approved for smoke and flame spread.
   3. Sealant must be UP 181 approved for humidity, mold growth, temperature, erosion and puncture resistance.

B. Duct Sealing Procedure:
   1. Preparation:
      a. Inspect the entire duct shaft and horizontal plenums for major leakage sites (larger than 1/2" across).
      b. Mechanically clean duct shaft per NADCA standards if more than 1/8" of surface contaminants are visible on duct surfaces.
      c. Repair all major leakage sites using mastic and fiberglass mesh tape per SMACNA standards.
      d. Temporarily remove or protect all building controls and smoke detectors from aerosol particles as recommended by the Manufacturer.
      e. Temporarily disable fire alarms and notify appropriate authorities.
      f. Temporarily isolate air-moving equipment and block off air inlets and air outlets as recommended by the manufacturer.
      g. Protect occupied spaces from aerosol particles as recommended by the Manufacturer.
      h. Protect air-moving equipment, air inlets and outlets and other devices and appurtenances as recommended by the manufacturers.
   2. Duct Sealing:
      a. Seal existing ductwork from the inside using automated aerosolized sealant injection as recommended by manufacturer or by manually caulking internally with sealant.
      b. Sealant must cure within 2 hours with no odor or VOC off-gasing thereafter.
      c. Sealant shall remain elastic (not harden rigidly) after curing.
      d. Sealant shall be deposited substantially at areas of leakage only, and shall not coat interior duct walls, duct lining material, dampers, or turning vanes.
      e. Seal all test holes using patching plates sealed with mastic.
      f. Repair or replace insulation to match existing.
      g. Seal all injection openings with duct access doors or replace ductwork to match existing.
   3. Duct Reassembly and Cleanup
      a. Reinstall building controls and smoke detectors.
      b. Enable fire alarms and notify appropriate authorities.

c. Remove blocking, reinstall grills and registers, and enable air handling fans.
d. Cleanup sealant residue that may have adhered to surfaces in occupied areas as recommended by the Manufacturer.
e. All work shall be done in a substantial and workmanlike manner by factory-trained technicians.

4. Testing
   a. Provide pre-sealing and post-sealing leakage profile reports indicating percentage reduction of duct leakage for both supply and return ductwork.
   b. Retest ductwork and document compliance with air leakage requirements as identified in section 23 05 93 Testing, Adjusting and Balancing.
5. Warranty
   a. The Contractor shall warrant that the aerosol sealant application will be free from defects for a period of 3 years from date of the sealing application. If defects should occur during this period, the Contractor shall repair or replace the defective duct seals, including the direct labor costs for performing the repair or replacement, at no additional cost to the Owner.

3.08 FIRE AND COMBINATION FIRE/SMOKE DAMPER INSTALLATION

A. Install per manufacturer's and UL installation requirements.

B. For buildings with no fire alarm system all fire/smoke dampers shall be interconnected with the HVAC unit's controls and duct smoke detectors. The detection of smoke at any fire/smoke damper shall stop for HVAC unit fans and close all fire/smoke dampers. A single test/reset station shall be capable or resetting all devices back to normal operation.

3.09 CONTROL DAMPER INSTALLATION

A. Note that installation of control dampers is a part of the mechanical contractor's work regardless of whether they are specified in this section or as part of products to be selected by the Control Contractor.

B. When electric actuators are provided, dampers shall be installed to allow direct over the shaft mounting of actuators. No connecting rods and stand off brackets shall be necessary.

C. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking (parallellogramming), bowing, or other installation error.

D. Blades shall close completely. Leakage shall not exceed manufacturer's specifications at rated static.

E. Structural support shall be provided as necessary for all multi-section dampers.

F. Where blankoffs or structural supports obstruct duct or air passages, the decrease in free area shall not exceed 15% of the damper face area unless otherwise specified here or on plans.

G. No individual damper section may exceed 20 sq. ft.

H. Dampers shall be parallel blades style for outside air economizer to facilitate improved mixing of outside air and return air. Airflows shall be directed towards each other.

3.010 SEISMIC REQUIREMENTS

A. See Section 23 05 49 for specific requirements.

B. All HVAC equipment and machinery shall be anchored to withstand forces generated by earthquake motions. As a minimum, equipment and equipment frames shall be designed to withstand a force of 100% of the weight of the equipment and frame acting at its center of gravity. Anchorage of the equipment and/or frame to the structure shall be for a force of four times gravity also acting at the center of gravity.

C. The seismic calculations shall be the responsibility of contractor.

3.011 EQUIPMENT

A. Install equipment as shown on plans and in accordance with manufacturer's installation recommendations.

3.012 SUPPLY DIFFUSER AND REGISTER LOCATIONS

A. Coordinate location of supply outlets with ceiling mounted smoke detectors. Locate outlets or outlet distribution so as to prevent airflow from inhibiting the operation of smoke detectors. Locate ceiling outlets a minimum of 3'-0" from smoke detectors.

3.013 PAINTING

A. Where the interior surfaces of ductwork are visible through the blades of supply outlets, return inlets, and exhaust inlets - paint the interior visible surfaces with one coat of flat black paint.

B. Ductwork exposed on the roof or exterior to the building shall be painted. Coordinate with Division 9 for requirements.

3.014 FIELD QUALITY CONTROL

A. Do not insulate or conceal ductwork before inspection by Owner's Representative, Architect or Engineer. If ductwork is insulated and concealed prior this inspection the Contractor shall remove insulation and ceiling to permit inspection at no additional cost to the Owner. The Contractor shall replace the insulation and ceiling after final inspection at no additional cost to the Owner.

B. Ductwork Deflection Criteria:
   1. Maximum inward and/or outward deflection at sheet metal panels shall be 3/4" under maximum static pressure operating conditions. Additional intermediate stiffening angles shall be installed where deflections exceed 3/4".
   2. Maximum inward and/or outward deflection at sheet metal elbows and joints shall be 1/4" under maximum static pressure operating conditions. Additional stiffening angles shall be installed where deflections exceed 1/4".

C. Acceptance of duct systems shall be contingent upon conformance with the requirements specified in Section 23 05 93 "Testing, Adjusting and Balancing".

3.015 ADJUSTING AND CLEANING

A. Clean the inside of plenums, casings, enclosures, fans, and accessible ductwork before starting fans. Blowout coils and condensate piping with compressed air. Comb all coil fins

that may be bent. Install a clean set of filters in each system prior to testing and balancing. Proceed with testing and balancing. All dampers shall be locked in place.

END OF SECTION

SECTION 23 34 13

FANS AND VENTS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 1, and shall include, but not necessarily be limited to, the following:
   1. Spun Aluminum and Steel Housed Centrifugal Exhaust Fans
      a. Upblast Spun Aluminum Exhaust Fan for roof or sidewall mount
      b. Upblast Spun Steel Exhaust Fan for high temperature kitchen exhaust
   2. Gravity roof vents

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 05 93: Testing, Adjusting and Balancing

C. Section 23 07 00: Mechanical Insulation

D. Section 23 09 00: Building Automation System (BAS) Controls

E. Section 23 31 13: Air Distribution

F. Division 26: Electrical

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide air handling units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Certifications: Provide certified ratings of units based on tests performed in accordance with ARI 430, "Central-Station Air Handling Units."

C. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:
   1. Air Movement and Control Association (AMCA):
      a. 99 standards Handbook
      b. 210 Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]
      c. 300 Reverberant Room Method for Sound Testing of Fans [Unit shall bear AMCA Certified Rating Seal]
      d. 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data
      e. 500 Test Method for Louvers, Dampers, and Shutters
   2. American National Standards Institute (ANSI):
      a. 9 Load Ratings and Fatigue Life for Ball Bearings

   b. 11 Load Ratings and Fatigue Life for Roller Bearings
   c. 900 Test Performance of Air Filter Units
3. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
   a. 350 Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
   b. 410 Forced-Circulation Air-Cooling and Air-Heating Coils
   c. 430 Central-Station Air-Handling Units
   d. 440 Room Fan-Coil Air-Conditioners
4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   a. 15 Safety Code for Mechanical Refrigeration
5. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.
6. National Fire Protection Association (NFPA): Provide air handling unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:
   a. 70 National Electrical Code
   b. 90A Standard for the Installation of Air Conditioning and Ventilating Systems
   c. 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems
7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."
8. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of air handling units, which have been listed and labeled by UL.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, and finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Shop Drawings: Submit shop drawings showing unit dimensions, weight loadings, required clearances, field connection details and methods of support. Draw to a scale of 1/4” per one foot. Include field fabricated mixing boxes, dampers and duct connections.

C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver unit to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect equipment and products against dirt, water, chemical, and mechanical damage. Do not install damaged unit - remove from project site.

1.08 SAFETY PROVISIONS

A. Provide all open drives and fan wheels subject to maintenance and potential entanglement with protective guards or screens meeting OSHA requirements.

1.09 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.01 GENERAL FAN REQUIREMENTS

A. Construction, Rating and Testing: Provide fans constructed and factory tested in accordance with the Air Moving and Conditioning Association (AMCA). All fan wheels shall be statically and dynamically balanced. Size, capacity and features as indicated on the Drawings. Provide extended bearing lubrication fittings where necessary to assure accessibility of all lubrication points.

B. Motors and Drives: Provide premium efficiency drip-proof motors with temperature rise not greater than 40°C above ambient temperature or electronically commutated (EC) motors. Belt drive assemblies, where applicable, shall be capable of 150% of the motor rated horsepower on one less than the total number of belts, for belt drives with two or more belts.

C. Accessories: Provide, as indicated on the Drawings and specified in other paragraphs of this Section, all related accessories to match the fan section, including access sections, diffusion sections, transition sections, flexible connections, vibration eliminators, and belt guards.

D. Submissions: For shop drawings include complete dimensional and physical data, CFM, SP, HP, discharge arrangement, rotation, class, base details, and fan curves.

2.02 HOUSED CENTRIFUGAL EXHAUST FANS (ROOF MOUNTED UPBLAST TYPE)

A. Manufacturer: Models as scheduled by Greenheck, Carnes, Cook, Penn, Twin City or equal. Size, capacity and features as indicated on the Drawings.

B. Fan Housing:
   1. Leakproof fan housing shall consist of the motor cover, shroud, curb cap and one-piece windband and shall be constructed of heavy gauge aluminum. The housing shall have a rigid internal support structure and leakproof design. The shroud shall be one piece with a rolled bead for extra strength which directs the exhaust air upward. Birdscreen shall be provided between the fan housing and shroud.
   2. The windband shall be welded to the one-piece curb cap and on all sizes with UL/CUL-762.

C. Fan Wheel:
   1. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced in accordance to ANSI/AMCA Standard 204.

D. General:
   1. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring. A NEMA 3R disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment.
   2. Fan shall bear the AMCA Certified Ratings Seal for sound and air performance. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.

3. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment or external to the fan.
4. Motors and drives shall be readily accessible for maintenance.

E. Motors: Provide direct drive or belt drive as scheduled on the Drawings.
1. Direct drive motors:
a. Motors shall be premium efficiency or ECM as scheduled on the Drawings.
b. Motors shall be mounted out of the airstream on vibration isolators. Fresh air for motor cooling shall be drawn into the motor compartment through a large space between the fan shroud and the motor cover. Motors shall be readily accessible for maintenance.
c. All ECM motors shall be speed controllable to 20% of full speed (80% turndown). Speed shall be controlled by a potentiometer dial mounted at the motor or by a 0-10 vdc signal. Motor shall be 85% efficient at all speeds.
2. Belt drive motors:
a. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Drive frame assembly shall be constructed of heavy gauge steel.
b. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum L_{10} life in excess of 100,000 hours or L_{50} life of 500,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing. Third pulley to be included for ease of adjusting drive belt tension and to enhance belt life and compliant with smoke control applications.

F. Smoke Control Exhaust Option:
1. Provide three belt drives be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.
2. Fans shall be listed by Underwriters Laboratory for UL/cUL 705 for electrical components and UL/cUL Listed for Emergency Smoke Control Systems 500°F (260°C) for 4 hours and 1,000°F (538°C) for 15 minutes.

2.03 HOUSED CENTRIFUGAL EXHAUST FANS (ROOF MOUNTED UPBLAST TYPE FOR HIGH TEMPERATURE KITCHEN EXHAUST)

A. Manufacturer: Models as scheduled by Greenheck, Carnes, Cook, Penn, Twin City or equal. Size, capacity and features as indicated on the Drawings.

B. General: Provide for charbroiler and solid fuel burning exhaust applications.
1. A NEMA-3R disconnect switch shall be factory installed and wired from the fan motor to a junction box installed outside the motor compartment.
2. Fan shall bear the AMCA Certified Ratings Seal for sound and air performance. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.
3. Hinge kit shall be constructed of heavy gauge hinges and shall include hold open cables for field installation.
4. Fans shall be listed by Underwriters Laboratory for UL/cUL 762. Listed for all electrical components and grease removal
5. Grease Provisions:
a. Drain connection shall be constructed of aluminum and allow for a single point drainage of grease, water or other residues.

b. Grease trap shall include the drain connection and shall be constructed from aluminum. The unit shall collect grease and water from the fan and extract the grease from the water for ease of grease disposal

C. The fan housing shall be constructed of 16-gauge galvanized steel with a rigid internal support structure and shall be leakproof. The fan housing shall be constructed with a one piece windband with an integral rolled bead for added strength and shall be joined to the curb cap with a continuously welded seam.
   1. Vented Curb Extensions: Shall be mounted between roof curb and roof mounted fans to meet NFPA requirements of 40-inch minimum discharge above the roof when mounted on a minimum 8-inch high roof curb.
   2. Windband Extension shall be constructed from heavy gauge aluminum tube that raises the discharge an additional 36 inches as scheduled on the Drawings.

D. Fan's windband shall have a Clean Out Port, a large diameter hole on the outside of the fan's windband with a grease repellent compression rubber fit, allowing access to entire wheel for cleaning.

E. Spun steel exhaust fans shall be centrifugal belt driven type. Fan wheel shall be centrifugal backward inclined type. The wheel shall be constructed of steel and coated with a non- stick coating similar to Teflon® as manufactured by Dupont. Wheel shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

F. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Drive frame assembly shall be constructed of heavy gauge galvanized steel. Motors and drives shall be mounted on heavy duty true vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment through a ten square inch tube free of discharge contaminants. Motors and drives shall be readily accessible for maintenance. Precision ground and polished 1-inch minimum diameter fan shafts shall be mounted in cast pillow block lubricatable ball bearings. Bearings shall be selected for a minimum L_{10} life in excess of 100,000 hours or L_{50} life of 500,000 hours at maximum cataloged operating speed. Dual drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

2.04 LOUVERED PENTHOUSE GRAVITY VENTILATOR

A. Refer to drawings for locations and sizes.

B. Manufacturer: Greenheck WIH, Cook, Penn or equal.

C. Type: Extruded aluminum tiered gravity ventilator.

D. Construction: 0.080 gauge extruded aluminum tiers welded to 8-gauge aluminum support frame. Hood constructed of minimum 0.063 aluminum and provided with a layer of anti-condensate coating. Base to be continuously welded curb cap corners. Birdscreen constructed of 1/2” galvanized mesh shall be mounted across the opening.

E. Sizing: Pressure drop less than or equal to 0.09"w.g.

F. Required Accessories: Prefab roof curb, bird screen, and removable hood.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate motor starters with Division 26 and controls contractor.

B. Install in accordance with manufacturer's instructions.

C. Examine site to verify if site is ready to receive work. Provide layout drawings of air handlers and fan locations to electrical installer.

D. Install unit on vibration isolators.

E. Install 3" flexible duct connection at inlets and outlets of units.

F. Control installers shall install all wiring associated with control signals into the fan starters.

G. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work

H. Exhaust fans servicing risers with subducts shall operate continuously and shall be connected to backup generator power supply or other uninterruptible backup power as required by the Building Code and NFPA. Coordinate with Division 26 work.

3.02 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four-hours travel from the job site.

END OF SECTION

SECTION 23 81 30

MINI-SPLIT AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:
   1. Split air conditioning unit.
   2. Controls and control connections.
   3. Electrical power connections.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 05 93: Testing, Adjusting and Balancing

C. Section 23 07 00: Mechanical Insulation

D. Section 23 09 00: Building Automation System (BAS) Controls

E. Section 23 23 00: Refrigerant Piping Systems

F. Section 23 31 13: Air Distribution

G. Division 26: Electrical

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide packaged units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:
   1. Air Movement and Control Association (AMCA):
      a. 99 - Standards Handbook
      b. 210 - Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]
   2. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
      a. 210 - Unitary Air-Conditioning Equipment
      b. 270 - Sound Rating of Outdoor Unitary Equipment
   3. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.
   4. National Fire Protection Association (NFPA): Provide unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:

a. 70 - National Electrical Code
b. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems
c. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems

5. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."
6. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL.
7. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values required by the local energy code.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for systems with air handler units, evaporator coils, and outdoor condensing units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 01.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store/protect products under provisions of Division 01. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

1.08 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

C. Provide five (5) year warranty on compressors.

PART 2 - PRODUCTS

2.01 SPLIT SYSTEM AIR CONDITIONING SYSTEM WITH INDOOR FAN COIL

A. Manufacturers: Mitsubishi, Sanyo, LG, Daikin, Carrier or equal.

B. Indoor Fan Coil Unit
1. General:

a. Factory fabricated wall or ceiling mounted fan coil units designed for ductless application of the size, type configuration and capacity as scheduled on the drawings.
b. Units shall be self-contained, factory assembled and pre-wired.
c. All pressure drops, motor horsepowers and dimensions shown are maximum allowable. All capacities shown are minimum allowable. All units must have AMCA certified performance data for fans tested in the unit casings. Bare fan certification without casing is not acceptable.
d. Manufacturers unable to meet this criterion will only be considered as an alternate to specified and as a deduct to base bid. Manufacturers listed by name does not imply that their standard construction meets the specifications nor that they are approved. All manufacturers are required to meet all details of this specification without exception.
e. Units shall be provided with factory welded mounting clips for mounting of units.

2. Unit Casing: Cabinet and grilles shall be zinc-coated bonderized steel finished with baked enamel paint or powdered coated finish. Grilles may be high-impact plastic.
3. Fan Assembly: Fan shall be direct drive with forward-curved blades, and be statically and dynamically balanced, with scrolls and fans constructed of galvanized steel. Rotating assembly shall provide a rigid support for motor and fan assembly. Assembly shall be accessible and entire assembly shall be removable for maintenance.
4. Motors: Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection or electrically commutated (EC). Fan motor to be multi-speed as specified on Drawings.
5. Coils: Coils shall be copper tube with ARI certified and of the same manufacturer as the unit to insure proper fit and quality mechanical bond. No exposed copper shall show between fins. Coils drip pan shall be galvanized steel coated with closed cell fire retardant foam insulation. A secondary drip pan shall be included under the coil header.
6. Filter Section: Filters shall be factory supplied cleanable filter or one-inch thick pleated.
7. Electrical: Unit electrical power shall be 115 volts, 1 phase, 60 hertz, or as specified on Drawings.

C. Outdoor Condensing Unit:
1. General: Provide remote outdoor air conditioning compressor units consisting of hermetic compressor with overload protection, direct drive condenser fan, aluminum fin/seamless copper tube coil, strainer, high and low pressure switches, accumulator, and thermostatic expansion valve.
2. Unit Cabinet: Galvanized steel, bonderized, and coated with powder coat paint.
3. Condenser Fans: Direct drive propeller type, discharging upward. Motors to be totally enclosed, single phase, with Class B insulation and permanently lubricated bearings. Condenser fan openings to be equipped with PVC-coated steel wire safety guards. Fan blades to be statically and dynamically balanced.
4. Coil: Aluminum fins mechanically bonded to copper tubes.
5. Refrigerant Components: Liquid tube shutoff valve with sweat connection, suction tube shutoff valves with sweat connection, refrigerant, accumulator, and reversing valve. An internal pressure relief valve to provide high-pressure protection to the refrigerant system.
6. Compressor: Hermetically sealed two-speed compressor mounted on rubber mountings. Protection to include internal PTC-type overloads. An internal pressure relief valve to provide high-pressure protection to the refrigerant system. Provide external service valves for the refrigerant circuit. A crankcase heater shall be factory mounted on the outside of the compressor.
7. Electrical: Unit electrical power shall be 208/230 volts, 1 phase, 60 hertz, or as specified on Drawings. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, DC.

D. Controls:
   1. Unit shall have a factory wired temperature controller to perform input functions necessary to operate the system.
   2. The controller shall consist of an on/off switch, thermostat setting, timer mode, high/medium/low fan speed, test run switching and check mode switching. Provide with 365-day programmability that allows the building occupants to program the temperature setpoints for at least four periods within 24 hours. A minimum of 5 holidays shall be programmable for up to 5 years. Daylight savings shall be provided as a standard feature in the programming calendar.
   3. Temperature changes shall be by 2°F increments with a range of 65 - 87°F (minimum).
   4. The control system shall consist of two (2) microprocessors interconnected by a single non-polar two wire cable.
   5. Wiring shall run direct from the indoor unit to the controller with no splices.
   6. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.
   7. Normal operation of the remote controller provides individual system control in which one remote controller and one indoor unit are installed in the same room.
   8. The control voltage from the controller to the indoor unit shall be 12 volts, DC.
   9. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, DC.
   10. The system shall be capable of automatic restart when power is restored after power interruption.
   11. The system shall include self-diagnostics including total hours of compressor run time.
   12. The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature, 24 hour on/off timer so that automatic operation function display, check mode for memory of most recent problem.
   13. Fan only operation shall be provided to permit room circulation when no cooling is required.
   14. Compressor time delay to limit cycling.

E. Special Features:
   1. Provide an internal condensate pump with interlock to unit operation in the event of malfunction.
   2. Provide external electronic programmable thermostat.
   3. Low ambient control capable of operating at 0ºF ambient temperature.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces are ready to receive work.

B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide layout drawings of units, locations and power requirements to electrical installer.

C. Install air filters in unit during installation phase. Do not operate the unit without filters in place.

D. In the case of suspended units, mount the fan coil units on springs or from spring hangers as required and as shown on Drawings. Provide Mason #DNHS combination isolator hangers to fully support horizontal units hung from building framing.

E. Provide 4" high concrete pad extending 6" beyond edge of condensing unit on all sides. Attach condensing unit to concrete pad with concrete anchors and angle brackets.

F. Install condensate drain piping and traps in accordance with manufacturer's instructions and as shown on the Drawings.

G. Install copper refrigerant piping and insulate lines.

H. Install controller and all wiring associated with control signals between air handling unit and condensing unit. Conceal low voltage wiring in building structure, or inside the refrigerant pipe insulation, or in conduit.

I. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work.

J. Install a new set of filters prior to final air balance and substantial completion.

3.03 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

END OF SECTION

SECTION 23 81 46

WATER SOURCE HEAT PUMP UNITS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, the following:
   1. Water source heat pump unit
   2. Controls and control connections
   3. Electrical power connections

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 05 93: Testing, Adjusting and Balancing

C. Section 23 07 19: HVAC Piping Insulation

D. Section 23 21 13: Hydronic Piping, Valves, and Specialties

E. Section 23 31 13: Air Distribution

F. Division 26: Electrical

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide packaged units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Ground Source Application: If the heat pump is to be used in a ground coupled system, the heat pump must meet the standards of the IGSHPA.

C. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:
   1. Air Movement and Control Association (AMCA):
      a. 99 - Standards Handbook
      b. 210 - Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]
      c. 300 - Reverberant Room Method for Sound Testing of Fans [Unit shall bear AMCA Certified Rating Seal]
      d. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data
      e. 500 - Test Method for Louvers, Dampers, and Shutters
   2. American National Standards Institute (ANSI):
      a. 9 - Load Ratings and Fatigue Life for Ball Bearings
      b. 11 - Load Ratings and Fatigue Life for Roller Bearings
      c. 900 - Test Performance of Air Filter Units
   3. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
      a. 320 - Water Source Heat Pump Equipment operating between 60-85°F.

b. 325 - Water Source Heat Pump Equipment operating between 45-85°F.
c. 330 - Water Source Heat Pump Equipment operating between 25-115°F.

4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   a. 15 - Safety Code for Mechanical Refrigeration
   b. 193 – Method of Test for Determining the Air Leakage of HVAC Equipment. All systems that move less than 3,000 cfm shall comply with less than 1.4% cabinet leakage rate.
5. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.
6. National Fire Protection Association (NFPA): Provide unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:
   a. 70 - National Electrical Code
   b. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems
   c. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems
7. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL.
8. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values required by the local energy code.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for systems with air handler units, evaporator coils, and outdoor condensing units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 01.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store/protect products under provisions of Division 01. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

1.08 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

C. Provide with five (5) year warranty on compressors.

PART 2 - PRODUCTS

2.01 GENERAL

A. The heating/cooling units shall be suspended (vertical) type with horizontal (bottom discharge) air inlet and (top) discharge. Units shall be AHRI Standard performance certified for the operating temperature ranges scheduled and listed by a nationally recognized safety-testing laboratory or agency, such as ETL Testing Laboratory or Canadian Standards Association (CSA). Each unit shall be computer run tested at the factory.

B. The units shall be designed to operate with entering liquid temperature between 25°F and 110°F

C. Manufacturers: Carrier, Trane, Daikin, ClimateMaster, WaterFurnace, or Florida Heat Pump.

2.02 CASING AND CABINET

A. The cabinet shall be fabricated from heavy-gauge galvanized steel and finished with corrosion-resistant electrostatic powder coating. The interior shall be insulated with a minimum of ½" thick, multi-density, coated glass fiber with edges sealed or tucked under flanges to prevent the introduction of glass fibers into the discharge air. One or two blower compartments and three compressor compartment access panels shall be provided and shall be removable with supply and return ductwork in place. The internal component layout shall provide for major service with the unit in-place for restricted access installations.

B. A duct collar shall be provided on the supply air opening. The units shall have an insulated divider panel between the air handling section and the compressor section to minimize the transmission of compressor noise, and to permit operational service testing without air bypass. Horizontal units shall be supplied with left or right air inlet, and side or end air discharge.

2.03 REFRIGERANT CIRCUIT

A. LEED Project Refrigerant Requirements: Provide charged with a refrigerant meeting one or both of the following options:
   1. Non-HCFC Refrigerant: Provide equipment designed and charged for operation at scheduled and specified stated efficiencies using a non-HCFC refrigerant.
   2. Provide documentation that the refrigerant/equipment combination will meet the LEED™ Technical and Scientific Advisory Committee HCFC Task Group requirements as described in their report, *The Treatment by LEED of the Environmental Impact of HVAC Refrigerants.* This means that the equipment falls into the “acceptable region” of global warming vs. ozone depletion performance as defined in the report.

B. All units shall contain a scaled refrigerant circuit including a hermetic motor-compressor, bidirectional thermal expansion valve, finned tube air-to-refrigerant exchanger, reversing valve, coaxial tube water-to-refrigerant heat exchanger, and service ports.

C. Compressors shall be high-efficiency designed for heat pump duty and mounted on vibration isolators. Compressor motors shall be single-phase PSC with external overload protection.

D. The finned tube coil shall be sized for low face velocity and constructed of lanced aluminum fins bonded to rifled copper tubes in a staggered pattern not less than three rows deep.

E. The coaxial water-to-refrigerant heat exchanger and refrigerant suction lines shall be insulated to prevent condensation at low liquid temperatures.

2.04 FAN MOTOR AND ASSEMBLY

A. The fan shall be a direct drive centrifugal type with a dynamically balanced wheel. The housing and wheel shall be designed for quiet low outlet velocity operation. Tight fan housing geometry shall not be permitted. The fan housing shall be removable from the unit without

disconnecting the supply air ductwork for servicing of the fan motor. The fan motor shall be a variable-speed ECM2 type. The ECM2 fan motor shall be soft-starting, shall automatically maintain constant CFM over its operating static range, and shall provide 12 field selectable CFM settings. The fan motor shall be isolated from the housing by rubber grommets. The motor shall be a permanently lubricated long-life ball bearing type and have thermal overload protection.

2.05 FILTERS

A. Provide 2” thick replaceable filter with a mean efficiency of 35% tested in accordance with ASHRAE 52.1. Mount filters in filter frames and provide access panels or doors for removal and replacement.

2.06 ELECTRICAL

A. A microprocessor-based controller shall be provided that interfaces with a multistage electronic thermostat to monitor and control unit operation. The control shall provide operational sequencing, fan and compressor speed control, high and low pressure switch monitoring, high compressor temperature sensing, freeze protection and hot water limit thermistor sensing, fan failure, condensate overflow sensing, auxiliary heat staging, lockout mode control, hot water and staged loop pump control, LED status and fault indicators, fault memory, field selectable options and accessory output.

B. A removable terminal block with screw terminals shall be provided for field low-voltage wiring. A circuit breaker protected 75VA low-voltage transformer shall be provided.

C. Line voltage terminal blocks or connection lugs shall be provided for unit and loop pump wiring. Units shall have knockouts for entrance of low and line voltage wiring. The fan motor and control box shall be harness plug-connected for easy removal.

D. The unit is to be supplied with a unit mounted fused disconnect switch.

2.07 PIPING

A. Supply and return water connections shall be brass swivel fittings which provide a union and eliminate the need for pipe wrenches and sealants when making field connections. All water piping shall be insulated to prevent condensation at low liquid temperatures. The condensate connection shall be a 3/4" PVC socket with internally-trapped hose(vertical units only) which can be routed to front or side locations.

2.08 HANGER KIT

A. The hanger kit shall consist of galvanized steel brackets, bolts, lock washers, and isolators and shall be designed to fasten to the unit bottom panel for suspension from 3/8" threaded rods.

2.09 REQUIRED ACCESSORIES AND OPTIONS (NOTE TO EDITOR: EDIT ACCESSORIES AS APPROPRIATE. NOTE THAT THE MOTORIZED WATER VALVE IS A REQUIREMENT OF OREGON ENERGY CODE. THERMOSTAT WILL NOT BE REQUIRED IN APPLICATIONS WITH BAS.

A. Proof of Operation contacts to be used by the control contractor for proof and/or interlock to associated relief fan.

B. Thermostat: Thermostat shall be 7 day programmable, multi-stage (3H/2C), manual or automatic change over with HEAT-OFF-COOL-AUTO system settings and fan ON-AUTO settings. Thermostat shall have an LCD display with temperature, setpoints, mode, and status indication. The temperature indication shall be selectable for °F or °C. A System Test feature shall be provided to simplify troubleshooting. The thermostat shall provide permanent memory

of setpoints and program without batteries. A fault LED shall be provided. Thermostat shall provide optional extended end of cycle fan operation, heating setpoint range limit, cooling setpoint range limit, temperature display offset, temperature display disable, keypad lockout, dead-band range setting, and inter-stage differential settings. Thermostat shall provide capability to average from 1 to 9 remote sensors.

C. The unit will be supplied with internally factory mounted motorized two-way water valve interlocked with compressor operation for variable speed pumping requirements.

D. A Low noise package consisting of high technology sound attenuating materials that are strategically applied to the cabinet, in addition to the standard insulation system, to further dampen sound.

E. Provide heat pump with extended range capability and electric resistance heat to permit the unit to provide heating at low condenser water temperatures.

F. Controls shall prevent the operation of supplemental electric resistance heating when the heating load can be served by the heat pump alone.

2.010 PROGRAMMABLE THERMOSTAT (NOTE TO EDITOR: REMOVE OR EDIT AS APPROPRIATE)

A. Thermostat with 365 day programmability that allows the building occupants to program the temperature setpoints for at least four periods within 24 hours. A minimum of 5 holidays shall be programmable for up to 5 years. Daylight savings shall be provided as a standard feature in the programming calendar.
   1. Manufacturers: Honeywell VisionPRO 8000 Series, Honeywell Prestige THX 9000 Series, Honeywell TB7600 Series, Venstar ColorTouch T6000 Series, EnTouch Pro/One or equal.

B. Minimum thermostat features shall include, but not limited to, the following:
   1. The thermostat shall have a touch screen and shall display both room temperature and cooling and heating setpoints simultaneously, and shall indicate when cooling or heating and what stage is energized on the main screen.
   2. Programming may be accomplished at the thermostat, or via free software. The program shall have an override mode to provide comfort on demand while in an unoccupied period. The unoccupied override shall be adjustable by pushing an override button and selecting thirty minute increments, up to four hours.
   3. The setback override shall be activated by a single button, and deactivated on demand.
   4. Setpoints shall be adjustable from 35^0F to 99^0F, with a minimum 5°F adjustable deadband available.
   5. Dual setpoints shall be provided with the ability to individually set heating and cooling temperatures with adjustable heating and cooling setpoint limits. Initial occupied mode cooling setpoint of 75^0F and heating setpoint of 70^0F. Initial unoccupied mode cooling setpoint of 85^0F and heating setpoint of 55^0F

C. The thermostat shall be capable of independently controlling an individual system, with up to three stages of heating and two stages of cooling, fan, and reversing valve.
   1. For heat pumps an adjustable auxiliary heat lockout temperature based on outdoor temperatures shall be provided.
   2. An Emergency Heat switch will be provided on the touch screen when set in heat pump mode.

D. The fan shall be programmable to operate continuously during occupied periods and in auto mode during unoccupied periods.

E. Controls shall be capable of alternating compressor starting sequence with a built in lead-lag operating logic.

1. Equipment protection options shall be provided to prevent compressor short-cycling, and to limit the number of cycles per hour. These options shall be overridden for use with zoning systems.

F. Pre-Occupancy purge cycle that energizes the fan before the programmed occupancy time, adjustable up to three (3) hours in 15-minute increments.
   1. Configurable terminals shall be provided for remote indoor, remote outdoor or remote supply air temperature sensing.

G. Multiple security levels to limit access to programming and configuration and will allow for a custom passcode. The various security levels will allow controlled access to programming, unoccupied override, and thermostat mode.

H. All programming information, except time of day, shall reside in nonvolatile memory. During a power failure, the thermostat shall maintain its program indefinitely without the use of batteries. Wi-Fi capable and controlled through local wireless internet routers. The thermostat shall be capable of receiving an automated demand response signal from the local electrical utility, and automatically reset the cooling and heating setpoints during the demand event. When the demand event is terminated by the local electrical power utility, the thermostat will reset to normal occupied and unoccupied setpoints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces are ready to receive work.

B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide layout drawings of units, locations and power requirements to electrical installer.

C. Install air filters in unit during installation phase. Do not operate the unit without filters in place.

D. In the case of suspended units, mount the fan coil units on springs or from spring hangers as required and as shown on Drawings. Provide Mason #DNHS combination isolator hangers to fully support horizontal units hung from building framing.

E. Install 2" flexible duct connection at inlets and outlets of ducted units.

F. Install condensate drain piping and traps in accordance with manufacturer's instructions and as shown on the Drawings.

G. Control installers shall install thermostat and all wiring associated with control signals into the units.

H. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work.

I. Install a new set of filters prior to final air balance and substantial completion.

3.03 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final

adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

END OF SECTION

SECTION 23 81 58

VARIABLE REFRIGERANT FLOW HEAT PUMP SYSTEMS

PART 1 - GENERAL

1.01 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 23 05 00 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.02 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:
   1. Condensing Units
      a. Water Cooled Condensing Unit – Heat Pump/Heat Recovery
   2. Branch Selector (BS) Units or Branch Circuit (BC) Terminal for Heat Recovery systems.
   3. Indoor Fan Coil Units:
      a. Non-ducted Recessed Ceiling Cassette Units
      b. Ducted Concealed Ceiling Fan Coil Units
         1) Ceiling Suspended Unit
      c. Wall Mounted Unit
   4. Controls

1.03 SYSTEM DESCRIPTION

A. Heat Recovery (heat and cool model)
   1. The variable capacity heat pump air conditioning system shall be a VRV/VRF series heat and cool model. The system shall consist of multiple evaporators, Branch Selector Units or Branch Circuit Terminals, heat recovery condensing unit with variable speed inverter driven compressors, and PID DDC (direct digital controls). All zones are each capable of operating separately with individual temperature control.
   2. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BAS interface.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00: Basic HVAC Materials and Methods

B. Section 23 05 93: Testing, Adjusting and Balancing

C. Section 23 07 00: HVAC Insulation

D. Section 23 23 00: Refrigerant Piping Systems

E. Section 23 31 13: Air Distribution

F. Division 26: Electrical

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide packaged units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:
1. Air Movement and Control Association (AMCA):
   a. 99 - Standards Handbook
   b. 210 - Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]
   c. 300 - Reverberant Room Method for Sound Testing of Fans [Unit shall bear AMCA Certified Rating Seal]
   d. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data
   e. 500 - Test Method for Louvers, Dampers, and Shutters
2. American National Standards Institute (ANSI):
   a. 9 - Load Ratings and Fatigue Life for Ball Bearings
   b. 11 - Load Ratings and Fatigue Life for Roller Bearings
   c. 900 - Test Performance of Air Filter Units
3. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
   a. 1230 - Variable Refrigerant Flow Multi-Split Air –conditioners and Heat Pumps
4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   a. 15 - Safety Code for Mechanical Refrigeration
   b. 193 – Method of Test for Determining the Air Leakage of HVAC Equipment. All systems that move less than 3,000 cfm shall comply with less than 1.4% cabinet leakage rate.
5. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.
6. National Fire Protection Association (NFPA): Provide unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:
   a. 70 - National Electrical Code
   b. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems
   c. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems
7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."
8. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL. This includes condensate pumps and other ancillary devices required for operation.
9. Electrical Laboratories (ETL): The units shall be listed by ETL and bear the ETL label.
10. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values required by the local energy code.

1.06 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for systems with air handler units, evaporator coils, and outdoor condensing units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 01.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store/protect products under provisions of Division 01 and according to manufacturer’s recommendation. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

1.09 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 23 05 00 for additional warranty and Substantial Completion requirements.

C. Provide extended warranty for compressors for a six (6) year period.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Daikin VRV III and IV, Mitsubishi City Multi, LG-Multi V, Trane/Samsung Advantage VRF, Fujitsu Airstage VRF, Hitachi, Carrier/Toshiba, or equal.

2.02 CONDENSING UNIT

A. General:
   1. The outdoor unit shall be designed for used with an integrated variable refrigerant flow zone system.
   2. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves,

solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.

3. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
4. (Heat Recovery Only) Refrigerant lines from the outdoor unit to the BS or BC unit shall be individually insulated between the condensing and fan coil units.
5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
6. The connection ratio of fan coil units to condensing unit shall be permitted up to 150% of outdoor rated capacity.
7. Each condensing system shall be able to support the connection of up to 50 indoor units dependent on the model of the condensing unit.
8. The sound pressure level standard shall no greater than 65 dBA at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time.
9. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
10. Water-cooled only:
    a. Each condensing unit shall have a 240VAC, 0.3mA-0.5A control circuit output for water pump or isolation valve operation. This circuit shall be configured at commissioning to operate based on system or compressor operation.
    b. Each condensing unit shall incorporate normally open, 15VDC and 1.0mA rated contacts for integration of a mandatory flow proving device.
11. The unit shall incorporate an auto-charging feature.
12. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
13. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
14. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
15. Each system shall maintain continuous heating during oil return operation.
16. The condensing unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
17. (Heat Recovery only) The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

B. Unit Cabinet:
   1. Water Cooled: The condensing unit shall be corrosion resistant. The unit shall be constructed from rust-proofed, mild steel panels coated with a baked enamel finish.

C. Condenser Heat Exchanger (water-cooled):
   1. The condenser heat exchanger shall be a stainless brazed plate type designed for closed loop/dry cooler applications.
   2. The heat exchanger shall have a maximum system water pressure of 285 psi (equivalent to 640ft of head).

D. Compressor:
   1. The inverter driven scroll hermetic compressors shall be variable speed controlled capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low

pressures detected are read and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.
2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll type
3. The capacity control range shall be as low as 4% to 100%.
4. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
6. Oil separators shall be standard in the equipment together with an intelligent oil management system.
7. The compressor shall be spring mounted to avoid the transmission of vibration.

E. Electrical:
1. The power supply to the condensing unit shall be 460 (208/230) volts, 3 phase, 60 hertz +/- 10%.
2. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.

2.03 BRANCH SELECTOR (BS) BOX/ BRANCH CIRCUIT (BC) CONTROLLER FOR HEAT RECOVERY SYSTEM

A. General: Branch selector boxes/ Branch circuit controllers are designed specifically for use with heat recovery system components.
1. Selector boxes / circuit controllers shall be factory assembled, wired, piped and run tested at the factory.
2. Selector boxes / circuit controllers must be mounted indoors.
3. When simultaneously heating and cooling, the units in heating mode shall energize their sub-cooling electronic expansion valve.

B. Unit Cabinet:
1. These units shall have a galvanized steel plate casing.
2. Each cabinet shall house multiple electronic expansion valves for refrigerant control per branch.
3. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.

C. Refrigerant Valves:
1. The refrigerant connections must be of the braze type.
2. Multiple indoor units may be connected to a branch selector box / branch circuit controller.

D. Condensate Removal:
1. Provide integral condensate pan if required for condensate removal.

E. Electrical:
1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 228 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum
4. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.04 INDOOR FAN COIL UNITS (NOTE TO EDITOR: REMOVE UNUSED FAN COIL UNITS.)

A. Non-Ducted Recessed Ceiling Cassette Units
   1. General: Indoor unit shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill. It shall be a four-way air distribution type, white, impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The indoor units sound pressure shall range from 28 dB(A) to 34 dB(A) at low speed measured at 5 feet below the unit.
   2. Indoor Unit:
      a. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
      b. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
      c. Both refrigerant lines shall be insulated from the outdoor unit.
      d. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
      e. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
      f. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21” of lift and has a built in safety shutoff and alarm.
      g. The indoor units shall be equipped with a return air thermistor.
   3. Unit Cabinet:
      a. The cabinet shall be space saving and shall be located into the ceiling.
      b. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
      c. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
      d. Fresh air intake shall be possible by way of optional fresh air intake kit. (3’x 3’ model only). Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet. (2’x 2 model only’)
      e. A branch duct knockout shall exist for branch ducting supply air.
      f. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
      g. Optional high efficiency MERV 8 and 13 air filters are available for each model unit. (3’x 3’ model only)
   4. Fan:
      a. The fan shall be direct-drive fan type with statically and dynamically balanced impeller with high and low fan speeds available.
      b. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.06 to 0.12 HP.
      c. The airflow rate shall be available in high and low settings.
      d. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the MERV 8 and 13 filter options (3’x 3’ model only).
      e. The fan motor shall be thermally protected.
   5. Filter:

a. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
b. Optional high efficiency disposable MERV 8 and 13 filters shall be available. (3'x 3' model only)

6. Coil:
   a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
   b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
   c. The coil shall be a 2-row cross fin copper evaporator coil completely factory tested.
   d. The refrigerant connections shall be flare connections.
   e. A condensate pan shall be located under the coil.
   f. A condensate pump, with minimum 21-inch lift, shall be located below the coil in the condensate pan with a built in safety alarm.
   g. A thermistor will be located on the liquid and gas line.
7. Electrical:
   a. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
   b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
   c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
8. Control:
   a. The unit shall have on board controls to perform input functions necessary to operate the system.
   b. The unit shall include all devices necessary to be compatible with interfacing with a BAS system via optional LonWorks or BACnet gateways.
9. Optional Accessories Available:
   a. A high efficiency disposable MERV 8 air filter kit. (3' x 3')
   b. A high efficiency disposable MERV 13 air filter kit. (3' x 3')
   c. Fresh air intake kit.
   d. Supply air branch duct connections.
   e. Remote "in-room" sensor kit.
   f. The wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

B. Ducted Concealed Ceiling Fan Coil Units
1. General:
   a. Indoor unit shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation in a ceiling cavity. It is constructed of a galvanized steel casing. It shall be a horizontal discharge air with horizontal return air configuration. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. Included as standard equipment, a condensate drain pan and drain pump kit that pumps up to 18-3/8" from the drain pipe opening.
   b. All pressure drops, horsepowers and dimensions shown on drawing schedules are maximum allowable. All capacities shown are minimum allowable. All units must have AMCA certified performance data for fans tested in the unit casings. Bare fan certification without casing is not acceptable.
   c. Manufacturers unable to meet these criteria will only be considered as an alternate to specified and as a deduct to base bid. Manufacturers listed by name does not imply that their standard construction meets the specifications nor that they are

approved. All manufacturers are required to meet all details of this specification without exception.

2. Sound Pressure Level:
   a. Large capacity, medium static units: 48 dB(A) at low speed measured 5 feet below the ducted unit.
   b. Small capacity, medium static units: 29 dB(A) to 40 dB(A) at low speed measured 5 feet below the ducted unit.
   c. Shallow depth fan coils: 29 dB(A) to 32 dB(A) at low speed and 33 dB(A) to 36 dB(A) at high speed 5 feet below the suction grille.
3. Indoor Unit: The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch (Large models). The unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning. This adjusts the airflow based on the installed external static pressure. (Small models)
   a. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
   b. Both refrigerant lines shall be insulated from the outdoor unit.
   c. The indoor units shall be equipped with a return air thermistor.
   d. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8” of lift from the center of the drain outlet (Small and slim model only)
   e. Return air shall be through a resin net mold resistant filter (slim model only)
4. Unit Cabinet:
   a. The cabinet shall be located within the ceiling and ducted to the supply and return openings.
   b. The cabinet shall be constructed with minimum ½” 1.5 lb internal insulation. Insulation shall be attached with adhesive with all exposed edges coated to prevent erosion or of an insulation type not requiring protection.
5. Fan:
   a. (Large models and slim duct):
      1) The fan shall be direct-drive type fan, statically and dynamically balanced impeller with high and low fan speeds available.
      2) The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.
      3) The airflow rate shall be available in high and low settings.
      4) The fan motor shall be thermally protected.
      5) The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
   b. Fan (Small models):
      1) The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
      2) The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
      3) The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
      4) The airflow rate shall be available in three settings.
      5) The fan motor shall be thermally protected.
      6) The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
6. Coil:
   a. Coils shall be ARI certified of the direct expansion type.
   b. All coil casings shall be galvanized steel minimum or stainless steel.

c. Copper tubes shall be a minimum thickness of 0.020 and return bends of minimum 0.035. Headers shall be non-ferrous seamless copper. Aluminum fins shall have a minimum thickness of 0.0080 and tubes shall be mechanically expanded into fin collars to provide permanent mechanical bond.
d. The coils shall be pressure tested at the factory.
e. The refrigerant connections shall be flare connections.
f. A thermistor will be located on the liquid and gas line.
g. A condensate pan shall be located under the coil
h. The condensate shall be capable of being gravity drained from the fan coil.
i. Where scheduled, a condensate pump with an 18" minimum lift shall be located below the coil in the condensate pan with a built in safety alarm.

7. Electrical:
   a. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
   b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
   c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
8. Control:
   a. The unit shall have on board controls to perform input functions necessary to operate the system.
   b. The unit shall include all devices necessary to be compatible with interfacing with a BAS system via optional LonWorks or BACnet gateways.
9. Optional Accessories Available:
   a. Remote "in-room" sensor kit (recommended).
   b. The wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

C. Non-Ducted Wall or Ceiling Fan Coil Units
1. General: Indoor unit shall be a fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall or ceiling within a conditioned space. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.
2. Condensate drain pan:
   a. Ceiling Suspended Cassette Unit: A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment.
   b. Wall Mounted Unit: A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment.
   c. Floor Console Unit: A mold-resistant, resin net air filter shall be included as standard equipment.
3. Sound Pressure:
   a. Ceiling Suspended Cassette Unit: The indoor units sound pressure shall range from 32 dB(A) to 38 dB(A) at low speed measured at 3.3 feet below and from the unit.
   b. Wall Mounted Unit: The indoor units sound pressure shall range from 31 dB(A) to 40 dB(A) at low speed measured at 3.3 feet below and from the unit.
   c. Floor Console Units (Surface mount and concealed types): The indoor units sound pressure shall range from 35 dB(A) to 40 dB(A) at high speed measured at 5 feet away and 5 feet high.
4. Indoor Unit:
   a. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit

board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops

b. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
c. Both refrigerant lines shall be insulated from the outdoor unit.
d. Return air shall be through a resin net mold resistant filter.
e. The indoor units shall be equipped with a condensate pan.
f. The indoor units shall be equipped with a return air thermistor.

5. Unit Cabinet:
   a. The cabinet shall be affixed to a factory supplied wall/ceiling hanging brackets and located in the conditioned space.
   b. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
6. Fan:
   a. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
   b. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz.
   c. The airflow rate shall be available in high and low settings.
   d. The fan motor shall be thermally protected.
7. Filter:
   a. The return air shall be filtered by means of a washable long-life filter with mildew proof resin (Floor console only).
8. Coil:
   a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
   b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
   c. The coil shall be a 2-row (3-row floor console only) cross fin copper evaporator coil completely factory tested.
   d. The refrigerant connections shall be flare connections.
   e. A thermistor will be located on the liquid and gas line.
   f. A condensate pan shall be located in the unit.
9. Electrical:
   a. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
   b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
   c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
10. Control:
    a. The unit shall have on board controls perform input functions necessary to operate the system.
    b. The unit shall include all devices necessary to be compatible with interfacing with a BAS system via optional LonWorks or BACnet gateways.
11. Optional Accessories Available:
    a. Remote “in-room” sensor kit.
    b. A condensate pump.

2.05 CONTROLS (NOTE TO EDITOR: REVIEW AND EDIT FEATURES AS APPLICABLE, DON’T LEAVE AS-IS.)

A. General:

1. Provide control devices necessary to support a fully operating system including but not limited to
   a. Local remote controllers,
   b. Centralized/multi-zone controllers,
   c. Open protocol network devices that transmit information via the communication bus and graphical user workstations.
2. The network shall have the capability to support
   a. Operation monitoring and scheduling,
   b. Error email distribution
   c. General user software, tenant billing, maintenance support, and integration with Building Automation Systems (BAS) using open protocol via BACnet or Lonworks interfaces.
3. General Electrical Requirements: The control wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to the branch circuit selector/controller (Heat Recovery System), then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. Wiring shall be non-shielded, 2-conductor sheathed vinyl core or cable, and 18 AWG stranded copper wire.

B. Local Remote Controllers (Note to Editor: suitable for small systems.)
1. The local remote controllers shall be capable of controlling up to 16 indoor units (referred to as a group). The local remote controllers shall maintain the optimal operation of the connected indoor units. Local remote controllers consist of deluxe, simplified and wireless models. No more than two of these controllers can be placed in the same group. No addressing shall be required with the local remote controllers.
2. Basic Operation: Local remote controller shall control the following group of operations:
   a. On/off, operation mode (cool, heat, fan, dry and Auto)
   b. Independent cooling and heating setpoints in the occupied mode
   c. Independent cooling setup and heating setback setpoint in the unoccupied mode.
   d. Fan speed
   e. Airflow direction
   f. The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period
   g. Function key lockout
3. Programmability:
   a. Controller shall support 7-day programmable scheduling,
   b. The controller shall support auto-changeover mode for both heat pump and heat recovery systems allowing the optimal room temperature to be maintained by automatically switching the indoors unit's mode between cool and heat according to the room temperature and temperature setpoint.
   c. The controller shall support an auto off timer for temporarily enabling indoor unit operation using unoccupied period.
   d. The room temperature shall be capable of being sensed at either, the remote controller, the indoor unit return air temperature sensor (default), or a remote temperature sensor.
4. Display Features
   a. LED display
   b. The controller shall display Operations Mode, Setpoint, and Fan Speed.
   c. System Status icons in large font.
   d. Room temperature display
   e. On/Off status
   f. Error codes displayed in the event of a system abnormality/error
   g. Optional: The following system temperatures can be displayed to assist service personnel in troubleshooting:
      1) Return air temperature

2) Liquid line temperature
3) Gas line Temperature
4) Discharge Air Temperature (depending on fan coil)
5) Temperature used for indoor unit control.

C. Centralized/Multizone Controllers (Note to Editor: suitable for large systems)
a. The Centralized/Multizone controllers shall be capable of controlling up to 64 indoor unit groups and 128 indoor units connected to up to 10 outdoor units The Centralized/Multizone Controllers shall be complete with power supply. The Centralized/Multizone Controllers can be used in conjunction with local remote controllers, BACnet and Lonworks interfaces to control the same indoor unit groups. Centralized/Multizone controllers shall be available with the option of interconnection with a network PC via the internet or Local Area Network (LAN).
b. Basic Operation: The Centralized/Multizone controller shall control the following group operations:
1) On/off, operation mode (cool, heat, fan, dry and Auto)
2) Independent cooling and heating setpoints in the occupied mode
3) Independent cooling setup and heating setback setpoint in the unoccupied mode.
4) Fan speed
5) Airflow direction
6) The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period
7) Remote controller permit/prohibit of ON/Off, Mode, and Setpoint.
8) Lockout setting for touch display
9) Indoor unit Group/Zone assignment

2. Programmability:
a. Controller shall support weekly schedule settings
b. Scheduling shall support unit On/Off
c. The controller shall support multiple auto-changeover methods for both Heat Pump and Heat Recovery systems based upon the Zone configurations. This will allow for the optimal room temperature to be maintained by automatically switching the indoors unit's mode between cool and heat according to the room temperature and temperature setpoint.
d. Controller shall support Interlock for use with 3rd party equipment to automatically control groups or zones corresponding to the change of the operation states or On/Off states of any group.
e. Optional Digital Input/Output unit shall be available to allow On/Off based monitoring and control of 3rd party equipment.
f. The controller shall support force shutdown of associated indoor unit

3. Display Features:
a. Backlit LCD display
b. Multi-language availability
c. The controller shall display On/Off, Operations Mode, Setpoint, space Temperature, Louver Position, Fan Speed for Group/Zone
d. Date, day of week and time of day
e. Daylight savings automatic adjustment
f. Display update every 3 seconds
g. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Set Schedule/Setback/Auto-changeover, Filter, and Screen Lock.
h. The controller shall display the temperature setpoint in one degree increments.
i. Zone configuration shall display Setpoint Range Limitation, Setback Temperature setting, and Auto-changeover for each Zone.

j. Indoor units shall be capable of being displayed by Zone or Group.
k. Error status shall be displayed in the event of system abnormality/error with one of two color coded icons placed over the indoor unit icon.

4. Software Options: All PC's shall be field supplied
   a. Web/Email software: Each Controller shall be capable of monitoring, operating, and scheduling a maximum of 64 indoor unit groups (128 indoor unit groups with the addition of an option adapter) from a networked PC's web browser. It shall also be capable of creating general user access and sending detailed error emails to a customized distribution list (up to 3 email addresses).
   b. Power Proportional Distribution (PPD): The tenant billing option shall be capable of calculating VRV Controls Network equipment energy usage in kWh based on the energy consumption of the outdoor unit(s) divided among the associated indoor units. This software is used in conjunction with the Watt Hour Meter (WHM). A maximum of 3 Watt Hour Meters can be connected to the Controller. The use of the optional adapter will add an additional 3 Watt Hour Meters.
   c. HTTP Interface: This option shall be capable of creating a software interface between the VRV Controls Network and Home Automation control systems.

D. System BAS Integration (Note to Editor: edit or remove as applicable.)
1. The VRV/VRF system shall support integration with Building Management Systems (BAS) via a BACnet® or LonWorks interface.
2. BAS to have capability to monitor and control of VRV indoor units.
3. The VRV/VRF systems supplier shall cooperate fully with BAS supplier to enable them to map points into the BAS.
4. The BAS supplier shall provide all labor and programming necessary to map VRF system points into BAS. At a minimum, through the BAS, the operator shall be enabled to monitor space temperature of all zones change space temperature setpoint of all zones, monitor fan, heating and cooling status of all zones, monitor indoor fan coil alarm, monitor status and alarms of outdoor units and schedule each zone.
5. Operation and monitoring points include but are not limited to:
   a. On/Off (setting)
   b. On/Off (status)
   c. Alarm Sign
   d. Error Code
   e. Operation Mode (setting)
   f. Operation Mode (status)
   g. Fan Speed (setting)
   h. Fan Speed (status)
   i. Measured Room Temperature
   j. Set Room Temperature
   k. Filter Limit Sign
   l. Filter Limit sign reset
   m. Remote Control Operation (On/Off)
   n. Remote control Operation (Operation Mode).
   o. Remote Control Operation (Set Temperature)
   p. Electrical Total Power
   q. Communication Status
   r. System Forced Off
   s. Forced Thermostat off (setting)
   t. Forced Thermostat off (status)
   u. Compressor Status
   v. Indoor Fan Status
   w. Heater operation Status

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces are ready to receive work.

B. Verify that proper power supply is available.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide layout drawings of units, locations and power requirements to electrical installer.

C. Install air filters in unit during installation phase. Do not operate the unit without filters in place.

D. In the case of suspended units, mount the fan coil units on springs or from spring hangers as required and as shown on Drawings. Provide Mason #DNHS combination isolator hangers to fully support horizontal units hung from building framing.

E. Provide 4" high concrete pad extending 6" beyond edge of condensing unit on all sides. Attach condensing unit to concrete pad with concrete anchors and angle brackets.

F. Install 2" flexible duct connection at inlets and outlets of ducted units.

G. Install condensate drain piping and traps in accordance with manufacturer's instructions and as shown on the Drawings. Where drainage to gravity waste is not possible provide condensate pumps.

H. Install copper refrigerant piping and insulate lines.

I. Control wiring: Communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector/controller (Heat Recovery system), then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The termination of the wiring shall be non-polar. The remote control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit. Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.

J. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work.

K. Install a new set of filters prior to final air balance and substantial completion.

L. Provide support to BAS supplier for mapping of VRV/VRF systems points into the BAS.

3.03 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final

adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

END OF SECTION

SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Basic electrical requirements for all Division 26 Sections.

1.02 RELATED WORK

A. General requirements specifically applicable to Division 26 in addition to the provisions of Division 1.

B. Work specified in other Divisions and Divison 26: (See Appendix A - Table of Contents)

1.03 QUALITY ASSURANCE

A. Provide equipment and materials which conform to the standards effective as of the date of the Contract Documents as promulgated by the following bodies:
1. Underwriters' Laboratories (UL).
2. National Electrical Manufacturers' Association (NEMA).
3. Electrical Testing Laboratories (ETL).
4. American National Standards Institute (ANSI).
5. Insulated Cable Engineers Association (ICEA).
6. California State Fire Marshal (CSFM).
7. California Electrical Code (CEC).
8. Titles 8, 19 and 24 of the California Code of Regulations (CCR).

1.04 SUBMITTALS

A. Submit electronic copies of manufacturer's submittal sheets or shop drawings for major items of electrical equipment and for any items specifically requested by the Electrical Engineer. When possible, make all electrical submittals at the same time.

1.05 INSTALLATION DRAWINGS

A. Prepare dimensionally accurate floor plans of each electrical and signal room and/or closet, fire control room and the like, drawn to 1/4" scale minimum. Submit electronic copies for review with two prints for Architect's record. Indicate all equipment within the rooms to scale based on shop drawing data, include structural support for suspended equipment and description of seismic bracing and fastening. Indicate system and equipment grounding details as applicable. Review elevator machine room shop drawings and coordinate location of electrical gear to maintain clearances. Submit with shop drawings.

B. Where conduit runs, 2" trade size and larger, are run in exposed locations, prepare dimensionally accurate floor plans indicating routing, coordinated with work of other trades and the structure. Submit legible reproducible transparencies with two prints for review.

1.06 PROJECT RECORD DOCUMENTS

A. Maintain Record Documents which clearly indicate variances from the specified systems and which accurately locate all underground electrical conduits and structures.

1.07 EXAMINATION OF DOCUMENTS

A. Before submitting a bid, visit the Project Site and become familiar with conditions which may be pertinent to, or affect the cost of, the electrical installation.

B. Become acquainted with the Work of other installers whose activities will adjoin or be affected by the electrical Work. Consult with these other installers and study all pertinent Drawings in order to coordinate the Work and to avoid conflicts, omissions and delays.

1.08 PERMITS AND FEES

A. Obtain and pay for all necessary electrical permits and fees.

1.09 SUBSTITUTIONS

A. Refer to other Sections of these Specifications for substitution requirements.

1.10 DRAWINGS

A. For purposes of clarity and legibility, the electrical Drawings are essentially diagrammatic. although the size and location of electrical equipment is drawn to scale wherever possible, make use of all data in all of the Contract Documents, and verify this at the Project Site. Determine the exact location of conduits, outlets and equipment by the study of details, shop drawings and/or the Architect's directions.

B. The electrical Drawings show the required size and points of termination of the conduits and the quantity and size of the conductors within. However, the Drawings do not show all of the necessary conduit bends. Install conduits in such a manner as to conform to structure, avoid obstruction, preserve headroom and keep passageways and openings clear.

C. Locate outlets symmetrically with architectural elements, notwithstanding the fact that the locations shown of the electrical drawings may be distorted for clarity of representation.

D. The architectural Drawings take precedence over the electrical Drawings. Study the reflected ceiling plans and interior elevations to determine the exact location of lighitng fixtures, wall-mounted devices and fixtures, etc. The Architect has taken a very active role in the placement of these items. Should there be a conflict between locations shown on the architectural and electrical drawings, contact the Engineer for clarification prior to rough-in.

E. Before submitting a bid, examine all pertinent Contract Documents for electrical requirements which are not necessarily indicated on the electrical Drawings and include in the bid a sum which is sufficient to cover the costs of these other requirements.

F. Should it be perceived that the Contract Documents do not sufficiently define the required electrical work, contact the Architect for clarification or further description. Failure to do

this will be construed as evidence of an understanding of the required electrical systems and their installation.

1.11 REQUESTS FOR INFORMATION (RFIs)

1.12 VERIFICATION OF AVAILABLE SPACE

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 1).
   1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
   2. RFIs shall address single questions and related issues only.
   3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to Owner’s Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
      a. Project number.
      b. Date.
      c. Name of Contractor.
      d. Name of Architect.
      e. RFI number, numbered sequentially and unique.
      f. RFI subject.
      g. Specification Section number and title and related paragraphs, as appropriate.
      h. Drawing number and detail references, as appropriate.
      i. Field dimensions and conditions, as appropriate.
      j. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
      k. Contractor's signature.
      l. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
         1) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Incomplete RFIs or inaccurately prepared RFIs.
      b. RFIs submitted without indication of review and approval for submission by General Contractor.
      c. RFIs addressing multiple unrelated issues.
      d. Requests for approval of submittals.
      e. Requests for approval of substitutions.
      f. Requests for approval of Contractor's means and methods.
      g. Requests for information already indicated in the Contract Documents.
      h. Requests for adjustments in the Contract Time or the Contract Sum.
      i. Requests for interpretation of Engineer's actions on submittals.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.13 VERIFICATION OF AVAILABLE SPACE

A. Throughout the course of construction, verify that sufficient space will be available for the equipment to be installed.

1.14 IDENTIFICATION MARKINGS

A. Switchboards, distribution and branch panelboards, terminal cabinets and other miscellaneous electrical equipment shall be identified with laminated black and white engraved plastic nameplates which properly identify each item. Nameplates shall be attached with steel rivets or bolts and nuts.

1.15 EXISTING FACILITIES

A. Examine the drawings and specifications of the completed work and inspect the site to establish the scope of demolition work and new work to be provided under this sections and clarification of the phasing of the work.

B. Based on project phasing and scheduling, demolition work will be taking place in and around existing areas that are to remain in service. Where the work under this section affects or interferes with the operation of any existing areas to remain in service, or portions of the work already in operation, provide all necessary work and material including premium pay, required to avoid shutdown of these areas during normal operations. Obtain Owner's approval for shutdown, in writing, 48 hours prior to shutdown.

C. Existing electrical and signal facilities outside of the demolition area to remain in place and in service during demolition.

D. Unless specifically noted or otherwise indicated or directed, remove all existing electrical equipment in the areas to be demolished. Deliver all equipment removed, including lighting fixtures, to the Owner's representative.

1.16 REMODELING

A. Where remodeling of existing areas is indicated, provide all work indicated and required for a complete and operating facility. Where work is adjacent to existing fixtures or devices, provide matching products to present uniform appearance. Salvage demolished material and equipment and deliver to Owner as directed. Dispose of salvaged materials and equipment where so directed in writing by Owner. Patch all openings in existing walls or floors caused by removal of materials and/or equipment under this work.

1.17 DEMOLITION

A. Where areas of existing facilities are indicated to be demolished or remodeled, visit site to determine scope of work. Relocate electric and signal system equipment, and reroute or replace conduit and wiring as required to conform with new use of the area and maintain operation of adjacent areas.

1.18 WATERPROOFING

A. Wherever electrical Work pierces waterproofing or waterproofing membranes, install it in an

approved watertight manner.

1.19 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect electrical equipment and materials during transit, storage and handling to prevent damage, soiling and deterioration.

B. Provide new electrical materials and deliver them to the Project Site in unbroken packages.

1.20 CUTTING AND PATCHING

A. Provide core drilling, cutting and patching of existing construction and surfaces for the installation of electrical systems. Concrete, asphalt or plaster surfaces which have been damaged by such drilling or cutting shall be patched and repaired to match the surrounding surface.

1.21 ADJUST AND CLEAN

A. Keep the Project Site free from accumulations of electrical rubbish and debris. Remove such accumulations from the Project Site.

B. Thoroughly clean electrical equipment and materials of plaster, cement and other foreign materials and leave smooth, clean and dry.

1.22 FIELD QUALITY CONTROL

A. At project Completion or upon request of the Architect anytime, make necessary tests under the observation of the Architect which will ensure that electrical equipment, materials and installation methods are as specified.

B. At Project Completion, test electrical loads and controls under full operating conditions and immediately replace, at no cost to the Owner, defective electrical equipment, devices and workmanship. Make standard electrical equipment, materials and performance tests and also tests as may be required by the Architect, such as electrical insulation and ground resistance, or temperature rise.

C. Closing-in of Work: Do not allow Electrical Work to be covered or enclosed until it has been observed by the Architect's Representative. Should unobserved Electrical Work be covered or enclosed, uncover it for observation and then make repairs as necessary to restore the Electrical Work and the Work of other affected installers to its original and proper condition, at no cost to the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:
   1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
   2. Division 26 Section "Undercarpet Electrical Power Cables" for flat cables for undercarpet installations.
   3. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. [**Aluminum**] [**and**] [**Copper**] Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types [**THW**] [**THHN-THWN**] [**XHHW**] [**UF**] [**USE**] [**and**] [**SO**].

D. Multiconductor Cable: Comply with NEMA WC 70 for [**armored cable, Type AC**] [**metal-clad cable, Type MC**] [**mineral-insulated, metal-sheathed cable, Type MI**] [**nonmetallic-sheathed cable, Type NM**] [**Type SO**] [**and**] [**Type USE**] with ground wire.

2.02 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: [**Copper**] [**Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger**]. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: [**Type THHN-THWN, single conductors in raceway**] [**Type XHHW, single conductors in raceway**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Type SE or USE multiconductor cable**].

B. Exposed Feeders: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Feeders Installed below Raised Flooring: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].

F. Feeders in Cable Tray: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

G. Exposed Branch Circuits, Including in Crawlspaces: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

J. Branch Circuits Installed below Raised Flooring: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].

K. Branch Circuits in Cable Tray: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].

L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

M. Class 1 Control Circuits: Type THHN-THWN, in raceway.

N. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Firestopping."

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
      a. Feeders to all panels
      b. Feeders to all motors over 1 HP
      c. Feeders and branch circuits to all Mechanical Equipment
      d. Feeders and branch circuits to all elevators.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
      a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Ground rings.
   4. Grounding arrangements and connections for separately derived systems.
   5. Grounding for sensitive electronic equipment.

C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Instructions for periodic testing and inspection of grounding features at test wells and grounding connections for separately derived systems based on NETA MTS.
      a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      b. Include recommended testing intervals.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Minimum length shall be 18 inches or as shown on drawings. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.02 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar. Provide exothermic where shown on drawings and where extending main service ground

2.03 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 2 inches minimum from wall, 18 inches above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.

C. Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.

D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.

E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.

G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.03 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.04 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
   8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
   1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-18-inch grounding bus.
   3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.05 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
   1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange.
   2. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
   1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.06 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
   1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
   5. Substations and Pad-Mounted Equipment: 5 ohms.
   6. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Sections include the following:
   1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
   4. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

B. Comply with NFPA 70.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. Fabco Plastics Wholesale Limited.
      d. Seasafe, Inc.
   3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
   5. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps .

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 .
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use **2500 psi (17.25 MPa)**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete ."

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Metal conduits, tubing, and fittings.
   2. Nonmetal conduits, tubing, and fittings.
   3. Metal wireways and auxiliary gutters.
   4. Nonmetal wireways and auxiliary gutters.
   5. Surface raceways.
   6. Boxes, enclosures, and cabinets.
   7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
   1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: RNC: Rigid nonmetallic conduit

J. ARC: Aluminum rigid conduit.

K. GRC: Galvanized rigid steel conduit.

L. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
   1. Structural members in paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AFC Cable Systems, Inc.
   2. Allied Tube & Conduit; a Tyco International Ltd. Co.
   3. Anamet Electrical, Inc.
   4. Electri-Flex Company.
   5. O-Z/Gedney; a brand of EGS Electrical Group.
   6. Republic Conduit.
   7. Robroy Industries.
   8. Southwire Company.
   9. Thomas & Betts Corporation.
   10. Western Tube and Conduit Corporation.
   11. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel
   b. Type: [**Setscrew**] [**or**] [**compression**].
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

K. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 PVC-COATED STEEL CONDUIT

A. Manufacturers: Subject to compliance with requirements manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Kor Kap
2. Perma-Cote
3. Plasti Bond
4. Thomas & Betts

B. Description: PVC-coated rigid steel conduit.
1. ETL Verified and must bear the ETL PVC-001 label.
2. Hot dip galvanized inside and out.
3. Comply with NEMA RN 1.
4. PVC Coating Thickness: 0.040 inch (1 mm), minimum.
5. Conduit must have a urethane coating on the interior of all conduit and fittings
   a. Urethane coating thickness: .002 inch (.05 mm), minimum.

C. Fittings for Conduit; listed for type and size raceway with which used, and for application and environment in which installed.
1. Condulets ½" through 2" diameter shall have tongue-in-groove gasket.
2. Condulets be supplied with plastic encapsulated stainless steel cover screws.

2.03 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; a Hubbell company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper B-Line, Inc.
   2. Hoffman; a Pentair company.
   3. Mono-Systems, Inc.
   4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as shown on drawings, unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Moulded Products, Inc.
   2. Hoffman; a Pentair company.
   3. Lamson & Sessions; Carlon Electrical Products.

4. Niedax-Kleinhuis USA, Inc.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Mono-Systems, Inc.
      b. Panduit Corp.
      c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Hubbell Incorporated; Wiring Device-Kellems Division.
      b. Mono-Systems, Inc.
      c. Panduit Corp.
      d. Wiremold / Legrand.

D. Tele-Power Poles:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Mono-Systems, Inc.
      b. Panduit Corp.
      c. Wiremold / Legrand.
   2. Material: Galvanized steel with ivory baked-enamel finish.

3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.07 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a Pentair company.
7. Hubbell Incorporated; Killark Division.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell Company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:
1. Material: Cast metal.
2. Type: Fully adjustable .
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

N. Gangable boxes are prohibited.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as shown on drawings with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic .
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:
   1. NEMA 250, Type 1, Type 3R, or Type 12 as shown on drawings, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.08 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Armorcast Products Company.

b. Carson Industries LLC.
c. CDR Systems Corporation; Hubbell Power Systems.
d. NewBasis.
e. Oldcastle Precast, Inc.; Christy Concrete Products.
f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

3. Standard: Comply with SCTE 77.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC.".
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.09 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground: GRC, IMC, or EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased where shown.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT .
2. Exposed, Not Subject to Severe Physical Damage: EMT Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:

a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
e. Electrical rooms.
f. Warehouse spaces

4. Concealed in Ceilings and Interior Walls and Partitions: EMT .

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel or nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (16-mm) to devices with 3/4-inch (21-mm) minimum homerun. 1-inch (32-mm) minimum trade size for ENT underground outdoor use.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. A. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum10-foot (3-m) intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 2 inches (50 mm) Insert dimension of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 24 inches (600 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:
   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
      c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
      d. Attics: 135 deg F (75 deg C) temperature change.
   3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
   4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
   5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

California Building Code (CBC) reference below are more restrictive than ADA and should be selected for all projects in California Engineer must edit to California or other.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to **[ADA][California Building Code]** requirements. Install boxes with height measured to top of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 18 inches (450 mm) below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and boxes.
   3. Manholes.

1.03 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for manholes, handholes, boxes, and other utility structures.
   4. Warning tape.
   5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Ladder details.
   5. Grounding details.
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design.
   3. Grounding details.
   4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.05 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

D. Source quality-control test reports.

E. Field quality-control test reports.

1.06 QUALITY ASSURANCE

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.08 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner's written permission.

1.09 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.010 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.01 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.02 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ARNCO Corp.
   2. Beck Manufacturing.
   3. Cantex, Inc.
   4. CertainTeed Corp.; Pipe & Plastics Group.
   5. Condux International, Inc.
   6. ElecSys, Inc.
   7. Electri-Flex Company.
   8. IPEX Inc.
   9. Lamson & Sessions; Carlon Electrical Products.
   10. Manhattan/CDT; a division of Cable Design Technologies.
   11. Spiraduct/AFC Cable Systems, Inc.

D. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

F. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.03 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Carder Concrete Products.
   2. Christy Concrete Products.
   3. Elmhurst-Chicago Stone Co.
   4. Oldcastle Precast Group.
   5. Riverton Concrete Products; a division of Cretex Companies, Inc.
   6. Utility Concrete Products, LLC.
   7. Utility Vault Co.

8. Wausau Tile, Inc.

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, As indicated for each service.
7. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension shall provide increased depth of 12 inches (300 mm).
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.04 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation.
   d. NewBasis.

2.05 PRECAST MANHOLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carder Concrete Products.
2. Christy Concrete Products.

3. Jensen Precast Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.

C. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.
   1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
      a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
      b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
      c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

D. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.06 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."

C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.07 UTILITY STRUCTURE ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Bilco Company (The).
   2. Campbell Foundry Company.
   3. Carder Concrete Products.
   4. Christy Concrete Products.
   5. McKinley Iron Works, Inc.
   6. NewBasis.
   7. Oldcastle Precast Group.
   8. Pennsylvania Insert Corporation.
   9. Riverton Concrete Products; a division of Cretex Companies, Inc..
   10. Strongwell Corporation; Lenoir City Division.
   11. Underground Devices, Inc.
   12. Utility Concrete Products, LLC.
   13. Utility Vault Co.

C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
   1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (737 mm).
      a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
      b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
   2. Cover Legend: Cast in. Selected to suit system.
      a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
      b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
      c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
   3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
      a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

D. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

E. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
   1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

F. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

G. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
   1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

H. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.
   1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

J. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
   1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
   2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
   3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

L. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

M. Fixed Manhole Ladders: Arranged for attachment to roof or wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin .

N. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches (900 mm). One required.

O. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N) and greater. Two required.

2.08 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40 -PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

G. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40 or DB-120-PVC, in direct-buried duct bank, unless otherwise indicated.

I. Underground Ducts Crossing Paved Paths Walks and Driveways Roadways and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.02 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin , structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.03 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.04 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm) , both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.

3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated on drawings.
9. Stub-Ups: Use manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
   b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm)

increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

I. Direct-Buried Duct Banks:
   1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
   2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
   3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
   4. Install backfill as specified in Division 31 Section "Earth Moving."
   5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
   6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts unless otherwise shown on drawings.
   7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
   8. Set elevation of bottom of duct bank below the frost line.
   10. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
      b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
   11. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.05 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

B. Precast Concrete Handhole and Manhole Installation:
   1. Comply with ASTM C 891, unless otherwise indicated.
   2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
   3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:
   1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.

2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line, 18 inches below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

F. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "Elastomeric Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

K. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.06 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, 18 inches below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
   1. Concrete: 2500 psi (16 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
   2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep) Insert dimensions.

3.07 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
   2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
   3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.09 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Color and legend requirements for raceways, conductors, and warning labels and signs.
   2. Labels.
   3. Bands and tubes.
   4. Tapes and stencils.
   5. Tags.
   6. Signs.
   7. Cable ties.
   8. Paint for identification.
   9. Fasteners for labels and signs.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: To be as indicated on drawings.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
   1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
   3. Color for Neutral: White.
   4. Color for Equipment Grounds: Green.
   5. Colors for Isolated Grounds: Green with white stripe.

C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
   1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
   2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Minimum Nominal Size:
      a. 1-1/2 by 6 inchesfor raceway and conductors.
      b. 3-1/2 by 5 inchesfor equipment.
      c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.05 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
   1. Tape:
      a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape shall be permanent and shall not be damaged by burial operations.
      c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   2. Color and Printing:
      a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
      b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
      c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.06 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on Tags:
   1. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
   2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.07 SIGNS

A. Baked-Enamel Signs:
   1. Preprinted aluminum signs,punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.
   3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:
a. For signs up to 20 sq. in., minimum 1/16 inch.
b. For signs larger than 20 sq. in., 1/8 inch thick.
c. Engraved legend with black letters on white face.
d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "Life Safety Power"
   2. "Critical Power "
   3. "Normal Power"

M. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using UV-stabilized cable ties.

Y. Nonmetallic Preprinted Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using UV-stabilized cable ties.

Z. Write-on Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using UV-stabilized cable ties.

AA. Baked-Enamel Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Metal-Backed Butyrate Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
   1. Locate identification at changes in direction, at penetrations of walls and floors, and at 30-foot maximum intervals.

D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "Life Safety Power"
   2. "Critical Power "
   3. "Normal Power"

G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, and handholes, use self-adhesive wraparound labels to identify the phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

J. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

N. Arc Flash Warning Labeling: Self-adhesive labels.

O. Operating Instruction Signs: Self-adhesive labels.

P. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

Q. Equipment Identification Labels:
   1. Indoor Equipment: Baked-enamel signs.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchboards.
      e. Emergency system boxes and enclosures.
      f. Enclosed switches.
      g. Enclosed circuit breakers.
      h. Enclosed controllers.
      i. Variable-speed controllers.
      j. Push-button stations.
      k. Power-transfer equipment.
      l. Contactors.
      m. Remote-controlled switches, dimmer modules, and control devices.
      n. Power-generating units.
      o. Monitoring and control equipment.

END OF SECTION 260553

SECTION 26 05 72

OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.03 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Short-circuit study input data, including completed computer program input data sheets.
   2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
      b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.06 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Power Analytics, Corporation.
   2. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:
      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Obtain all data necessary for the conduct of the study.
   1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
   2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
   7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   9. Motor horsepower and NEMA MG 1 code letter designation.
   10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.02 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
   1. Electric utility's supply termination point.
   2. Incoming switchgear.
   3. Unit substation primary and secondary terminals.
   4. Low-voltage switchgear.
   5. Motor-control centers.
   6. Control panels.
   7. Standby generators and automatic transfer switches.
   8. Branch circuit panelboards.
   9. Disconnect switches.

3.03 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.04 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
   1. Study results shall be used to determine coordination of series-rated devices.

1.03 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and equipment evaluation reports.
   3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. The following parts from the Protective Device Coordination Study Report:
         1) One-line diagram.
         2) Protective device coordination study.
         3) Time-current coordination curves.
      b. Power system data.

1.07 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Power Analytics, Corporation.
      b. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
   1. Optional Features:
      a. Arcing faults.
      b. Simultaneous faults.
      c. Explicit negative sequence.
      d. Mutual coupling in zero sequence.

2.02 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
   2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
   3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
   4. Plot the following listed characteristic curves, as applicable:
      a. Power utility's overcurrent protective device.
      b. Medium-voltage equipment overcurrent relays.
      c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
      d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
      e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
      f. Cables and conductors damage curves.
      g. Ground-fault protective devices.
      h. Motor-starting characteristics and motor damage points.
      i. Generator short-circuit decrement curve and generator damage point.
      j. The largest feeder circuit breaker in each motor-control center and panelboard.
   5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
   6. Provide adequate time margins between device characteristics such that selective operation is achieved.
   7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

   1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:
   1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
   2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
   1. Electric utility's supply termination point.
   2. Switchgear.
   3. Unit substation primary and secondary terminals.
   4. Low-voltage switchgear.
   5. Motor-control centers.
   6. Standby generators and automatic transfer switches.
   7. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.03 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
   1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
   2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
   3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.04 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

3.05 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.
   1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
   2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Electrical power utility impedance at the service.
   3. Power sources and ties.
   4. Short-circuit current at each system bus, three phase and line-to-ground.
   5. Full-load current of all loads.

6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.06 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.07 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:
1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 26 05 74

OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.03 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
   1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
   2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.07 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Power Analytics, Corporation.
   2. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Working distance.
   6. Incident energy.
   7. Hazard risk category.
   8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.03 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Location designation.
   2. Nominal voltage.
   3. Flash protection boundary.
   4. Hazard risk category.
   5. Incident energy.
   6. Working distance.
   7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.02 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:
   1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
   2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.
   1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
   2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
   1. When the circuit breaker is in a separate enclosure.
   2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.03 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
   1. Verify completeness of data supplied on the one-line diagram on. Call discrepancies to the attention of Architect.
   2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. Short-circuit current at each system bus, three phase and line-to-ground.
   5. Full-load current of all loads.
   6. Voltage level at each bus.
   7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
   8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
   9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
   10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
   12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   13. Motor horsepower and NEMA MG 1 code letter designation.
   14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
   15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.04 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
   1. Motor-control center.
   2. Low-voltage switchboard.
   3. Switchgear.
   4. Medium-voltage switch.
   5. Control panel.

3.05 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.06 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes: Distribution , dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
   2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
   3. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For transformers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control reports.

D. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting DOE 2016 energy efficiency standards as codified by 10 CFR Part 431 (2016).

kVA	Single Phase Efficiency	kVA	Three Phase Efficiency
15	97.70%	15	97.89%
25	98.00%	30	98.23%
37.5	98.20%	45	98.40%
50	98.30%	75	98.60%
75	98.50%	112.5	98.74%
100	98.60%	150	98.83%
167	98.70%	225	98.94%
250	98.80%	300	99.02%
333	98.90%	500	99.14%
-	-	750	99.23%
-	-	1000	99.28%

1.07 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ACME Electric Corporation; Power Distribution Products Division.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
4. General Electric Company.
5. Hammond Co.; Matra Electric, Inc.
6. Magnetek Power Electronics Group.
7. Sola/Hevi-Duty.

8. Square D; Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.02 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger: Comply with DOE 10 CFR 431 (2016) energy-efficiency levels.

D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

E. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum or Copper.

F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.03 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated .
1. NEMA 250, Type 2 : Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.

E. Enclosure (outdoor): Ventilated .
1. NEMA 250, Type 3R : Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

F. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: NSF/ANSI 61 gray.

G. Taps for Transformers 3 kVA and Smaller: None.

H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity .

I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

J. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

K. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 -deg C rise above 40-deg C ambient temperature.

L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
   1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
   2. Indicate value of K-factor on transformer nameplate.
   3. Unit shall meet requirements of DOE 10 CFR 431 (2016) when tested with a K-factor equal to one.

M. Electrostatic Shielding (as indicated on the drawings): Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
   1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
   2. Include special terminal for grounding the shield.

N. Neutral: Rated 200 percent of full load current for K-factor rated transformers (K rating or 4 or more).

O. Wall Brackets: Manufacturer's standard brackets.

P. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
   1. 9 kVA and Less: 40 dBA.
   2. 30 to 50 kVA: 45 dBA.
   3. 51 to 150 kVA: 50 dBA.
   4. 151 to 300 kVA: 55 dBA.
   5. 301 to 500 kVA: 60 dBA.
   6. 501 to 750 kVA: 62 dBA.
   7. 751 to 1000 kVA: 64 dBA.
   8. 1001 to 1500 kVA: 65 dBA.

2.04 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall be listed and labeled as complying with UL 506 or UL 1561.
   1. Standard impedance at 60Hz: 2 percent to 5 percent (up to 10 kVA), 4 percent to 6.5 percent (above 10 kVA).
   2. Nameplate Rating: Linear load, 60Hz.
   3. Insulation Class: 220 deg C system.
   4. Temperature Rise: 150 deg C .
   5. Core Construction: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

6. Coil Conductors: Continuous aluminum windings, with terminations brazed, welded, or bolted.
7. Coil Impregnation: Vacuum impregnated with polyester resin.
8. Sound Level: Not exceeding values listed above for distribution transformers.
9. Enclosure: Ventilated, NEMA 250, Type 3R.
10. Terminations: Transformer coils shall terminate in mounting pads. Mounting lugs shall be provided on all units up to and including 270 A ratings.
11. Antivibration pads or isolators shall be used between the transformer core and coil and the enclosure.
12. Ground core and coil assembly to enclosure with a flexible copper grounding strap or equivalent.
13. Mounting:
    a. Ventilated Units up to 750 lb (340 kG): Suitable for wall, floor, or ceiling mounting (drip plate required).
    b. Ventilated Units over 750 lb (340 kG): Suitable for floor mounting only.
    c. Encapsulated Units up to 285 lb (130 kG): Suitable for wall or floor mounting.
    d. Encapsulated Units over 285 lb (130 kG): Suitable for floor mounting only.
14. Seismic: Floor-mounted units comply with Earthquake Loads Section of International Building Code with site-specific parameters of Occupancy Category III and Site Profile Type SD with the seismic forces defined as Spectral Acceleration for Short Periods equal to 1.0 g.
15. Finish Color: NSF/ANSI 61 gray.

2.05 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution or buck-boost transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.06 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:
    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.
9. Temperature tests.

B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
   2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
   1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.03 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
   3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

1.03 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer

B. Seismic Qualification Certificates: For switchboards, overcurrent protective devices, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Routine maintenance requirements for switchboards and all installed components.
      b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
      c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
   2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.09 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:
   1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
      b. Altitude: Not exceeding 6600 feet (2000 m).

C. Unusual Service Conditions: NEMA PB 2, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet (2000 m).

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
   2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.02 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Square D; by Schneider Electric
   2. Eaton.
   3. General Electric Company.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

   1. Main Devices: Fixed, individually mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.

I. Nominal System Voltage: Per plans.

J. Main-Bus Continuous: Per plans.

K. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

L. Indoor Enclosures: Steel, NEMA 250, Type 1.

M. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

N. Outdoor Enclosures: Type 3R.
1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
3. Doors: Personnel door at each end of aisle, minimum width of [**30 inches (762 mm)**]; opening outwards; with panic hardware and provisions for padlocking. At least one door shall be sized to permit the largest single switchboard section to pass through without disassembling doors, hinges, or switchboard section.
4. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors.

O. Barriers: Between adjacent switchboard sections.

P. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

Q. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

R. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

S. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

T. Removable Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

U. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

V. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.

4. Copper feeder circuit-breaker line connections.
5. Tin-plated aluminum feeder circuit-breaker line connections.
6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
7. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
8. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
9. Disconnect Links:
   a. Isolate neutral bus from incoming neutral conductors.
   b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
10. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
11. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

W. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

X. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.03 SURGE PROTECTION DEVICES

A. SPDs: Comply with UL 1449, Type 1.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.

C. Features and Accessories:
   1. Integral disconnect switch.
   2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   3. Indicator light display for protection status.
   4. Surge counter.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 1200 V for 480Y/277 V.
   2. Line to Ground: 1200 V for 480Y/277 V.
   3. Line to Line: 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 100 kA.

G. Nominal Rating: 20 kA.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long and short time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
   6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   8. MCCB Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
      f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
      g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.
      h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
      i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
   1. Fixed circuit-breaker mounting.
   2. Two-step, stored-energy closing.
   3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Time adjustments for long- and short-time pickup.
      c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: 40-V dc.

2.05 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, and the following:
   1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, [**single**] [**tapped**] [**double**] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
   2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; [**wound**] [**bushing**] [**bar or window**] type; [**single**] [**double**] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
   3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
   4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
      a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
      b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
      c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
      d. Megawatts: Plus or minus 1 percent.
      e. Megavars: Plus or minus 1 percent.
      f. Power Factor: Plus or minus 1 percent.
      g. Frequency: Plus or minus 0.1 percent.
      h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
      i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
      j. Contact devices to operate remote impulse-totalizing demand meter.
   2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.06 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
   1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
   2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
   3. Protect from moisture, dust, dirt, and debris during storage and installation.
   4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
   1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches (50-mm) above concrete base after switchboard is anchored in place.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to switchboards.
   6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, surge protection devices, and instrumentation.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.03 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Section 260536 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

C. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

D. Support and secure conductors within the switchboard according to NFPA 70.

E. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
   1. Acceptance Testing:
      a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
      b. Test continuity of each circuit.
   2. Test ground-fault protection of equipment for service equipment per NFPA 70.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.07 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of NRTL listing for SPD as installed in panelboard.

7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Two spares for each type of panelboard cabinet lock.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.010 FIELD CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.
3. Comply with NFPA 70E.

1.011 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
1. SPD Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets. See schedules on plans for enclosure and NEMA types.
1. Rated for environmental conditions at installed location.
a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Height: 84 inches (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel for recessed panels and same finish as panels and trim for surface mounted.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: To be coordinated by Contractor, see drawings and schedules for requirements.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:
1. Material: [**Tin-plated aluminum**] [**Hard-drawn copper, 98 percent conductivity**].
   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box. See drawings and schedules for where required.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter. See drawings and schedules for where required
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter. See drawings and schedules for where required.
7. Split Bus: Vertical buses divided into individual vertical sections. See drawings and schedules for where required.

I. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Tin-plated aluminum .
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.

5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device. See drawings and schedules for where required.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device. See drawings and schedules for where required.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
   1. Percentage of Future Space Capacity: Ten percent.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
   1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
   2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.03 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Eaton Electrical Sector; Eaton Corporation.
   2. General Electric Company; GE Energy Management - Electrical Distribution.
   3. Siemens Energy.
   4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only. See drawings and schedules for requirements.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers .

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers .

G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Energy.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses. See plans and schedules for where required.
1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

1. ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Energy.

4. Square D; by Schneider Electric.

5. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. SPD. See drawings and schedules for where required.
1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
   a. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
   b. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
   c. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
   d. Line to Line: 2000 V for 480Y/277 V and 1200 V for 208Y/120 V.
4. SCCR: Equal to the SCCR of the panelboard in which installed or exceed 100 kA .
5. Inominal Rating: 20 kA.

G. Buses:
1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs. See plans and schedules for bus requirements.
2. Copper equipment and isolated ground buses. See plans and schedules for bus requirements.

2.06 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: 400A or less.
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Electronic Trip Circuit Breakers: Greater than 400A
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:
      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip). See Drawings and schedules for where required.
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).See Drawings and schedules for where required.
6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration. See Drawings and schedules for where required.
7. Subfeed Circuit Breakers: Vertically mounted. See Drawings and schedules for where required.
8. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
1. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage. See Drawings and schedules for where required.
    a. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    b. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    c. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    d. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    e. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
1. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position. See Drawings and schedules for where required.
    a. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
    1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
    2. Fused Switch Features and Accessories:
        a. Standard ampere ratings and number of poles.
        b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
        c. Auxiliary Contacts: [**One**] [**Two**] normally open and normally closed contact(s) that operate with switch handle operation.

2.07 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.08 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
   2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 80 inches (2032 mm) above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

K. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) or 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.

L. Install overcurrent protective devices and controllers not already factory installed.
   1. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

M. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

N. Install filler plates in unused spaces.

O. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-EMT) empty conduits into raised floor space or below slab not on grade.

P. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

Q. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
   1. Measure loads during period of normal facility operations.
   2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.06 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, combination receptacles with USB ports, and associated device plates.
   2. Twist-locking receptacles.
   3. Receptacles with integral surge-suppression units.
   4. Isolated-ground receptacles.
   5. Hospital-grade receptacles.
   6. Tamper-resistant receptacles.
   7. Weather-resistant receptacles.
   8. Snap switches and wall-box dimmers.
   9. Solid-state fan speed controls.
   10. Wall-switch and exterior occupancy sensors.
   11. Communications outlets.
   12. Pendant cord-connector devices.
   13. Cord and plug sets.
   14. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

G. USB: Universal serial bus

1.04 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Service/Power Poles: One for every 10, but no fewer than one.
   2. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
   3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
   4. Surge Protective Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

1.09 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   3. Leviton Mfg. Company Inc. (Leviton).
   4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved.
   1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 5351 (single), CR5362 (duplex) 6362 (decora).
      b. Hubbell; HBL5351 (single), HBL5352 (duplex) HBL2162 (decora).
      c. Leviton; 5891 (single), 5352 (duplex) 16362 (decora).
      d. Pass & Seymour; 5361 (single), 5362 (duplex) 26352 (decora).

B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 8310 (single), AH8300 (duplex).
      b. Hubbell; HBL8310 (single), HBL8300 (duplex).
      c. Leviton; 8310 (single), 8300 (duplex).
      d. Pass & Seymour; 8301 (single), 8300H (duplex).
   2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
   3. Hospital-Grade includes receptacles for any combination of GFCI, IG, and TVSS as required.

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; IG5362RN.
      b. Hubbell; IG5362.
      c. Leviton; 5362-IG.
      d. Pass & Seymour; IG5362.
   2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; TR8300.
b. Hubbell; HBL8300SGA.
c. Leviton; 8300-SGG.
d. Pass & Seymour; TR63H.

2. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

E. Controlled Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596. Marking permanently printed, molded, or stamped on the face of the receptacle and in compliance with Controlled Receptacle Marking requirements stated in Article 406.3(E) of the 2014 National Electrical Code.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pass & Seymour; 26352CD, 26352CH (half-controlled for split circuit installations)

2.04 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type.

1. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
2. Include indicator light that shows when the GFCI has malfunctioned or tripped and no longer provides proper GFCI protection.
3. End of life function by rendering itself incapable of delivering power when the test fails or indicating visually/audibly that the device must be replaced.
4. Reverse line-load miswiring function by denying power to the receptacle face if it is miswired

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; VGF20.
   b. Hubbell; GFR5352L.
   c. Pass & Seymour; 2095 or 2096.
   d. Leviton; 7590.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Hubbell; GFTR20.
   b. Pass & Seymour; 2096TR.

D. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; VGFH20.
   b. Hubbell; HFR8300HL.
   c. Leviton; 7899-HG.
   d. Pass & Seymour; 2095HG.

2.05 SURGE PROTECTIVE DEVICES - RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral surge protection in line to ground, line to neutral, and neutral to ground.

1. Surge Protection Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active Surge Protection Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex Surge Protection Devices - Convenience Receptacles:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 5362BLS.
      b. Hubbell; HBL5362SA.
      c. Leviton; 5380.
      d. Pass & Seymour; 5362BLSP.
   2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.

C. Isolated-Ground, Duplex Convenience Receptacles:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; IG5362BLS.
      b. Hubbell; IG5362SA.
      c. Leviton; 5380-IG.
      d. Pass & Seymour; IG5362BLSP.
   2. Description:
      a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
      b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement sd.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 8300BLS.
      b. Hubbell; HBL8362SA.
      c. Leviton; 8380.
      d. Pass & Seymour; 8300BLSP.
   2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
   3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   4. Comply with NFPA 70.

E. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; IG8300HGBLS.
      b. Hubbell; IG8362SA.
      c. Leviton; 8380-IG.
      d. Pass & Seymour; IG8300BLSP.
   2. Description:
      a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
      b. Comply with UL 498 Supplement sd.
      c. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting

strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.06 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper Crouse-Hinds.
      b. EGS/Appleton Electric.
      c. Killark; Division of Hubbell Inc.

2.07 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; CWL520R.
      b. Hubbell; HBL2310.
      c. Leviton; 2310.
      d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; IGL520R.
      b. Hubbell; IG2310.
      c. Leviton; 2310-IG.
      d. Pass & Seymour; IG4700.
   2. Description:
      a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
      b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.08 PENDANT CORD-CONNECTOR DEVICES

A. Description:
   1. Matching, locking-type plug and receptacle body connector.
   2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
   3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
      a. Pass & Seymour L520P and L520C
   4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
      a. Pass & Seymour FC_GL Series

2.09 CORD AND PLUG SETS

A. Description:
   1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
   3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.010 SNAP SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Single Pole:
         1) Cooper; AH1221.
         2) Hubbell; HBL1221.
         3) Leviton; 1221-2.
         4) Pass & Seymour; CSB20AC1.
      b. Two Pole:
         1) Cooper; AH1222.
         2) Hubbell; HBL1222.
         3) Leviton; 1222-2.
         4) Pass & Seymour; CSB20AC2.
      c. Three Way:
         1) Cooper; AH1223.
         2) Hubbell; HBL1223.
         3) Leviton; 1223-2.
         4) Pass & Seymour; CSB20AC3.
      d. Four Way:
         1) Cooper; AH1224.
         2) Hubbell; HBL1224.
         3) Leviton; 1224-2.
         4) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; AH1221PL for 120 and 277 V.
      b. Hubbell; HBL1201PL for 120 and 277 V.
      c. Leviton; 1221-LH1.
      d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
   2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Locking Type Key-Operated Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; AH1221L.
      b. Hubbell; HBL1221L.
      c. Leviton; 1221-2L.

d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 1995.
   b. Hubbell; HBL1557.
   c. Leviton; 1257.
   d. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 1995L.
   b. Hubbell; HBL1557L.
   c. Leviton; 1257L.
   d. Pass & Seymour; 1251L.

2.011 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 6252.
   b. Hubbell; DR15.
   c. Leviton; 16252.
   d. Pass & Seymour; 26252.

B. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; TR6252.
   b. Hubbell; DR15TR.
   c. Pass & Seymour; TR26252.
2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; TWRBR15.
   b. Hubbell; DR15TR.
   c. LevitonTRW15.
   d. Pass & Seymour; TRW26252.

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

D. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; VGF15.
      b. Hubbell; GF15LA.
      c. Leviton; 8599.
      d. Pass & Seymour; 1594.

E. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; TWRVGF15.
      b. Hubbell; GFTR15.
      c. Pass & Seymour; 1594TRWR.
   2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

F. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 7621 (single pole), 7623 (three way).
      b. Hubbell; DS115 (single pole), DS315 (three way).
      c. Leviton; 5621-2 (single pole), 5623-2 (three way).
      d. Pass & Seymour; 2621 (single pole), 2623 (three way).

G. Lighted Toggle Switches, Square Face, 120 V, 15 A: Comply with NEMA WD 1 and UL 20.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 7631 (single pole), 7633 (three way).
      b. Hubbell; DS120IL (single pole), DS320 (three way).
      c. Leviton; 5631-2 (single pole), 5633-2 (three way).
      d. Pass & Seymour; 2625 (single pole), 2626 (three way).
   2. Description: With neon-lighted handle, illuminated when switch is "off."

A. Residential-Grade, Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

B. Weather-Resistant and Tamper-Resistant Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

C. Fan Speed Controls:

D. Telephone Outlet:

E. Combination TV and Telephone Outlet:

2.013 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider ; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.014 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Smooth, high-impact thermoplastic
   3. Material for Unfinished Spaces: Galvanized steel .
   4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.015 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type , dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular , solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening [Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Division 27 Section "Communications Horizontal Cabling."]

2.016 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand.
3. Square D/Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold/Legrand.

C. Description:
1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks complying with requirements in Division 27 Section "Communications Horizontal Cabling."
4. Size: Selected to fit nominal 3-inch (75-mm) cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 3-inch (75-mm) or 4-inch (100-mm) cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Division 27 Section "Communications Horizontal Cabling."

2.017 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold/Legrand.

C. Description:
1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: Metal, with manufacturer's standard finish .

E. Multioutlet Harness:
1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 6 inches (150 mm) .
3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.018 SERVICE POLES

A. Description:
1. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

2. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Finishes: Manufacturer's standard painted finish and trim combination .
5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.
6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
7. Voice and Data Communication Outlets: Blank insert with bushed cable opening complying with requirements in Division 27 Section "Communications Horizontal Cabling."

2.019 FINISHES

A. Device Color:
1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing. Match existing as applicable.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up , and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections[with the assistance of a factory-authorized service representative]:
   1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
   2. Test Instruments: Use instruments that comply with UL 1436.
   3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Receptacle switches.
   4. Shunt trip switches.
   5. Molded-case circuit breakers (MCCBs).
   6. Molded-case switches.
   7. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
      b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.02 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.03 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:
   1. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
   2. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: Mechanical type, suitable for number, size, and conductor material.
   7. Service-Rated Switches: Labeled for use as service equipment.

2.04 NONFUSIBLE SWITCHES

A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Three Pole, Single Throw, **600**-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: type, suitable for number, size, and conductor material.
   7. Service-Rated Switches: Labeled for use as service equipment.

2.05 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1). NEMA 3R when installed outdoors.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

3.03 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Kitchen Wash-Down Areas: NEMA 250, Type 4X

3.04 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.05 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
      i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
   e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

F. Tests and Inspections for Molded Case Circuit Breakers:
   1. Visual and Mechanical Inspection:
      a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage, alignment, grounding, and clearances.
      d. Verify that the unit is clean.
      e. Operate the circuit breaker to ensure smooth operation.
      f. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
      g. Inspect operating mechanism, contacts, and chutes in unsealed units.
      h. Perform adjustments for final protective device settings in accordance with the coordination study.
   2. Electrical Tests:
      a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
      b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:
1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.
1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.07 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.
   2. Lighting fixture supports.

B. Related Requirements:
   1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Section 26 09 43 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule: For luminaires and lamps refer to luminaire schedule on drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
a. Other luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

G. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. LED Board replacements or whole fixture replacements: Five for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
   1. Obtain Architect's approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
   1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. Bulb shape complying with ANSI C79.1.

F. Lamp base complying with ANSI C81.61.

G. CRI of 80 minimum. CCT of 3500K unless otherwise noted on plans.

H. Rated lamp life of 50,000 hours minimum.

I. Lamps dimmable from 100 percent to 10 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 277 V ac.
   1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

L. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear anodized and/or powder-coat finish.

2.03 CYLINDER

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. With integral mounting provisions.

2.04 DOWNLIGHT

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Universal mounting bracket.

D. Integral junction box with conduit fittings.

2.05 PARKING GARAGE

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Low-profile housing and heat sink.

D. Fully gasketed and sealed. IP 65 rated.

E. Stainless-steel latches.

F. Integral pressure equalizer.

2.06 RECESSED LINEAR

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.07 STRIP LIGHT

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.08 SURFACE MOUNT, LINEAR

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.09 SURFACE MOUNT, NONLINEAR

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.10 SUSPENDED, LINEAR

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

2.11 SUSPENDED, NONLINEAR

A. Refer to luminaire schedule on plans.

B. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.12 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
   1. Diffuse glass, prismatic acrylic, clear, UV-stabilized acrylic
   2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Glass: Annealed crystal glass unless otherwise indicated.
   4. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear anodized and/or powder-coat finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI for all luminaires.

2.13 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.14 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
   2. Ceiling mount with pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
   3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
   3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.06 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 09 43.16 "Addressable-Fixture Lighting Controls."

B. Comply with requirements for startup specified in Section 26 09 43.23 "Relay-Based Lighting Controls."

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for clearing, grubbing and disposing of vegetation, including bushes, brush, trees, stumps, fallen timber, logs, roots, rubbish, refuse trash, and debris within the indicated site limits.

B. Protection from injury or defacement of trees and other vegetation and objects indicated to be preserved.

C. Removal, salvage, or other disposition of slabs, footings and foundations; existing pavement, curbs and gutters, sidewalks, headwalls, walls, and steps; utility service facilities; guardrail and posts, highway and street signs and fences; and other miscellaneous structures and site improvements which interfere with construction.

1.02 REFERENCES

A. California Code of Regulations, Title 8, Chapter 4, Subchapter 4 Construction Safety Orders.

B. California Code of Regulations, Title 24, Part 2, California Building Code, Chapter 33, Site Work, Demolition and Construction.

C. State of California, Department of Transportation (Caltrans), Standard Specifications.

1.03 JOBSITE CONDITIONS

A. Stockpile salvaged material in a secured location.

B. Clear and restore areas used for the Design Builder's convenience. Restore such areas to their original condition, and provide mulching, seeding and planting as required.

C. Protect survey markers and monuments, existing improvements, and adjacent properties from removal and damage.

D. Give written notices to utility companies and municipal departments requesting discontinuance of services to areas which will be affected by the site preparation work.

PART 2 - EXECUTION

2.01 MATERIALS AND EQUIPMENT

A. Furnish all materials, tools, equipment, facilities, and services as required for performing site clearing and preparation work.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Perform clearing and grubbing as necessary to remove vegetation and objectionable material from the site. Clear the site within the limits indicated, and remove cleared materials and debris from the site.

B. Remove stumps and roots completely in excavation areas and under embankments where the original ground level is within 3.5 feet of subgrade or slope of embankments. In embankment areas, where the original ground level is more than 3.5 feet below the subgrade or slope of embankment, cut off trees, stumps, and brush to within six inches of the ground.

C. Do not start earthwork operations in areas where clearing and grubbing are not complete, except that stumps and large roots may be removed concurrently with excavation.

D. Where the work includes requirements for wood chip mulch, acceptable material from clearing and grubbing activities may be used to produce such mulch.

3.02 TREE BRANCHES

A. Remove tree branches overhanging trackways, roadways, and other designated areas of the site to within 20 feet of finish grade. Cut off branches neatly and close to the tree boles. Remove other branches as necessary to present a balanced appearance. Treat scars resulting from tree branch removal with a heavy coat of an approved asphaltic tree paint.

3.03 REMOVAL

A. Remove existing pavements, structures, and site improvements which interfere with construction, where demolition is not indicated.

B. Remove walls and masonry construction to a minimum depth of two feet below existing ground level in areas where such items do not interfere with construction.

C. Slabs may be broken for drainage and left in place where they are not detrimental to the structural integrity of the fill or structure to be placed above.

3.04 DISPOSAL OF REMOVED MATERIALS AND DEBRIS

A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.

B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.

C. Remove trash and debris from the site at frequent intervals so that its presence will not delay the progress of the work.

D. Removed materials, waste, trash, and debris shall become the property of the Design Builder and shall be removed from the District's property and disposed of in a legal manner. Location of disposal site and length of haul shall be the Design Builder's responsibility.

3.05 SALVAGE

A. Items or materials to be salvaged are indicated on the Contract Drawings and in the Contract Specifications.

B. Protect metallic coatings on salvaged items. Remove adhering concrete from salvaged items.

C. Repair, or replace with new material, salvaged material damaged or destroyed due to Design Builder's negligence.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for the excavation, filling, recompacting, grading and disposal of excess material.

1.02 RELATED SECTIONS

A. Section 31 23 19 – Dewatering

B. Section 31 23 33 – Trenching and Backfilling

C. Section 32 11 23 - Aggregate Base

1.03 REFERENCES

A. ASTM C136-84a – Standard Method for Sieve Analysis of Fine and Coarse Aggregate

B. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort

C. ASTM D2922 – Density of Soil and Soil-Aggregate in Place by Nuclear Methods

D. Caltrans – State of California Standard Specifications; latest edition

E. Geotechnical Report – Geotechnical Report prepared by _____ is available for review at _____.

1.04 DEFINITIONS

A. Compaction

1. The degree of compaction is specified as percent compaction. Maximum densities refer to the maximum laboratory dry soil densities obtainable at optimum moisture content as determined by ASTM D1557.

2. Percent compaction (relative compaction) is the ratio of the measured field dry density to the laboratory maximum dry density.

B. Excavation Slope: Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.

1.05 SUBMITTALS

A. Product Data

1. Fill materials

2. Source of concrete and aggregate for approval

B. Test Reports

1. Gradation (ASTM C136)

2. Density-In-Place (ASTM D2922)

PART 2 - PRODUCTS

2.01 FILL MATERIALS

A. Class 2 Aggregate Base

1. Class 2 aggregate base for subsequent backfill and/or pavement base to be ¾ inches maximum Class 2 aggregate base conforming to Caltrans, Section 26

B. Engineered Fill Material: Soil excavated from site.

1. Imported materials should have a plasticity index not less than 5 nor greater than 15, as determined by ASTM D4318; and expansion index not exceeding 20, as determined by UBC Specification 29-2; and a particle size not exceeding 3 inches as determined by ASTM D422.

C Imported Fill Requirements: Imported fill, where required, shall be non expansive granular soil, free of organic matter and deleterious substances. Imported fill material shall conform to the following requirements:

1. Grading:

U. S. Sieve Size	Percentage Passing Sieve
2 ½ inch	100
No. 8	25-45
No. 200	0-10

2. Be thoroughly compactable without excessive voids.
3. Meet the following plasticity requirements:
   a. Maximum Plasticity Index of 12, as determined by ASTM D4318.
   b. Maximum Liquid Limit of 35, as determined by ASTM D4318

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Surplus Material

1. Unless otherwise specified, surplus excavated material shall be disposed of off site in accordance with applicable ordinances and environment requirements at the expense of the Design Builder.

B. Hauling

1. When hauling is down over highways or city streets, loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading.

2. Loads shall be watered after trimming to eliminate dust.

C. Subgrade

1. Unless directed otherwise on the drawings, existing subgrade shall be compacted to 90% RC, 12” in depth, prior to placement of base material.

2. Subgrade shall be inspected for compliance to the soils report by the District/Geotechnical District’s Design Consultant prior to filling or on achieving final cut depth

D. Finish Grading

1. Finish surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.

2. Finish grades shall be as specified on the plans, except where a local change in elevation is required to match existing conditions, or to ensure proper drainage.

3. When the work is at an intermediate stage of completion, lines and grades shall be as specified within □0.5 footor as necessary to provide adequate drainage.

3.02 FIELD QUALITY CONTROL

A. Fill material shall be placed in horizontal layers and compacted with power operated tampers, rollers, idlers, or vibratory equipment. Material type, maximum layer depth, relative compaction, and general application are specified in Table A, below. Unless otherwise specified, fill classes shall be used where specified in Table A under General Application.

Table A: Fill Classification

Material Type	Maximum Uncompressed Layer Depth (Inches)	Minimum Relative Compaction (Percent)	General Application
Aggregate Base	8"	95%	Roadway Grades

3.03 TESTS

A. Inspection Trenches

1. District will direct Design Builder to construct inspection trenches in compacted or consolidated backfill to determine that Design Builder has complied with these Specifications.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications and procedure for the dewatering of excavations and disposal of water.

1.02 SUBMITTALS

A. Prior to installation of the dewatering system, submit shop drawings and design data indicating the following:

1. The proposed type of dewatering system

2. Arrangement, location and depths of system components

3. Complete description of equipment and instrumentation to be used, with installation, operation and maintenance procedures

4. Methods of disposal of pumped water

5. Necessary permits for water disposal

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Furnish all materials, tools, equipment, facilities, and services as required for providing the necessary dewatering work and facilities.

B. Provide backup equipment as necessary for the replacement and for unanticipated emergencies.

PART 3 - EXECUTION

3.01 DEWATERING

A. Keep excavation and drilled shaft foundations reasonably free from water during construction.

B. Disposal of water shall not damage property or create a public nuisance.

C. Have on hand pump equipment and machinery in good working condition for emergencies and workmen available for its operation.

D. Dewatering systems shall operate continuously until drilled shaft foundations are poured.

E. Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of “quick” conditions.

F. Dewatering systems shall not remove natural soils.

G. Control surface runoff to prevent entry or collection of water excavations.

H. Release of groundwater shall be controlled to prevent disturbance of the natural foundation soils or compact fill.

I. There shall be no discharge of turbid water on site.

J. Discharge or disposal of water shall be controlled to prevent erosion.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for excavating, backfilling and compacting for the installation of pipe and pipeline appurtenances (i.e. manholes, catch basins, area drains, etc.)

1.02 RELATED SECTIONS

A. Section 32 11 23 – Aggregate Base

1.03 REFERENCES

A. North Marin Water District Standard Specifications - Latest Edition

B. Novato Sanitary District Standard Specifications - Latest Edition

C. PG&E Standard Specifications - Latest Edition

D. AT&T Standard Specifications - Latest Edition

E. Marin County Uniform Construction Standards, May 2008

F. California Plumbing Code - Latest Edition

G. Caltrans Standard Specifications and Drawings - Latest Edition

PART 2 - PRODUCTS

2.01 BACKFILL MATERIAL

A. Trench backfill shall consist of Class 2 Aggregate Base, unless otherwise noted.

2.02 PIPING MATERIAL

A. All piping material shall conform to respective utility agency and the California Plumbing Code.

2.03 BURIED WARNING AND IDENTIFICATION TAPE

A. Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3-inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, ‘CAUTION, BURIED (intended service) LINE BELOW” or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

1. Warning Tape Color Codes.

   Red: Electric

   Yellow: Gas, Oil; Dangerous Materials.

   Orange: Telephone and Other Communications.

   Blue: Water Systems.

   Green: Sewer Systems.

   White: Steam Systems.

   Grey: Compressed Air.

2. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

3. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3-feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.04 DETECTION WIRE FOR NON-METALLIC PIPING

A. Detection wire shall be insulated single strand, solid copper wire with a minimum of 12 AWG.

PART 3 - EXECUTION

3.01 EXCAVATION

A. GENERAL

1. Keep trench dry throughout construction operations.

2. Trench excavation shall follow the alignment of the pipe or utility centerline.

3. No more than 100 LF of trench shall be open at one time.

B. Shoring and Bracing

1. Design Builder is responsible for any damage or injury resulting from his construction operations. Design Builder shall perform, at his own expense, all necessary repair work or reconstruction.

2. Design Builder will be responsible for all shoring with bracing design and installation.

C. Excavation Required Beyond Trench Limits

1. Excavation (bell holes) where necessary in the sides and bottom of the trench at pipe joint locations shall be large enough to make joints and permit inspection.

2. Excavation to a greater depth than shown on the plans may be ordered by the Project Geotechnical Consultant if the native material at the bottom of the trench will not provide proper support for the pipe or if the excavation is in rock.

3. Remove all adjacent, saturated material where pipeline leaks occur.

3.02 UTILITIES

A. Location

1. Approximate known locations of underground utilities and structures are indicated on the plans. Design Builder shall determine exact location of underground utilities and structures prior to construction.

2. Adjustments of pipe alignment and elevation will be authorized by the District where exploratory work indicates the need.

B. Excavation Around Utilities

1. Excavation and other work under or adjacent to utilities shall not interfere with their safe operations and use.

2. Probe carefully to determine the exact location of utility and hand excavate where necessary to avoid damage.

3. In the event of damage incurred during construction near such structures or property, Design Builder shall immediately notify the District and other appropriate utility or public safety authorities and shall arrange for immediate repairs at Design Builder’s expense.

C. Tunneling Under Utilities

1. Tunneling may be allowed for short distances with the approval from the Project Geotechnical Consultation

3.03 BLASTING

A. Blasting will not be permitted.

3.04 BACKFILL OF TRENCHES

A. Prior to backfilling, the trench shall be cleared of all wood and debris.

B. Backfill pipeline trenches to the level of the original ground surface or the underside of the pavement base course.

C. Backfill material shall not be dropped directly on the pipe.

D. Carefully remove timbering, sheeting, shoring and sheet piling, according to the instructions of the shoring system District’s Design Consultant or the manufacturer, using methods that will

minimize caving. If caving is occurring, the shoring system will be required to remain in place up to one to six inches above the top of the pipe.

E. Jetting of trench backfill is not permitted.

F. If trench has been excavated below the specified depth, that portion of the trench shall be backfilled with Class 2 or select material and compacted before pipe installation, at the Design Builder's expense.

G. If pipe or conduit has less than 18 inches of final cover, trench shall be backfilled with Control Density Fill (CDF) to a depth specified by the District's Design Consultant.

END OF SECTION

SECTION 32 05 24

CONCRETE PAVING

1.01 GENERAL

1.02 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and Division l, General Requirements, apply to the work specified in this section.

1.03 DESCRIPTION OF WORK

A. Work Included: All labor, materials and equipment necessary to complete the installation of all site concrete work shown on the Landscape Drawings and herein specified.

B. Work Specified Under Other Sections: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete, finished and workmanlike installation.

1.04 REFERENCES AND STANDARDS

A. The following references and standards are hereby made a part of this Section and concrete material and installation shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings.

B. Standard Specifications: Where referred to in these Specifications, "State Specifications" shall mean the California Caltrans Specifications, latest edition.

C. Percent Compaction: As referred to in these Specifications, percent compaction or relative compaction is required in place dry density of the same material determined by the Engineer in accordance with the ASTM Test Method D1557-78.

D. "Specifications for Structural Concrete for Buildings", American Concrete Institute, latest edition.

E. American Concrete Institute (ACI).

F. The American Society for Testing and Materials (ASTM).

1.05 SUBMITTALS

A. Materials: furnish signed certificates from the suppliers of material and manufactured items showing conformance with standards specified in this Section.

B. Mix Designs: furnish copies of the mix design data for each type of concrete to be used on the work.

C. Samples:

D. Provide 3 foot square samples of paving finishes.

E. Provide 3 foot square sample panel of wall finishes.

1.06 QUALITY ASSURANCE

A. Work shall comply with the requirements of governing codes, ordinances, laws, regulations, safety orders and directives relating to the work.

B. Poured in Place Concrete: Conform with all applicable requirements of the State Specifications.

C. Any surface requiring patching shall be patched so that the surface is consistent and uniform throughout, matching the surface adjacent to the patched area.

1.07 SOILS ENGINEER

A. The Engineer will inspect subgrade and aggregate base prior to installation of paving.

1.08 LAYOUT OF THE WORK

A. A licensed surveyor or registered civil engineer shall lay out and establish all lines, levels, grades and positions of all parts of the work.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Portland cement, concrete and reinforcing shall conform to applicable requirements set forth in Section 90 1 through 90 9 inclusive of the State Specifications, as well as to all supplementary requirements of this Specification.

B. Schedule:

Location	Min. No. of sacks of cement per Cu.Yd of Concrete	Minimum Strength in lbs. per Sq.In at 28 Days	Max. Size of Coarse Aggregates in Inches	Slump in Inches	Special Aggregate
Retaining Walls	5.5	3,000	1 ½”	4”	
Headers & Dividers	6.0	3,000	3/4”	4	
Broom Finish & Sandblast Paving	5.5	2,500			
Miscellaneous Footings	5.5	2,500	3/4	4	

C. Driveway aprons, public sidewalks and street curbing: Conform with city standard plans and specifications.

2.02 BASE COURSE

A. Untreated base courses shall be installed under paving where indicated in the Drawings. Material shall be 1 1/2 inch maximum size broken stone or crushed gravel conforming to the requirements of Class 2 aggregate base of Section 26 1 of the State Specifications.

2.03 REINFORCEMENT

A. Bars, mesh and wire shall be in accordance with Section 52 1.01 through 52 1.08F inclusive, of the State Specifications.

2.04 FORMWORK

A. Plywood: 5-ply, 5/8 inch thick minimum, moisture resistant 'Plyform'.

B. Lumber for Formwork: Construction grade Douglas Fir.

2.05 MIX DESIGN

A. Concrete mixtures except for lean concrete shall be signed by a testing laboratory approved by the District's Representative. Mixes shall be verified by actual tests on cylinders prior to placing concrete, and compression tests shall show values at least 25 percent greater than the minimum strength indicated or specified. Mixes shall conform to governing building code requirements and to the most recent ACI Standards' publication, and shall be approved by the District's Representative. Contractor shall pay the testing laboratory for cost incurred for the mix design.

B. The amount of fine and coarse aggregates shall be proportioned with respect to each other and with respect to the water content, so that the concrete may be placed without segregation, but in no case shall the volume of the fine aggregates be less than 35 percent of the sum of volumes of fine and coarse aggregates when measured in loose, dry volumes before being combined. The amount of aggregates before combining shall not exceed 6 ½ cubic feet per each sack of cement.

C. Water, including moisture contained in the aggregate, shall not exceed the amounts specified in Table 502 (a) of the ACI Building code 318.

2.06 BATCHING AND MIXING

A. General: Except as otherwise specified, concrete shall be ready-mixed or job-mixed in accordance with requirements of the governing building code and ACI 318, most recent publication.

B. Ready Mixed Concrete:

C. Ready-mixed concrete shall be mixed and delivered to the point designated as specified in ASTM C94.

D. Do not add water on the job unless authorized by the Construction Manager. The amount of water, if added, shall be recorded on the delivery ticket. If water is permitted to be added to mixed concrete upon arrival at the job, an additional mixing of 20 revolutions of the drum shall be required.

E. Furnish duplicate delivery tickets with each load of concrete delivered to the job, one for the Contractor and one for the District's Representative. Delivery tickets shall provide the following information:
   1. Date
   2. Name of ready-mix concrete plant
   3. Job location
   4. Contractor

5. Type and brand name of cement
6. Class and specified cement contents in bags per cubic yard of concrete
7. Truck number
8. Time dispatched and time unloaded
9. Amount of concrete in load in cubic yards
10. Admixtures in concrete, if any
11. Maximum size of aggregate and amount of aggregate of each size per cubic yard
12. Water added at job, if any

2.07 PREMOULDED EXPANSION MATERIAL

A. Wood Fiber, asphalt impregnated; with removable polystyrene strip mechanically attached to the top edge.

2.08 SEALANTS

A. Horizontal and vertical surfaces not exceeding 1" wide and ½ deep: One (1) part, self leveling, non sagging, puncture resistant polyurethane; specifically designed for the use intended; color to match adjacent concrete.

B. Horizontal and vertical surfaces exceeding 1" wide and ½ deep: Two (2) parts, self leveling, non sagging, puncture resistant polyurethane; specifically designed for the use intended; color to match adjacent concrete.

C. Testing: provide test data to demonstrate that the sealant being proposed will adhere to the surfaces to which it will be applied.

2.09 BACKER ROD

A. Butyl rubber; material shall not react chemically with the sealant.

2.10 INTEGRAL COLORING MATERIAL

A. Light fast, lime proof, finely divided mineral oxide terrazzo matrix coloring.

2.11 SAFETY STRIP FOR STAIR NOSING

A. Safety strip for stair nosing, type 24 extruded anchor (meets Title 24 for visually impaired) as manufactured by American Safety Tread Company, Helena, Alabama 35080.Telephone 1-800-245-4881.

2.12 DAMPPROOFING

A. Manufacturer: BASF Construction, Chemicals, LLC Building systems, 889 Valley park Drive, Shakopee, MN 55379.

B. Product: Hydrocide 700B; cold applied emulsified asphalt sub-grade dampproofing, ASTM D1227, Type 2, Class 1 and ASTM D 1187, Type 1. 30-35 FT2 per coat, 0.74-0.87 M 2/L per coat (2 coats required). Color: Black. VOC Content: 0.20 lbs/gal or 24 g/l. Shall qualify for LEED EQ Credit 4.2.

PART 3 - INSTALLATION

3.01 INSPECTION

A. Examine the substrate under which concrete work is to be installed. Notify the District's Representative, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 LINES AND LEVELS

A. Finished grades shown on the Drawings are given in feet and decimals of feet and are to be the top of all graded or paved surfaces. Slope uniformly between given spot elevations unless otherwise indicated.

B. Surfaces shall be true to within 1/8 inch when tested in any direction with a 10 foot straightedge. There shall be no pools of water standing on the pavement after a rain.

C. Transition between changes in vertical gradient of walks and paving shall be smooth and gradual with no abrupt or sharp changes.

D. Horizontal curves and radii shall be laid out tangent to adjacent straight lines or adjacent compound curves. Curves shall be smooth and flowing.

E. Horizontal layout shall not vary more than l inch from dimensions indicated on the Drawings. Make minor field adjustments in the layout as necessary to make radii tangent and curves smooth and flowing as indicated on the Drawings.

3.03 SUBGRADE

A. Refer to preparation of Sub Grade, Section 31 00 00

B. Do not install base or paving until subgrade has been reviewed by the Soils Engineer.

3.04 BASE COURSE

A. Base course where required on the Drawings shall be of the compacted thicknesses shown on the Drawings. Base course shall be compacted by rolling or other approved method to 95 percent of compaction.

B. Conform to the requirements of Class 2 aggregate base of Section 26 1 of the State Specifications.

3.05 CONSTRUCTION

A. Forming, reinforcing, placing and curing shall conform to all pertinent requirements as set forth in Sections 40, 51, 52 and 90 of the State Specifications as well as to all supplementary requirements specified herein.

B. Formwork: Construct carefully so that straight lines are perfectly tangent to radii, curves are smooth and flowing, and transitions between changes in vertical gradient of curbs, walls, walks and paving are smooth and gradual with no abrupt or sharp changes.

C. Expansion Joints:

1. Hold joint filler straight, true to line and at proper level by stapling to 2X wood form; pour adjacent slabs separately.
2. Neatly tool edges of joint flush with removable strip.
   Carefully remove the removable strip when concrete is sufficiently set.
3. Avoid damaging tooled joint edges; any damaged edges shall be repaired to the satisfaction of the District's Representative.

D. Expansion Joints in Curbs & Headers:
   1. Install where shown on the Drawings; align with joints in adjacent paving.
   2. Where no joints are shown, install them at 20 feet on center.

E. Score marks: Sawcut straight lines; hone edges

3.06 FINISHES

A. Sandblast Finish:
   1. Extent: Where shown on the Drawings, and as indicated herein.
   2. Light sandblast: Remove approximately 1/16 inch of cement-sand matrix to expose aggregate face until aggregate is in uniform relief.
   3. Produce surface color and texture in a manner to duplicate District's Representative-approved sample panel.

3.07 SAFETY STRIP FOR STAIR NOSING

A. Work under this Section includes furnishing and installation of all sealants, backing rods, primers and associated work and materials in expansion joints in concrete work.

B. Prime joints and install per manufacturers printed instructions.

3.08 SEALANTS

A. Work under this Section includes furnishing and installation of all sealants, backing rods, primers and associated work and materials in expansion joints in concrete work.

B. Prime joints and install per manufacturers printed instructions.

C. Hold sealant flush with paving surface.

D. Sealant shall be smooth with no voids or irregularities.

3.09 DAMPPROOFING

A. Scope: All retaining walls and seat walls unless otherwise indicated on the drawings.

B. Preparation of Surfaces: All cracks, holes, voids, open areas and other defects in concrete surfaces to receive dampproofing shall be carefully repaired with Portland cement mortar, struck flush, and permitted to dry. Before applying dampproofing all such surfaces shall be dry, clean and free from dirt, grease, excess mortar and other foreign matter which might interfere with adhesion and penetration of the coating.

C. Application:
   1. Cover entire retaining surface of backside of walls from top of footing to finished grade with two brush coats of specified dampproofing. Apply according to this specification and non-conflicting requirements of manufacturer's printed instructions.

2. Apply first coat at minimum rate of 30 square feet per gallon of material. Brush into surface thoroughly making sure that coverage is uniform. Pay special attention to chases, reveals, recesses, joints and corners.
3. Allow first coat to dry for 24 hours and apply second coat at minimum rate of 35 square feet per gallon of material. Brush second coat at right angles to assure thorough coverage of entire surface. At completion, damproofing shall present a continuous, uniform, unbroken, impervious film, free from pinholes and other surface breaks.

3.10 CLEAN UP

A. At completion of work and/or when directed by the District's Representative, remove all surplus material, debris and rubbish resulting from work under this Section from the site.

END OF SECTION

SECTION 32 10 00

LANDSCAPE WOOD CONSTRUCTION

GENERAL

1.01 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

1.02 DESCRIPTION OF WORK

A. Work Included: All labor, materials and equipment necessary to complete the installation of carpentry work shown on the Landscape Drawings.

B. Work Specified Under Other Sections: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete, finished and workmanlike installation.

1.03 REFERENCES AND STANDARDS

The following references and standards are hereby made a part of this Section and wood construction material and installation shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings.

A. Lumber grading rules and wood species: Conform to Product Standard PS 20 70 AND "Standard Grading and Dressing Rules No. 16" of the West Coast Lumber Inspection Bureau (WCLIB).

B. Redwood: Conform to "Standard Specification of Grades of Redwood Lumber" of the California Redwood Association (CRA).

C. Conform to applicable requirements of local building code and Uniform Building Code, Chapter 25, latest edition, unless otherwise noted.

D. Manual of Millwork, Woodwork Institute of California, latest edition. (WIC)

E. Architectural Woodwork Quality Standards (AWI).

F. American Softwood Lumber Standard.

1.04 SUBMITTALS

A. Samples: submit samples of lumber and finishes for approval prior to delivery to the site.

B. Shop Drawings: submit shop drawings of the following:

1. Custom Wood Benches

C. Wood preservative treatment certification, in writing, by the plant(s) performing the wood preservative treatment(s) specified herein, will be required. Two copies of the certification shall be delivered to the District's Representative prior to each shipment of lumber, timber, or piles. Certification shall indicate that treatment applied complies with the criteria and physical requirements for ACQ (alkaline copper quaterney) preservative-treated wood products as specified herein.

1.05 QUALITY ASSURANCE

A. Lumber may be rejected by the District's Representative, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

B. Finished Carpentry shall conform with applicable sections of the manual for millwork.

1.06 PRODUCT DELIVERY AND STORAGE

A. Immediately upon delivery to project, place materials in staging area and protect from weather.

B. Protect all lumber stored on site from rain and excessive sun, and stack in such fashion as to prevent twisting and warping and avoid contact with the ground.

PRODUCTS

1.07 LUMBER

A. Dimensions:

1. Specified lumber dimensions are nominal.

2. Actual net dimensions for all lumber, including members with "resawn" surfaces, shall conform to industry standards established by the National Grading Rule Committee.

3. Softwood lumber shall conform to the American Softwood Lumber Standards.

B. Moisture Content:

1. Redwood: CRA grades as specified; kiln dried sizes 2 inches and smaller; maximum moisture content of 19 percent.

2. Other Species: WIC custom grade for opaque finish; maximum moisture content of 10 percent; species as scheduled.

C. Dressing: Lumber shall be dressed S4S, unless otherwise noted.

D. Species: Refer to the drawings.

E. Grading: Each piece of lumber for use in structural framing shall be graded and marked with the grade and trade mark of a lumber grading organization approved by the District's Representative, except that a certificate of grade furnished by such organization may be accepted in lieu of grade and trade marks when approved by the District's Representative.

F. Redwood beams, joists and posts: Select Heart.

G. Redwood slats: Select Heart

1.08 ROUGH HARDWARE

A. Furnish all nails, spikes, bolts, screws, and framing connectors of standard manufacture required to complete the Work.

B. Hot dip galvanize all items.

C. Joist Hangers and Framing Connectors: Simpson or equal, complete with required fasteners.

D. Mild Steel: ASTM A 283.

E. Steel Pipe: ASTM A 53.

F. Zinc Coated Sheet Steel: ASTM A 526, A 525, G90.

G. Bolts and nuts: ASTM A 307 78, Grade A.

H. Lag Bolts: Fed. Spec. FF B 561.

I. Nails: Fed. Spec. FF N 101, common unless otherwise noted or specified.

J. Explosive Driven Fasteners: Driv It, Omark, Ramset, Remington, or approved equal, each use and fastener type subject to prior approval by District's Representative.

1.09 SEALING

A. Stain for Wood Construction:
   1. Acceptable manufacturer: Pennofin or approved equal
   2. Color: Clear stain to be selected by District's Representative.

EXECUTION

1.10 GENERAL

Construction shall be in accordance with minimum requirements of the Uniform Building Code, latest edition. Contractor shall furnish and install adequate shoring, bracing, and formwork, for protection of life and property during construction, and is solely responsible for jobsite safety.

1.11 INSPECTION

Examine the substrate under which carpentry work is to be installed. Notify the District's Representative, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1.12 INSTALLATION

A. Install work in accord with approved shop drawings and referenced AWI Standards.

B. All carpentry work shall be carried out in a skillful manner. Horizontal and vertical members shall be plumb and true to line and grade. All joints shall be tight and accurately fitted. Shims will not be allowed unless specifically called for on the plans. All wood surfaces shall be sanded where necessary to remove undesirable rough edges. All knot holes, pitch pockets, or sappy portions shall be sealed with an approved resin sealer under natural finishes.

C. Metal work shall be fabricated to the details shown, shall have all brackets necessary for the attachment of woodwork.

D. Select individual pieces of lumber so that knots and obvious minor defects will not interfere with placing of bolts, proper nailing, or making of proper connections. In exposed locations, select for appearance satisfactory to the District's Representative.

E. Framing shall be closely fitted, accurately set in plumb planes to required lines and levels and rigidly secured in place. Beams shall be set with crowned edge up; bottom edges shall be free from pronounced defects. Special framing or construction, not explicitly shown or specified, shall be provided as directed by the District's Representative to complete work in the best workmanlike manner.

F. Provide all bolting, nailing and other fastenings required to complete the wood construction shown on the drawings.

G. Bolt holes shall be 1/32 inch to 1/16 inch larger than bolts, and shall be accurately located to permit proper alignment of members and easy driving of bolts. A standard cut washer, or the equivalent thereof, shall be installed between each bolt head and nut and wood. Bolts shall be taken up snug and shall be retightened at the latest practicable time during the construction work.
   1. Counter sink all bolt heads and nuts.
   2. Vandal proof all bolting and other connections by burring threads.

H. Holes, cuts, etc., made in lumber and posts, after wood preservative treatment, shall be heavily coated with a concentrated solution of the wood preservative used.

I. Nailing shall be done in a workmanlike manner, care being exercised to avoid splitting wood. All nailing clips, hangers, and the like shall receive full number of nails of proper size as furnished with clips or recommended in manufacturer's printed instructions.

J. Edges shall be rounded and smoothed.

K. Construct to WIC specifications for Custom Work.

1.13 SEALING

A. Preparation of Surfaces:
   1. General:
      a. Do not apply finish to wet, damp, oily, greasy, rusty, dusty, dirty, fingermarked, rough, un-finished or defective surfaces.
      b. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
      c. Correct minor defects and clean surfaces which affect work of this Section.
   2. Wood:
      a. Sandpaper smooth all exposed surfaces and remove dust. Seal knots and permissible pitch pockets with shellac or manufacturer's recommended knot sealer.

B. Sealing Schedule:
   1. General: Finish surfaces in accord with the following schedule:
      a. Wood: Once sanding and patching has been completed, prime with one coat and apply two coats of finish paint.
         1) Pretreatment as herein specified.
         2) Apply two coats of the sealer.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for furnishing, spreading, and compacting aggregate base course for pavements as indicated.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D3017 Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

B. State of California, Department of Transportation (Caltrans), Standard Specifications:

Section 17 Watering

Section 26 Aggregate Bases

C. State of California, Department of Transportation (Caltrans), Standard Test Methods:

Calif. Test 201 Method of Soil and Aggregate Sample Preparation Aggregates

Calif. Test 202 Method of Tests for Sieve Analysis of Fine and Coarse Aggregates

Calif. Test 205 Method of Determining Percentage of Crushed Particles

Calif. Test 216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates

Calif. Test 217 Method of Test for Sand Equivalent

Calif. Test 229 Method of Test for Durability Index

Calif. Test 301 Method of Test for Resistance “R” Value of Treated and Untreated Bases, Subbases and Basement Soils by the Stabilometer

PART 2 - PRODUCTS

2.01 AGGREGATE BASE MATERIAL

A. Class 2 aggregate base shall be free of vegetable matter and other deleterious substances. Coarse aggregate, material contained on the No. 4 sieve, shall consist of material of which 25

percent by weight shall be crushed particles as determined by California Test Method No. 205. Class 2 aggregate base shall conform to one of the following gradings, determined in accordance with California Test Method No. 202:

Percentage Passing Sieves for ¾" maximum

Sieve Sizes	
2 inch	**----**
1 ½ inch	**----**
1 inch	**100**
3/4 inch	**90-100**
No. 4	**35-60**
No. 30	**10-30**
No. 200	**2-9**

B. Class 2 aggregate base shall conform to the following additional requirements:

Tests	Test Method No. Calif.	Requirements
Resistance (R-Value)	301	78 min.
Sand Equivalent	217	22 min.

Tests	Test Method No. Calif.	Requirements
Durability Index	229	35 min.

2.02 SOURCE QUALITY CONTROL

A. Submit certificate of compliance for approval prior to installation of material.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Call for an inspection by the District's Design Consultant and obtain written acceptance of the prepared subgrade or subbase before proceeding with the placement of aggregate base course.

B. The subgrade or subbase to receive aggregate base course, immediately prior to spreading, shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.02 INSTALLATION STANDARDS

A. Aggregate base course shall be applied over the prepared subgrade or subbase and compacted in accordance with Section 26 of the Caltrans Standard Specifications.

B. Aggregate base course shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches for driveways/sidewalks and eight inches for roadways.

C. All compaction expressed in percentages in this section refers to the maximum dry density as determined by California Test Method No. 216.

3.03 SPREADING OF MATERIAL

A. Aggregate for base course shall be delivered as uniform mixture of fine and coarse aggregate and shall be spread in layers without segregation.

B. Aggregate base course material shall be free from pockets of large and fine material. Segregated materials shall be remixed until uniform.

C. Aggregate base material shall be moisture-conditioned to near optimum moisture content in accordance with the applicable requirements of Section 17 of the Caltrans Standard Specifications.

D. Aggregate base course six inches and less in thickness may be spread and compacted in one layer. For thicknesses greater than six inches, the base course aggregate shall be spread and compacted in two or more layers of uniform thickness not greater than six inches each.

3.04 COMPACTING

A. Relative compaction of each layer of compacted aggregate base material shall be not less than 95 percent as determined by California Test Method No. 216.

B. Thickness of finished base course shall not vary more than 3/4 inch from the indicated thickness at any point. Base which does not conform to this requirement shall be reshaped or reworked, watered, and recompacted to achieve compliance with specified requirements.

C. The surface of the finished aggregate base course at any point shall not vary more than 3/4 inch above or below the indicated grade.

3.05 FIELD QUALITY CONTROL

A. Perform field tests in accordance with ASTM D2922 to determine compliance with specified requirements for density and compaction of aggregate base material, and with ASTM D3017 to determine moisture-content compliance of the installed base course.

END OF SECTION

SECTION 32 12 16

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for providing asphaltic concrete paving as indicated.

1.02 RELATED SECTIONS

A. Section 32 11 23 – Aggregate Base

B. Section 32 17 23 – Pavement Marking

1.03 REFERENCES

A. State of California, Department of Transportation (Caltrans), Standard Specifications

Section 39	Asphalt Concrete
Section 92	Asphalts
Section 93	Liquid Asphalts
Section 94	Asphaltic Emulsions

B. State of California, Department of Transportation (Caltrans), Standard Test Methods

Calif. Test 202	Method of Tests for Sieve Analysis of Fine and Coarse Aggregates
Calif. Test 304	Method of Preparation of Bituminous Mixtures for Testing
Calif. Test 366	Method of Test for Stabilometer Value
Calif. Test 375	Determining the In Place Density and Relative Compaction of AC Pavement

1.04 PROTECTION

A. Protect concrete pavements and walks, curbs and bases, and other improvements adjacent to the operations with suitable materials. The Design Builder shall be responsible for any damage caused by the Design Builder's employees or equipment and shall make necessary repairs. Building and other surfaces shall be covered with paper or other protection, where required. All damage caused by the Design Builder's operations shall be prepared or replaced as required.

PART 2 - PRODUCTS

2.01 BASE COURSE MATERIAL

A. Class 2 Aggregate Base. Percentage composition by weight of aggregate base material shall conform to the 3/4 inch maximum grading when determined by California Test 202.

2.02 TACK COAT (VERTICAL SURFACES)

A. Tack Coat: Diluted SS-1 or SS-1h emulsion or undiluted RS-1 emulsion in conformance with Section 94 or the Caltrans Standard Specifications.

2.03 ASPHALT PAVING MATERIALS

A. Paving Asphalt: All purpose, aged residue, steam refined, PG 64-16 grade, in accordance with Section 92 of the Caltrans Standard Specifications.

B. Aggregate: Type A, with the grading of the combined aggregate conforming to 1/2 inch maximum size, medium grading, as specified in Section 39 of the Caltrans Standard Specifications.

C. Mixing Facilities: Asphalt concrete surfacing material shall be furnished from an approved commercial asphalt central mixing plant.

2.04 SOURCE QUALITY CONTROL

A. Design Builder shall submit Certificate of Compliance from manufacturer for approval prior to installation.

2.05 A.C.DIKE/BERM

A. A.C. dikes shall be per Caltrans Standard A87, Type B. Dikes shall be installed by means of a continuance automatic curbing machine.

B. A.C. berms shall be installed as detailed in the drawing.

PART 3 - EXECUTION

3.01 PLACING OF BASE COURSE

A. The Design Builder shall call for an inspection by the District's Design Consultant and obtain written approval of the subgrade before proceeding with the base course.

B. Base course shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches for parking stalls and eight inches for roads, driveways, and aisles of parking areas.

C. Base course shall be placed over finished subgrade and compacted in accordance with Section 32 11 00 - Aggregate Base.

D. After base course has been completed, the Design Builder shall call for an inspection by the District's Design Consultant and obtain written approval before proceeding with application of the asphalt wearing surface.

3.02 PLACING ASPHALT CONCRETE

A. Areas to be paved shall be covered with a layer of hot asphalt concrete surfacing not less than the thickness indicated after compaction. Where not indicated, compacted thickness shall be two inches for parking stalls and three inches for roads, driveways, and aisles of parking areas.

B. Paving asphaltic concrete shall be delivered, laid, rolled, and finished in accordance with Section 39 of the Caltrans Standard Specifications.

C. Before placing asphalt concrete, a tack coat (paint binder) shall be applied to all vertical surfaces against which asphalt concrete surfacing will be placed. Tack coat (paint binder) shall be applied in accordance with Section 39-4 of the Caltrans Standard Specifications at the rate of from 0.02 to 0.10 gallons per square yard.

D. Finish surface of the wearing course shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, cold joints, or other irregularities.

E. Finish paving shall conform to slopes, lines, and finish grades indicated, and shall drain properly. Where adjacent surfaces are intended to be flush (as at concrete gutters, walks, and paving), they shall conform smoothly at all joints.

F. Ridges, indentations, and other objectionable marks left in the surface of the asphalt concrete by paving or rolling equipment shall be eliminated by rolling. The use of equipment that leaves ridges, indentations, or other objectionable marks in the asphalt concrete shall be discontinued, and other acceptable equipment shall be employed.

G. Where cold joints are indicated or necessary, cut back the placed and compacted cold asphalt a minimum of three inches with a concrete or masonry power saw, so that a vertical face of compacted full thickness material is exposed. Treat this surface with a tack coat before proceeding with the placement of new asphaltic concrete surfacing.

H. Finish paving shall conform to finish elevations within plus or minus 0.01 of a foot and shall be level to within plus or minus 1/4 inch in 10 feet when measured with a 10 foot straightedge in any direction.

3.03 FIELD QUALITY CONTROL

A. The Design Builder shall control the quality of the work and shall provide adequate testing to assure compliance with these Specifications.

B. After completion of paving work, all paving shall be flooded with water, and any resulting “ponds” shall be ringed with chalk. Such hollows shall be corrected with addition of asphalt paving materials and rerolling until all paving is completely level and free from hollows and high spots.

C. The District’s Design Consultant shall perform in-place density and compaction tests of the completed pavement in accordance with California Test 375 to determine compliance with specified requirements. Test shall be performed as often as necessary to verify compliance, but not less frequently than the following:

1. One test for each street or driveway intersection for which asphalt pavement replacement is required.

2. One test for every 1,000 square yards of asphalt pavement at locations where the paved area exceeds 1,000 square yards.

3.04 MAINTENANCE OF PAVEMENT

A. Upon completion of final rolling, traffic shall not be permitted on the finished pavement for at least six hours, and until the asphalt concrete has cooled sufficiently to withstand traffic without being deformed.

B. Finished pavement shall be maintained in finished clean condition until the work is accepted by the District.

END OF SECTION

SECTION 32 14 00

UNIT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. The Work under this section is subject to requirements of the Contract Documents including the GENERAL CONDITIONS, SPECIAL CONDITIONS, and sections under Division 1 - GENERAL REQUIREMENTS.

B. Work Included: All labor, materials and equipment necessary to complete the installation of unit pavers and assembly types as shown on the Landscape Drawings and herein specified.

1.02 ACTION SUBMITTALS

A. Shop Drawings: Indicate locations of required access doors not shown on the Drawings.

B. Sustainable Design (LEED):
   1. Submit information necessary to establish and document compliance with the LEED Certification goals for this Project.
   2. LEED design submittals are in addition to other submittals.

C. Product Data: Submit manufacturer's technical data for each manufactured product, including certification that each product complies with specified requirements.

D. Samples: Demonstrate complete range of color and textural variation to be expected in the final work for each paver manufacturer and required.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Installer who has successfully completed within the last 3 years at least 3 unit paver applications similar in type and size to that of this project and who will assign mechanics from these earlier jobs to this project, of which one will serve as lead mechanic.

B. Field-Constructed Mock-Up: Prior to installation of Work, provide one 8 ft. by 8 ft. mock-up of structured courtyard paver assembly using materials, pattern and joint treatment approved for final work, include joints at contiguous work

   1. Obtain Architect's approval of visual qualities of mock-up before start of unit paver work.
   2. Approved mock-up may be incorporated into final Work.

PART 2 - PRODUCTS

2.1 CONCRETE UNIT PAVERS

A. Manufacturer: Stepstone Inc., 17025 So. Main Street, Gardena, CA 90248, phone: (310) 327-7474, or District Approved Equal

B. Product: Large Scale Narrow Modular Pavers 12”x48”

1. Color: Almond 1406
2. Size: 12”x48”x2-1/2”
3. Finish: Light. Sandblast w/ Slag
4. Layout Pattern: Running bond per plan

C. Product: Truncated Dome Pavers

1. Color: Charcoal Light Sandblast 1811
2. Size: 11 7/8” x 11 7/8” x 2”
3. Finish: Light. Sandblast
4. Layout Pattern: Per Manufacturer

D. Sealer: All unit paving shall be sealed with a sand binder sealer as recommended by the manufacturer to achieve the protection and color as reviewed by the District’s Representative.

E. Base in ‘on-Grade’ Areas: Untreated base courses shall be installed under paving where indicated in the Drawings. Material shall be 1 ½ inch maximum size broken stone or crushed gravel conforming to the requirements of Class 2 aggregate base of Section 26-1 of the State Specifications.

F. Setting Bed: Sand setting bed and sand to be brushed into joints shall be: ASTM C33, sharp crushed sand No. 30 by No. 8, permeability of 0.15 gpm/sf at a hydraulic gradient of one, clean, sterile, and free of contaminants that could promote biological growth.

Sieve Size		
Inches	Millimeters	Percent Passing
½”	12.5	100%
3/8	9.5	99%
#4	4.75	14%
#8	2.36	1%
#16	1.18	1%
#30	0.60	1%
#50	0.30	1%
#100	0.15	1%
#200	0.075	0.6%

E. Soil Filter Material: Mirafi Filterweave FW 700 (in lightweight soil mixes) and 140N (earth) Drainage Fabric, as manufactured by TC Mirafi (706) 693-2226. Local Representative: John Towns & Associates (800) 222-6036 or District Approved Equal.

F. Herbicide: Pre-emergency herbicide, registered for use required.

2.3 METAL HEADERS

A. Metal Headers: 3/16” x 4” (3.2 MM x 89 MM), 0.060” (1.52 MM) Thick w/ 0.200” (5.08 MM) Exposed top lip w/ 12” stakes. As manufactured by Permaloc Corporation, Holland, MI. (t)800.356.9660, (616)399.9600. www.permaloc.com. Finish: Mill finish per manufacturer or District Approved Equal.

PART 1 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces to receive paving comply with Project requirements; beginning installation of unit pavers will be interpreted as installer's acceptance of conditions.

3.2 PREPARATION

A. Remove contaminants and substances that could impair performance of installed paving system.

B. Proof roll prepared subgrade, do not install unit pavers until completely compacted and unstable areas have been corrected.

1. Comply with requirements of Section 02200 Earthwork for subgrade preparation for paving not on structured deck.

C. Apply herbicide over aggregate base prior to installation of pavement, comply with manufacturer's recommendations and requirements agencies regulating use of herbicides at the Project.

3.3 INSTALLATION

A. Comply with recommendations of National Concrete Masonry Association Tek Bulletins 75, and 87A.

B. Base: Place to minimum depth required on compacted subgrade, and to provide required finish grade; compact to 100 percent of ASTM D 1557 maximum laboratory density.

1. Pedestrian Section On-Grade: 12 inches minimum depth base rock. Refer to details.

C. Edging: Ensure that all pavement edges are restrained with paving, or metal edging. On edges where no concrete occurs, install metal headers as shown in the details. Refer to section 2.3 Metal Headers.

E. Filter Fabric: Comply with manufacturer's recommendations; overlap joints 3 inches; flash fabric into terminations, and penetrations as indicated, and necessary to provide a contiguous filter layer.

1. ‘On Grade’: Install soil filter material in a continuous layer between aggregate base and sand leveling bed.

F. Setting Bed: Place loose and screed to uniform depth indicated, but not less than 0.5 inch, do not compact until pavers are installed.

G. Pavers: Full-size units to greatest extent possible, install hand tight, in pattern indicated, with uniform joints and surfaces; do not disturb leveling base. Blend color and texture variations of units.

1. Cut pavers with masonry saw, provide clean, sharp, unchipped edges.
2. Spaces between the pavers shall not be greater than 1/8". Spacers are provided by Stepstone for installation. Narrow Modular Pavers by Stepstone® are to be laid with even bearing, supported equally, and with proper containment.

I. Vibrate pavers into sand setting bed with a plate vibrator capable of a 3,500 to 5,000 lb. compaction force. Perform this operation on installed areas of paving at end of each day, and before any rain.

J. In on-grade areas, brush joints with setting bed sand after vibration, brush and vibrate until joints are completely filled.

K. Tolerances: Do not exceed 0.0625 inch unit-to-unit offset from flush, and 0.25 inch in 10 feet from elevation, and slope indicated for paving surface, and plus or minus 0.0625 inch in joint width.

L. Prevent displacement and damage to pavement; protect areas subject to construction traffic.

3.4 METAL HEADERS

A. Install headers true to line and grade as indicated on the Drawings and per manufacturer's instructions.

3.5 CLEANING

When work is otherwise complete, clean entire paver installation using no acid or acid cleaners except that mild acid cleaners may be used for pavers where so recommended by manufacturer.

3.6 FIELD QUALITY CONTROL

A. Remove and replace loose, stained, damaged, misaligned and unmatched unit pavers. Undamaged pavers may be reused when acceptable to District's Representative.

B. Provide final protection and maintain conditions in a manner acceptable to District's Representative. Ensure unit paver work is without damage, and deterioration at time of substantial completion.

END OF SECTION

SECTION 32 16 13

CONCRETE CURBS, GUTTERS, AND WALKS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for providing portland concrete curbs, gutter, sidewalks, driveways, and island paving, as indicated.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete

B. Section 32 11 23 - Aggregate Base

1.03 REFERENCES

A. American Concrete Institute (ACI):

ACI 301	Standard Specifications for Structural Concrete
ACI 318/ 381R	Building Code Requirements for Structural Concrete and Commentary

B. American Society for Testing and Materials (ASTM)

ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
ASTM A615/ A615M	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A663/ A663M	Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C881	Specification for Epoxy-Resin-Base bonding Systems for Concrete

C. UCS Marin County Uniform Construction Standards, May 2008

1.04 SUBMITTALS

A. Product Data

Respective manufacturer’s product data for manufactured products.

1.05 QUALITY ASSURANCE

A. Tolerances

1. Construct concrete surfaces within 1/4 inch of the indicated elevation, and deviating not more than 1/8 inch from a 10 foot straightedge placed anywhere on the surface.

2. Slab tolerances shall be as specified in ACI 301.

B. Finishes

Slab finishes shall be as specified herein accordance with the requirements of ACI 301.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide Class of Concrete indicated on the Contract Drawings or Construction Drawings.

a. Provide air-entrainment of three percent (± one percent) with admixture conforming to ASTM C260.

b. Nominal size of large aggregate shall be 1”.

c. Minimum total cement content shall be 520 pounds per cubic yard of concrete.

d. Minimum strength of concrete shall be 3000 psi.

B. Tie Bars

ASTM A615, Grade 60, of type and size indicated.

C. Dowels

Plain round bars meeting requirements of ASTM A615/A615M, Grade 60, of ASTM A663/A663M, Grade 80, epoxy-coated bars, furnished with approved snugfitting ASTM A53 galvanized pipe sleeve. Provide sleeve with one end closed.

D. Weep Holes

ASTM A53 galvanized pipe of size indicated.

E. Concrete Curing Compound

ASTM C309, Type 1.

F. Epoxy Adhesive

ASTM C881, Type V for load bearing concrete, Grade and Class as determined by project conditions and requirements.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBGRADE

A. Excavate for and prepare the subgrade as specified true to the indicated grade and cross section.

B. Test completed subgrade for correct grade and cross section by means of template supported on side forms.

C. Dampen subgrade and forms just before placing concrete.

3.02 TYPES OF CONSTRUCTION

A. Provide cast-in-place concrete construction, plain or reinforced as indicated. Curbs, gutters, and walks shall be formed accurately to indicated section profile with template screed.

B. Extruded curbs and gutter, placed by an extrusion machine, may be provided where site conditions are suitable and the extrusion process is appropriate for the purpose.

3.03 JOINTS

A. Expansion Joints

1. Construct ½ inch thick expansion joints in the following locations:

   a. In curb and combination curb and gutter at the locations of expansion joints in the concrete roadway.

   b. In curb or combination curb and gutter, at points where curved and tangent sections join.

   c. Between curb or combination curb and gutter, and any drain inlet, or similar structure occurring within the limits of the curb or combination curb and gutter.

   d. At corners in sidewalks, following the projections of the building lines from the corner of the building to the curb.

   e. Between sidewalks and any permanent structure.

   f. Between sidewalk and curb.

2. Construct 1/4 inch thick expansion joints in the following locations:

   a. Through sidewalks at intervals not greater than 15 feet.

   b. In sidewalks, encircling fixtures more than 12 inches in diameter.

3. Construct expansion joints as specified in UCS, except that load transfer devices will not be required unless indicated. Shape performed filler to cross section of curbs and combination curb and gutter.

B. Contraction Joints

In sidewalks, construct contraction joints in uniform intervals not greater than six feet, by means of a suitable tool which will form a groove 1/2 inch deep and 1/4 inch wide, with the edges rounded to a 1/4 inch radius.

C. Tooling

Finish joints with an edging tool having 1/4 inch radius, leaving joints free of mortar and concrete. In preformed type joints, leave joint filler material exposed for full length of joint with clean and true edges.

D. Joint Sealing

1. Seal to within 1/8 inch of pavement surface all joints in curbs and gutters, including gutter surfaces of combination curb and gutter sections, all joints between curbs and vehicular pavement, all joints between gutters and vehicular pavement, and all other expansion joints. Do not seal other joints unless so indicated.

2. Do not seal joints until concrete curing is complete. Prior to installation of the joint sealing compound, clean the joints of dirt and other foreign material. Joints may be cleaned with compressed air jets provided that the air in such jets is free of oil or water. Do not fill joints when there is any free water in or adjacent to joints. Joint walls and all surfaces to which the sealing material is to adhere shall be surface dry for at least three hours prior to sealing.

3. Apply with approved pressurized equipment. Perform sealing joints to make them impervious to water and to prevent the sealing compound from spreading over the surface of the pavement.

3.04 FORM REMOVAL

A. Remove front curb forms not less than two or more than six hours after placing concrete, but in no case while the concrete is still plastic enough to slump.

B. Remove other forms not less than 12 hours after finishing is completed.

3.05 FINISHING

A. Curb and Combination Curb and Gutter:

1. Trowel the face of curb smooth to a depth of not less than two inches below the flow line, or the flow line of integral curb and gutter, and finish with a steel trowel, all immediately after removal of front curb forms.

2. Finish all curb edges with a radius of 1/2 inch.

3. Provide a final fine brush finish to both top and face of curb with brush strokes parallel to the line of the curb, so that both top and front face present the same uniform appearance.

4. Keep the curb face wet during above finishing operations.

5. Allow no coarse aggregate to show on the finished curb surface.

B. Sidewalk, Island Paving and Ramps

1. After the concrete has been placed, consolidated, struck off, leveled, grooved and edged as specified herein, and in UCS, do not work the concrete further until ready for floating.

2. Provide “floated finish” or light “broom finish” as indicated in accordance with the requirements of ACI 301.

3. For pedestrian and wheelchair ramps, and all other surfaces where the Contract Drawings require a non-slip finish, provide a “non-slip finish” in combination with a “floated finish” or “broom finish” in accordance with the requirements of ACI 301.

4. Broom finish shall be applied perpendicular to the direction of traffic flow.

C. Joints and Edges

As soon as the condition of the work permits, perform joint work, edging and marking. Finish all edges with a radius of 1/4 inch.

3.06 CURING AND PROTECTION

A. Comply with the applicable requirements for curing concrete with liquid membrane-forming curing compound. Do not permit traffic on new concrete pavement until the concrete has cured a minimum period of ten days.

B. Provide damp curing only for concrete slab surfaces indicated to be treated with concrete hardener and dust proofer.

3.07 FIELD QUALITY CONTROL

A. The District’s Design Consultant shall perform inspections and tests. The Design Builder shall provide such samples and services to facilitate testing.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for providing traffic striping and control markings on pavement, parking stall striping, and painted curbs as indicated.

1.02 RELATED SECTIONS

A. Section 32 12 16 – Asphaltic Concrete Paving

1.03 REFERENCES

A. State of California, Department of Transportation (Caltrans), Standard Specifications/ Manuals

Section 84 Traffic Stripes and Pavement Markings

Section 85 Pavement Markers

Traffic Manual Standard Drawings Latest Edition

B. State of California, Department of Transportation (Caltrans), Standard Test Methods

Calif. Test 669 Testing for Specification Compliance of Non-Reflective and Reflective Pavement Markers

C. California Air Resources Board (CARB)

CARB/VOC Permissible Content of Volatile Compounds (VOC in Paints)

1.04 SUBMITTALS

A. Shop Drawings

Submit drawings and diagrams, indicating stripe width of roadway divider stripes and parking stalls, configuration and dimensions of directional arrows, style and size of letters for “compact car” designation, configuration and dimensions of international handicapped symbol, and any other traffic control markings on pavement, such as “in” and “out” or “enter” and “exit” designations.

B. Certificate of Compliance

Submit evidence or affidavit which certifies that paint to be used complies with latest CARB/VOC regulations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Traffic Line Paint

Provide paint conforming to the requirements of Section 84 of the Caltrans Standard Specifications, white in color for traffic striping, parking stalls, and other control markings on pavement, yellow in color for traffic control markings where indicated, blue in color for handicapped parking stalls, red in color for curbs where no parking is indicated, white in color for curbs where passenger discharge and pickup is indicated.

B. Thermoplastic Traffic Stripes and Pavement Markings

Provide thermoplastic traffic stripes and pavement markings where indicated, including glass beads, conforming to the requirements of Section 84 of the Caltrans Standard Specifications.

C. Paint for parking stalls and ADA Striping shall be waterborne, white, State Specification PTWB-01R2 (March 2010)

D. Markers

Provide markers and adhesive in accordance with Section 85 of the Caltrans Standard Specifications.

Markers for hydrants 4" x 4" x ¾", blue prismatic, high-impact plastic conforming to ASTM D-788, Grade 8 and shall conformed to the local Fire Protection District Standards. The hydrant markers shall be attached to the pavement using a hot melt bituminous adhesive conforming to Section 85 of the Standard Specifications.

PART 3 - EXECUTION

3.01 APPLICATION

A. Provide traffic striping and control markings on pavement and parking stalls in accordance with the layout, configurations, and dimensions indicated on the Contract Drawings or Construction Drawings and approved shop drawings.

B. Paint application equipment shall conform to the requirements of the Caltrans Standard Specifications. Place markers in accordance with Section 85 of the Caltrans Standard Specifications.

C. Traffic control markings and parking stalls shall be applied with the use of substantial cutout patterns and templates, or with striping equipment which applies straight, uniform width, sharp lines. Coverage of paint shall be thorough and complete in accordance with the paint manufacturer's instructions and recommendations.

D. Where "enter" and "exit" control markings are side-by-side on pavements, indicating two-way traffic, such as "enter and "exit" designations shall be different colors, such as white and yellow, with a centerline separating the two directions of traffic.

E. Traffic control markings and parking stalls shall be sharp and accurate, straight where required, without fuzziness at edges of lines.

F. Accessible parking stalls shall include the International Accessible Symbol.

G. At completion, Design Builder shall check the work thoroughly and shall touch-up traffic control markings and parking stalls which are not distinct or thorough in coverage, or which are not uniform in color.

H. Pavement markers shall be placed according to the State Traffic Manual details, except as modified by the project plans or District's Design Consultant. All missing and/or broken reflectors shall be replaced with in the project limits. The blue reflector shall be installed in the center of the traffic lane adjacent to each fire hydrant. It is the Design Builder's responsibility to locate each fire hydrant. Pavement markers shall be applied within four days of resurfacing.

3.02 FIELD QUALITY CONTROL

A. Perform tests in accordance with Caltrans Test 669 to verify compliance with Specification requirements.

END OF SECTION

SECTION 32 31 20

MISCELLANEOUS LANDSCAPE METAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

The general provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

1.02 DESCRIPTION OF WORK

A. Work Included: All labor, materials and equipment necessary to complete the installation of miscellaneous metal work shown on the Landscape Drawings.

B. Work Specified Under Other Sections: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete, finished and workmanlike installation.

1.03 REFERENCES AND STANDARDS

The following references and standards are hereby made a part of this Section and miscellaneous metal material and installation shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings.

A. Shop detailing and fabrication practices: Conform to the standards of the National Association of Architectural Metal Manufacturers (NAAMM) in the Architectural Metal Handbook, latest edition.

B. Welding: Conform with requirements of the American Welding Society.

C. "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", American Institute of Steel Construction, latest edition.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings of the following:

1. Stair Handrails
2. Custom Wood Bench Hardware

1.05 QUALITY ASSURANCE

A. Materials and Fabrication: Conform to the requirements specified for the particular item; and where these requirements are not specified in detail, the materials shall be suitable for the intended usage of the item and be of first quality workmanship.

1.06 PRODUCT DELIVERY AND STORAGE

A. Protect metal work at all times. Damaged work will be rejected.

PART 2 - PRODUCTS

2.01 STEEL

A. Structural Steel, Rolled Shapes: ASTM A 36.

B. Steel plates, shapes and bars: ASTM A 36.

C. Steel plates to be bent or cold formed: ASTM A 283, Grade C.

D. Steel bars and bar size shapes: ASTM A 306, Grade 65, or ASTM A 36.

E. Steel tubing: (Hot formed, welded or seamless), ASTM A 501.

2.02 STAINLESS STEEL: AISI NO. 316 WITH NO 4 POLISH FINISH BOTH SIDES; ASTM A 240.

A. Handrails and Guardrails

2.03 ROUGH HARDWARE

A. Furnish all nails, spikes, bolts, screws, and framing connectors of standard manufacture required to complete the work.

B. Hot-dip galvanize all items after fabrication.

C. Custom Wood Bench Bolts and Nuts: ASTM A307, standard steel washers shall be used on all trellis bolts except where nuts and bolt heads are in contact with steel plates.

D. Lag Bolts: Fed. Spec. FF-B-561.

E. Nails: Fed. Spec. FF-N-101, common wire nails. Nail holes shall be sub-bored where necessary to avoid splitting. Split pieces shall be removed and replaced.

2.04 MISCELLANEOUS MATERIALS

A. Grout: Non shrink, non metallic, ASTM C 109, C 827, C 191.

B. Isolator for metals causing electrolytic action: Asphalt bitumen emulsion.

C. All bolts and screws for attachment of galvanized items shall be galvanized or of approved non corrodible material which will not cause galvanic action.

2.05 GALVANIZING

A. All steel and ferrous metal items fabricated and/or furnished under this Section shall be galvanized by the hot dip process, conforming to ASTM A 123. Galvanizing shall be done after fabrication, in the largest sections possible. Items too large for available dip tanks shall be sprayed, by approved methods, with molten zinc to coating thickness of .003" to .004". Weight of the zinc coating per square foot of actual surface shall average not less than 2.0 ounces and no individual specimen shall show less than l.8 ounces.

2.06 BONDERIZING

A. All ferrous metal surfaces including galvanized surfaces to be painted shall be thoroughly chemically cleaned and bonderized prior to application of the shop prime coat. Bonderizing shall conform to Federal Specification TT C 490, Type I and II, as applicable.

2.07 WELDING

A. Welding shall be in accordance with the "Structural Welding Code", American Welding Society, latest edition.

2.08 PAINTING

A. Acceptable Manufacturers: Tnemec Company, Napa, California and Kansas City, Missouri, or District Approved Equal. Color to be selected by District's Representative

B. Acceptable Materials for Ferrous Metals: or District Approved Equal.
   1. Polyamide Cured Epoxy (Tnemec Series 66), Solids by Volume: 54% minimum.
   2. Alipatic Polyester Based Polyurethane (Tnemec Series 70. Solids by Volume: 54% minimum.
   3. Color: to be selected by District's Representative.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the substrate under which miscellaneous metal work is to be installed. Notify the District's Representative, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 FABRICATION

A. Provide all miscellaneous steel angles, channels, tees, zee bars, plates and shapes, threaded rods, pipe, tubes, bolts, nuts, washers, spacers, and fastenings required to complete the work whether shown on the drawings or not.

B. Shop Assembly Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and power driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Slotted inserts shall be of types required to engage with the anchors.

C. Dissimilar Metals Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure treated wood or absorptive materials subject to wetting, the surfaces shall be protected with non absorptive tape, heavy bodied bituminous tape, or zinc chromate primer.

D. Perform work using mechanics particularly skilled in type of work required. Insofar as possible, fit and shop assemble, ready for erection. Make jointings and intersections accurately, tightly fitted, and in true places with adequate fastenings. Unless otherwise shown or specified, use

flat and countersunk head bolt or screws wherever exposed. Provide all cutting, punching, drilling and other work for attachment of work of other trades to architectural metals work.

E. Install work plumb, true to line and grade, rigidly and
   1. permanently secured.

F. Make neat and regular joining and mitering where required and only those welds necessary for fabrication of the metal units will be allowed. Do not construct or cut sections of material, for galvanizing or for any reason, so that welds in addition to those above specified will be required.

G. GIve particular attention to the finish of the exposed edges, corners, and surfaces. Any imperfections or roughness thereof shall be ground smooth. All edges and corners shall be rounded off.

H. Shop prime all items to be painted.

3.03 FIELD GALVANIZING

A. All galvanized metal work that requires field soldering or welding shall have galvanizing thus damaged restored by field cold galvanizing with Ferraloy Tin Easy Fluid, or Galvaloy.

3.04 PAINTING

A. Preparation of Surfaces:
   1. General:
      a. Do not apply finish to wet, damp, oily, greasy, rust, dusty, dirty, fingermarked, rough, unfinished or defective surfaces.
      b. Correct minor defects and clean surfaces which affect work of this Section.
   2. Metal:
      a. Unprimed ferrous metal: Clean surfaces in accord with SSPC-SP3 "Power Tool Cleaning".
      b. Shop-coated metal: Thoroughly remove all oil, grease, dirt and foreign matter. Touch up field connections, welds, soldered joints, and burned and abraded portions with the same type paint materials as used in the shop coats. Sand surfaces for succeeding coat.
      c. Galvanized metal: Remove surface contamination and oils and wash with solvent. Provide phosphate treatment in accordance with Military Spec. MIL-P-15328. Touch up field connection welds, soldered joints and burned and abraded portions with the specified touch-up primer.

3.05 PROTECTION

A. Protect finished installation from damage until final acceptance of entire project.

END OF SECTION

SECTION 32 70 01

SITE FURNISHINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

The general provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this section.

1.02 DESCRIPTION OF WORK

The general provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this section.

A. Work Included: Furnish all labor, tools, equipment, material and transportation and perform all operations necessary and incidental to proper execution and completion of all work in accordance with the Drawings and Specifications.

B. Work Specified Under Other Sections: Consult all other Sections, determine extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete, finished and workmanlike installation.
   1. Concrete Paving Section 32 05 24

C. All equipment to be furnished and installed in accordance with the manufacturer's instructions.

D. Close cooperation between subcontractors is required for the proper sequence of installing various equipment. The contractor shall be responsible for coordinating the installation of these items of equipment to avoid any time lost, delays in completion, or damage to previously installed work.

1.03 SUBMITTALS

The general provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this section.

A. Shop Drawings: Submit shop drawings of all manufactured site furnishings as indicated on drawings, including but not limited to all footings, post, piers, play equipment, benches, tables, drinking fountain, trash containers, bridges, storage enclosure, etc. Complete manufacturer's literature, specifications and finishes for site furnishings for review prior to delivery to the site.

B. Shop Drawings: Submit shop drawings of all manufactured site furnishings as indicated on drawings, including but not limited to all footings, post, piers, play equipment, benches, tables, drinking fountain, trash containers, bridges, storage enclosure, etc.

C. No equipment shall be installed other than equipment specified without written approval by the Landscape Architect.

1.04 PRODUCT DELIVERY AND STORAGE

A. Deliver, store and protect site furnishings from damage and weather prior to installation or setting. Damaged products will be rejected.

PART 2 – PRODUCTS

2.01 BIKE RACKS

A. Manufacturer: Bikeparking.com, Palmer Group, LLC, 415.333.6428 or District Approved Equal.

B. Model: Welle Circular Rack, Square Tube w/ Surface Flange

C. Finish: Powdercoat T357-GR105 Silver Metallic. Submit color samples for District Representative approval.Approval.

D. Qty: 4

2.02 BIKE STORAGE LOCKERS

A. Manufacturer: Dero, San Francisco, CA, 415.425.7562, peter@dero.com, https://www.dero.com/contact/ or District Approved Equal.

B. Model: Dero Bike Locker 33, Surface mount..

C. Finish: Powdercoat Silver. Submit color samples for District Representative approval.

D. Qty: 2

2.03 FIBERGLASS PLANTERS

A. Fiberglass Planters: As manufactured by Tournesol Siteworks LLC. 30955 San Antonio Street, Hayward, CA 94544. T 800.542.2282 or District Approved Equal.

1. Planter: Fiberglass Reinforced Planter, Model: Wilshire Rectangles Four. WR-482424 (96”x 24”x 24” height). Options: 2 Drain holes. Color: Shadow. Texture: T-0. Qty: 7. Submit color samples for District Representative approval.

PART 3 -- EXECUTION

3.01 GENERAL

A. Coordinate delivery and installation of site furnishings with other site work. Avoid too early installation and undue exposure to damage.

B. Verify location of site furnishings and obtain the Owner Representative’s approval thereof prior to final installation.

C. Replace damaged furnishings; no patching or repair will be allowed.

D. Install all items plumb, and true to line and grade.

E. Installation of individual equipment shall be installed as per manufacturer's specifications and as per plans and details. Contractor to verify that manufacturer's recommendations are current at time of construction.

END OF SECTION

SECTION 32 93 00

PLANTING

PART 1 - PART 1--GENERAL

1.01 RELATED DOCUMENTS

The general provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

1.02 DESCRIPTION OF WORK

A. Work Included In This Section: Furnish all labor, tools, equipment, material, and transportation and perform all operations necessary and incidental to proper execution and completion of all work in accordance with the Drawings and Specifications.

B. Related Work Specified Under Other Sections: Consult all other sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a finished, workmanlike installation.

C. The Contractor shall exercise care when working in areas adjacent to existing planting and irrigation to remain. Existing trees, shrubs, lawns and other plant materials to remain shall be protected at all times. Irrigation lines servicing existing planting areas to remain shall be cut and temporarily capped during demolition and restored to full operation under this contract, unless specifically noted on the plans as being otherwise. Contractor shall provide temporary irrigation in these areas until irrigation can be fully restored. Existing plant materials shall be maintained in a healthy condition, unless otherwise noted on the plans as being removed or replaced. Surveys do not fully document the existing irrigation system. The Contractor shall consult with the Owner and their maintenance staff for irrigation requirements in areas where new construction affects existing irrigation that is to remain.

1.03 REFERENCES AND STANDARDS

A. Compost: is the product of controlled biological decomposition of organic materials, often including urban plant debris and food waste. It is an organic matter resource that has the unique ability to improve the chemical, physical and biological characteristics of soils or growing media. It contains plant nutrients, but is typically not characterized as a fertilizer.

B. Integrated Pest Management: is a holistic approach to mitigating insects, plant diseases, weeds, and other pests. It involves the use of many strategies for managing, but not eliminating pests. Integrated Pest Management (IPM) uses cultural, mechanical, physical, and biological control methods before using pesticides to control pests and diseases in the landscape. Chemical controls are applied only when monitoring indicates that preventative and non-chemical methods are not keeping pests below acceptable levels. When pesticides are required, the least toxic and the least persistent pesticide that will provide adequate pest control is applied.

C. The Organic Materials Research Institute (OMRI): is a national nonprofit organization founded in 1997 to support the organic community. OMRI reviews products to determine their suitability for producing, processing and handling organic food and fiber under the USDA National Organic Program Rule (OMRI General Materials List).

D. Pesticide: As defined in Section 12753 of the California Food and Agricultural Code, a pesticide includes any of the following: ‘(a) Any spray adjuvant. (B) Any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, which may infest or be detrimental to

vegetation, man, animals, or households, or be present in any agricultural or nonagricultural environment whatsoever'. Antimicrobial agents are excluded from the definition of pesticide.

1.04 SUBMITTALS

A. Test Reports: Provide soils samples to testing laboratory Test results including analysis and comment to be sent directly to District's Representative and General Contractor by the testing lab. Testing shall be performed by Soil and Plant Laboratory, 352 Mathew St., Santa Clara, CA 408-727-0330. Tests to be performed:

1. Import Topsoil: One test per source. Fertility test to include: pH, salinity, nitrate, ammonium, phosphate, potassium, calcium, magnesium. Agricultural suitability test to include: pH, salinity, boron, sodium absorption ratio. Particle size appraisal test to include: Organic content, USDA particle size.

2. Existing Soil: One test. Fertility test to include: pH, salinity, nitrate, ammonium, phosphate, potassium, calcium, magnesium. Agricultural suitability test to include: pH, salinity, boron, sodium absorption ratio. Particle size appraisal test to include: pH, salinity, organic content, USDA particle size. Soil test results shall be presented in a report form, and should include recommendations for soil amendment, fertilization, drainage mitigation, and other necessary measures, for both planting and during the initial maintenance period.

3. Organic Amendment: Physical Properties, Nitrogen content on a dry weight basis, Organic matter in lbs./cu. yd., Iron content, Salinity (Ece) and Reaction (pH).

B. Samples:

1. Submit duplicate samples and manufacturer's guaranteed analysis of the following items and such other materials as may be required by the District's Representative and obtain written approval thereof before beginning fabrication or delivery of material to the Project site. Finished work shall match approved samples.

   a. Import Topsoil: 1/4 Cubic Foot physical sample, and test results with recommendations performed by the specified soils testing laboratory.
   b. Organic Soil Amendment: 1/4 Cubic Foot physical sample, and test results with recommendations performed by the specified soils testing laboratory.
   c. Mulch material: 1/4 Cubic Foot physical sample.
   d. Tree guying materials: One example of each item to be used.
   e. Fertilizers: Manufacturers printed description and guaranteed analysis.

C. Product Data: Manufacturer's specifications, catalog cuts, data sheets, and installation instructions.

D. Certification: Furnish duplicate, legible copies of certificates and/or invoices for all soil, fertilizer, plants, and other materials, stating the grade, weight or quantity, source, and date of delivery.

E. Plant Sources: Submit name and address of proposed suppliers of plant materials to Owner within 30 days of notice to proceed. List plants to be obtained from each source. For any plant found to be unattainable, show suggested substitute species or size, with source. Obtain Owner acceptance of sources and/or substitutions.

F. Ordering of Plants: Submit documentation, within 21 days following acceptance of nursery sources, that plant material has been ordered. Indicate size of plant, container size and quantity

of each on order form. Instruct nursery to label each plant with botanical name.

G. Water Need Categories

H. Plant material species have been specified meeting the water need categories as defined in the current edition of 'Guide to Estimating irrigation Water Needs of Landscape Plantings in California' as published by the University of California Cooperative Extension and the California Department of Water Resources, also known as WUCOLS III.

1. Any substitution made of plant material specified shall be brought to the attention of the District's Representative by noting on the submittal list as herein required. Substituted plant species shall meet the same water need category of originally specified plant species.

1.05 PROJECT CONDITIONS

A. Existing utilities may exist within areas where new planting and irrigation are to be installed. Locate all utilities prior to beginning work.

B. Existing Conditions: Exercise caution against injury to, or defacement of, existing conditions. At Contractor's expense, repair or replace items damaged from installation operations.

1.06 ENVIRONMENTAL CONDITIONS

A. Planting of trees shrubs, and groundcovers shall be done only during periods which are normal for such work as determined by the season, weather conditions and accepted practices.

1.07 PROJECT SITE CONDITIONS

A. Sequencing and scheduling: Coordinate all phases of landscape installation with other phases of construction so as not to incur any scheduling or installation conflicts.

B. Keep work site and adjacent areas clean, neat and orderly at all times. Remove debris and waste materials and excess earth materials at least once a day and more often if appropriate.

C. Protect existing improvements: repair or replace all damaged items; protect completed work.

D. Verify location and existence of underground utilities. Protect existing utilities from damage due to construction activity. Repair damage to utility items.

E. Broom and hose off areas to maintain clean pavement.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

A. Quantities: Plant materials shall be furnished in quantities required to complete work as indicated on the Drawings and shall be of species, kinds, sizes, etc., specified.

B. Nomenclatures: Plant names listed on drawings conform to standardized plant names established by American Joint Committee on Horticultural Nomenclature, except that for names not covered therein, the established custom of the nursery trade is followed.

C. Quality:

1. Plants shall conform with American Association of Nurserymen Standards, ANSI Z60, in all ways.
2. Plants shall be symmetrical and typical for variety and species.
3. Plants shall be nursery grown under climatic conditions similar to those in Marin County.
4. Plants shall be sound, healthy, vigorous, and free from plant disease and insect pests or their eggs.
5. All trees and shrubs shall be container grown or established "boxed-out", field-grown material, unless otherwise specified.
6. Container stock shall be grown for at least 8 months, in containers in which delivered, but shall not be root bound. Container plants with cracked or broken balls of earth when taken from containers may be planted only with specific approval of the District's Representative.
7. Plants shall not be pruned prior to delivery, except as authorized by the District's Representative.
8. Protect plants in transit and after delivery to the Project site. Plants in broken containers and plants with broken branches or injured trunks will be rejected. Remove rejected material from the site immediately.
9. Furnish all certificates of inspection that are required by county or state authorities.
10. Substitutions will be allowed only when specified material is proved unavailable and only with approval of the District's Representative. Proposals will be considered for use of nearest equivalent size and variety with equitable adjustment to the Contract price.

D. Dimensions: Height and spread of specimen plant materials are specified on the drawings. The first figure following the name of the plant is the height, and the second figure is the spread. All measurements shall be made with material in a normal position without support of the branches. Plants specified by container size only shall be equal in size to similar plants in local retail nurseries.

E. Plant Observation:

1. Right of observation for approval or rejection is reserved at the place of growth and/or on the project site at any time upon delivery or during the work. Plants shall be observed for size, variety, condition, defects or injury.
2. Notify the District's Representative of the source of material no later than 30 days after award of the contract.
3. One observation at the place of growth shall be made. All plant materials requiring observation by the owner shall be assembled and available for observation.

4. If the District's Representative is required to make additional observations at the place of growth due to failure of the Contractor to assemble the required plant materials or rejection of plant materials, the District's Representative's time and expense shall be reimbursed by the Contractor.
5. Provide transportation for the District's Representative to the place of growth for all additional observations of plant materials.

F. Groundcover Plants:

1. Groundcover plants, unless otherwise indicated on the drawings, shall be rooted plants grown in flats.
2. Plants shall be full and compact, not "leggy".

2.02 FERTILIZERS AND SOIL CONDITIONERS

A. Soil amendments for use 'on grade' shall be WonderGrow Compost as supplied by Grover Soil Solutions a division of Grover Landscape Services, Inc., 2825 Kiernan Avenue, Modesto, CA 95356. Phone: (209) 545-4401 or (800) 585-4401, or District Approved equal.

1. 1. Generic Ingredients — Percent by Weight
   1) Clean green waste from tree
      a) branches, grass, wood chips — 60-90%
   b. Vegetable waste from lettuce,
      a) olives, kiwi fruit, vegetable
      b) pumice — 10-20%

2. Visual Indicators:
   a. All material is dark brown.
   b. Parent material no longer visible.
   c. Structure is mixture of fine and medium size particles and humus crumbs.

3. Physical Indicators:
   a. Fine texture (all below ½" mesh, with high percentage below 1/8" mesh particles).
   b. Moisture: 25-40%

4. Odor Indicators:
   a. Smells like rich humus from the forest floor (high actinomycetes)
   b. No ammonia odor
   c. No petrefaction or anaerobic odor.

5. Nutrient Indicators:
   a. Carbon: Nitrogen Ratio (optimum 15:1; tolerable up to 20:1)
   b. Total Organic Matter: 20-35%
   c. Total Nitrogen: 1.0-2%
   d. Nitrate Nitrogen: 250-300 PPM
   e. Nitrite Nitrogen: 0 PPM
   f. Sulfite: 0 PPM
   g. Ammonium: less than 20 PPM
   h. pH: 7-8
   i. Other nutrient levels consistent with parent materials.

6. Biological Indicators:gh Cation Exchange Capacity (50-80 CEC on scale of 100)
   1) b. High Humic Acid content (5-15%)
   b. High Fulvic Acid content (2-5%)
   c. Moderate ERGS Readings (less than 3,000)
   d. LaMotte Humus Reading (between 25-30)
   e. rH reading of 26-28 (rH=relative Humus)
   f. High Available Oxygen Reading (28-29 ORPS)

B. Supplemental Organic Fertilizer: Whitney Farms All-Natural lawn Food, 8-2-4
   1. (N-P-K). Whitney Farms Consumer Services, 14111 Scottslawn Road, Marysville, OH 43041, www.whitneyfarms.com , phone: 866-541-3118, or District Approved equal.. No chemical fertilizers are allowed.

C. Controlled Release Organic Fertilizer Tablets: AgSafe 20-10-5 Planting Tablets with 10% Humus, as manufactured by Agritab Corporation, P.O. Box 70410, West Valley, UT 84170. 1-801-969-6906. www.agritab.com, or approved equal. No chemical fertilizers are allowed.

D. Ammonium Sulfate: 21-0-0 (N-P-K).

E. Bark for Mulching: Mocha Chip - 2" or less processed wood product which is colored with a UV protected colorant. Natural ferric oxide dye which lasts long without fading. Available at Lyngso Garden Materials. 19 Seaport Blvd. Redwood City, CA 94603. (t) 650.364.1730 or District Approved equal.

F. All fertilizer and soil conditions shall be first quality, standard brand, agricultural products and non-synthetic. Synthetic, quick-release fertilizers shall not be permitted. Fertilizers prohibited in the Generic Materials List by the organic Materials review Institute (OMRI) are prohibited in the project.

G. Materials Delivery and Storage: Manufactured materials shall be delivered in original containers with brand and maker's name marked thereon. Materials in broken containers or showing evidence of damage will be rejected and must be immediately removed from the site. Odorous materials shall not be brought to the site until they are to be used.

H. Certificates: Furnish a certificate with each delivery of material to the site in containers, or in bulk. Certificate shall state source, quantity, or weight, type and analysis, and date of delivery. Deliver all certificates to the District's Representative.

2.03 MISCELLANEOUS MATERIALS

A. Import Topsoil:

1. Provide Combination Fertility, Agricultural Suitability, and Particle-Size Test, performed by a soils laboratory approved by the District's Representative.

   a. Agricultural Suitability:

      a) Salinity (ECe x l0(3)): 0-2.
      b) Sodium (SAR): 0-4.
      c) Boron (PPM in Saturated Extract): 0-0.7.

   b. Particle Size:

	Minimum	Maximum
b) Clay and Silt	20 percent	50 percent
c) Fine Sand	30 percent	40 percent
d) Coarse Sand	5 percent	20 percent
e) Gravel (Maximum		
f) Aggregate size 3/4")	0 percent	8 percent
g) Decomposed Organic		
h) Matter	2 percent	50 percent

2. Should the samples not meet all of the standards given above, the soil laboratory may submit in the report what additives (in addition to the material already called for in these specifications) should be installed to correct these problems. Contractor shall install the additives as recommended by the soils laboratory at no additional cost to the Owner.

B. Tree Guys:

1. Anchors: 1-inch galvanized pipe, 3 feet long.
2. Wires: 1/8-inch flexible galvanized cable.
3. Hose Collars: Fabric reinforced rubber hose; color - dull green.
4. Tubing: Polyethylene; translucent white; ½-inch diameter.
5. Cable Clamps: Galvanized.
6. Turnbuckles: 6-inch open aluminum turnbuckle; eye end fittings 5/16" in diameter; 4-1/4" take-up.

C. Metal Headers: Refer to Section 32 14 00 Unit Pavers

PART 3 - EXECUTION

3.01 INSPECTION

Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the District's Representative of any discrepancy between the drawings and/or specifications and actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the District's Representative.

B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.03 SOIL PREPARATION

A. Grades:

1. Subgrades for areas to receive topsoil have been established under work of another Section. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.

2. Grades of planting areas not to receive topsoil have been established to within l inch of finished grade under work of another section.

3. Notify the District's Representative prior to commencing soil
    1) preparation work if existing grades are not satisfactory, or assume responsibility for conditions as they exist.

B. Weed and Debris Removal:

1. All ground areas to be planted shall be cleaned of all weeds and debris prior to any soil preparation or grading work. Weeds and debris shall be disposed of off the site.

C. Contaminated Soil:

1. Do not perform any soil preparation work in areas where soil is contaminated with cement, plaster, paint or other construction debris. Bring such areas to the attention

of the District's Representative and do not proceed until the contaminated soil is removed and replaced.

2. Soil contaminated by chemical herbicides in parking area islands and plant areas shall be removed to a depth of 12 inches and replaced with soil.

D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.

E. Soil Loosening: Soil in all planting areas shall be ripped or cultivated to the depths specified below. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed to the specified depth and shall be removed from the site.

1. Subgrade of areas to receive topsoil: 8 inches' deep
2. Areas not to receive topsoil: 8 inches' deep
3. Slopes 3:1 and steeper: No loosening required unless slope is to receive topsoil.

3.04 INSTALLATION OF TOPSOIL

A. No finished grading or installation of topsoil shall be done until soil loosening has been approved by the District's Representative.

B. Moisture Content: Topsoil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.

C. Installation:

1. Noxious weeds, rocks over 2 inches in diameter, and debris shall be removed from topsoil and disposed of off the site.
2. Thickness of topsoil, including soil conditioners to be added later under the paragraph entitled SOIL CONDITIONING, shall be 6 inches and grades shall conform to those indicated on the site grading plans and specified herein.
3. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regraded in accordance with the paragraph entitled FINISHED GRADING.

3.05 SOIL CONDITIONING

A. General: After soil preparation has been completed and high and low spots graded, add soil amendments as indicated below and/or as recommended by soils laboratory, and rototill, making repeated passes with the cultivator to the depth specified until the amendments have been thoroughly mixed.

B. Tree and Shrub Planting Holes:

1. Planting Holes:
   a. Locate planting holes per planting plans bringing any conflict with underground utility lines to the attention of the District's Representative. Locations for holes shall be staked on the site and the District's Representative's approval thereof obtained prior to excavating planting holes.

b. Excavate square and round holes to the sizes and depths indicated on the drawings.
c. Dispose of excavated soil off the site at no additional cost to the owner.
d. Scarify the sides and bottom of the holes.

2. Backfilling:
   1) Backfill the planting holes with the special backfill mix herein specified.
   2) Water-settle backfill thoroughly or compact by other approved method prior to planting so plants do not settle.
   3) Apply 4 cubic yards of composted amendment at the rate of 4 cubic yards per 1000 square feet as required by MWELO to all planting areas
3. Special Backfill Mix for Planting Holes:
   a. Materials:
      1) 70 percent topsoil.
      2) 30 percent composted amendment.
      3) Amendments as recommended by soils laboratory.
   b. Mixing:
      1) Prepare the mix in stockpiles on site; do not mix at each individual planting hole.
      2) Mix thoroughly, leaving no layers of soil amendments or clods of soil.

   c. Fertilizer Tablets: Place organic tablets in the backfilled planting holes per the manufacturer's printed rate recommendations.

C. Drainage Holes for Tree Planting Holes:

1. Following excavation of tree holes and prior to placing backfill, fill planting hole with water and allow water to percolate into existing soil for 24 hours. Any planting holes not totally drained within 24 hours shall have drainage holes as detailed. After drilling drainage hole, refill with water and repeat process above as directed by project architect.

3.06 FINISHED GRADING

A. When weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled, all planting areas shall be smooth-graded, ready for placement of plant materials and for seeding and/or sodding.

B. Grading shall be done when soil is at optimum moisture content of working.

C. Grades:

1. The Contractor shall make themselves familiar with site grading plans and as herein specified.
2. Finished grades shown on site grading plans are given in feet and decimal fractions of feet. Slope uniformly between given spot elevations. Planting areas shall be true to grade within 1 inch when tested in any direction with a 10-foot straightedge.
3. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given or between points established by walks, paving, curbs, or catch basins. Finish grades shall be smooth, even, and on a uniform plane with no abrupt changes of surface. Minor adjustments of finish grades shall be made at the direction of the District's Representative, if required.
4. All grades shall provide for natural runoff of water without low spots or pockets. Flow-line grades shall be accurately set and shall be not less than 2 percent gradient wherever possible.

5. Shrub Areas: Finished grades shall be 1-1/2 inches below top of adjacent pavement, headers, curbs, or walls, unless otherwise indicated on the drawings.
6. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.

3.07 PLANTING

A. General:

1. Do not install plant materials until all construction work has been completed and sprinkler systems have been installed and tested. Planting areas shall have been graded and prepared as herein specified and shall have been approved by the District's Representative.
2. Do not plant during unfavorable weather.
3. Soil shall be at an optimum moisture content for planting.
   c. Do not plant in dry soil or muddy soil.

B. Weed Control: Integrated Pest Management (IPM) practices shall be used to control weeds. Synthetic pre-emergents are prohibited. Cut or pull weeds using hand operated equipment.

C. Container Plants:
1. Do not lift or handle container plants by tops, stems, or trunks at any time.
2. All plants shall be set so that, when settled, the soil level in the container is 4 inches above the finished grade of lawns and 2 inches above finished grade of other planting beds.
   c. Taper finished grade away from root ball.
3. Fertilizer Tablets: Refer to paragraph 3.5 D.3 above.
4. All plants shall be planted immediately after the containers are cut, and containers shall be regularly removed from the site so as not to present a hazard to persons using the area.
5. Watering Basins: Form circular earth basin centered on the stem of each plant. The rim of basin shall be 4 inches above the grade at the stem. Do not form watering basins around trees in lawn areas.

3.08 PROTECTION

A. Protect all planted areas and plants against trespassing and damage at all times. If any plants are damaged, treat or replace as directed by the District's Representative, without additional cost to the owner.

B. Do not execute work in or over prepared plant areas or adjacent to planting without proper safeguards and protection.

3.09 MISCELLANEOUS ITEMS

A. Mulching:

1. Install bark mulch over planting areas indicated on the drawings.
2. Mulch shall be 3 inches deep; taper down flush with adjacent paving curbs or headers.
3. Where watering basins are required, fill basin with 3 inch deep mulch.

B. Tree Guying:
1. Scope:

a. Guy all boxed specimen trees, 30 inch box and larger.

2. Installation:
   a. Neatly form hose and cable collars to prevent any bare cable chafing against the tree trunk or branches.
   b. Weld loop to pipe anchors and galvanize after fabrication.
   c. Use cable clamps or crimping device for all attachments.
   d. Do not leave sharp cable ends protruding.
   e. Install polyethylene marker tubing on all guy wires.

PART 4 - 3.10 GENERAL CLEANUP

B. Remove all cans, surplus materials, and other debris from site. Neatly dress and finish all planting areas. Flush walks, paved areas, and the like clean to the satisfaction of the District's Representative.

C. Rinse foliage of all plant materials within the construction area as often as necessary to keep the foliage free from dust generated by the work of this contract.

PART 5 - 3.11 MAINTENANCE

B. Establishing Maintenance Period:

1. As soon as all planting is completed, a planting review and preliminary inspection to determine the condition of the plantings will be held by the District's Representative upon request of the Contractor.

2. Upon approval of the work by the District's Representative, the 60-day maintenance period shall begin.

C. Maintenance of Planting:

1. Continuously maintain all plantings in areas included in the contract from the beginning of contract work, during the progress of work, and for a period of 60 days after completion of all work until final acceptance of all contract work by the owner.

2. Scope:

   a. New plantings.

   b. Existing plantings within the construction area.

   c. Continuous operations of watering, weeding, cultivating, mowing, trimming, edging, rolling, fertilizing, insect, pest, fungus, and rodent control, and any other operations to assure good normal growth.

3. Fertilizing: In addition to fertilizing of trees, shrubs, groundcovers, and lawns herein specified, furnish and apply any additional fertilizers necessary to maintain plantings in a healthy, green, vigorous growing condition during the maintenance period.

4. Weeding, Cultivating, and Cleanup: Planting areas shall be kept neat and free from debris at all times and shall be cultivated and weeded at not more than 10-day intervals.

5. Integrated Management:

6. Contractor shall utilize integrated pest management (IPM) practices during installation and maintenance to control pests and disease in the landscape. IPM uses cultural, mechanical, physical, and biological control methods before using pesticides. Chemical controls are applied only when monitoring indicates that preventative and non-chemical methods are not keeping pests below acceptable levels. When pesticides are required, the least toxic and the least persistent pesticide that will provide adequate pest control is applied.

7. Controls:
   a. Cultural/Mechanical/physical methods will be used as the first choice in weed management.

      aa. Monitor planting areas frequently to identify and eradicate weeds early in the growth stage prior to their setting seed.
      bb. Cut or pull weeds using hand operated equipment where possible.
      cc. Propane-fueled flamers may be used in winter and spring with required permits and approval by the Fire Marshall to kill early-season, non-grass weeds by heating the cells until they burst. The weed quickly wilts and dies.

   b. Contractor shall apply all chemicals in a safe manner and according to label instructions and Agency, State and Federal requirements. A California Chemical Applicators license is required by the Contractor for chemical applications. The Contractor shall mix and apply chemicals to protect against accidental spills and drift to non-target areas, and to insure safety of the applicator. Any spilled chemicals, as well as contaminated soil, water, and/or landscape materials must be removed from the Project and disposed of in accordance with the Agency requirements. The Contractor shall maintain applicator's licenses and records of applications as required by the State.

   c. A Chemical Work Report shall be completed for each chemical application. The Contractor is responsible for submitting chemical usage reports to the County Agricultural Department.

   d. Contractor shall maintain records of all pest management activities. Each record shall include the following information:

      aa. Target pest;
      bb. Type and quantity of pesticide used;
      cc. Site of pesticide application;
      dd. Date the pesticide was used;
      ee. Name of the pesticide applicator;
      ff. Application equipment used;
      gg. Prevention and other non-chemical methods of control used.

   e. Contractor shall submit the pest management record to Owner on monthly basis.

   f. Herbicides:
   g. Least toxic herbicides may be employed by Contractor as a last resort. (Trade names are used only as examples and are not intended as an endorsement). Examples are:

      aa. Fatty acid potassium salts (herbicidal soaps, e.g. Safer's Superfast Weed and Grass Killer®, Dr. Bronner's Peppermint Anti-Bacterial Soap)
      bb. Acetic and citric acids (e.g. Nature's Glory Weed and Grass Killer RTU®)

cc. Clove, citrus, mint and thyme oil (e.g. Matran II®, Xpress®)
dd. Corn gluten
ee. Low-Toxic, low-residual herbicide (e.g. glyphosate (Round-up®), glufosinate-ammonium (Final), pelargoic acid (Scythe®)

h. Restricted herbicides that may not be used because they have been identified as ground water contaminants are (trade names in parentheses):

aa. Atrazine (Aatrex)
bb. Simazine (Princep)
cc. Bromacil (Hyvar, Krovar)
dd. Prometon (Pramitol)
ee. Bentazon (Basagran)
ff. Norflurazon (Solicam, Predict, Zorial)

i. Restricted herbicides that may not be used because they have been identified as a compost contaminant are:

aa. Picloram
bb. Clopyralid

8. Pruning:

a. Prune new trees and shrubs at the direction of the District's Representative.

b. Shape branching structure and thin out foliage.

c. Do not remove lower branches from low-branching or multi-trunk trees, unless directed to do so by the District's Representative.

9. Protection: Work under this Section shall include complete responsibility for maintaining adequate protection for all areas. Any damaged areas shall be repaired at no additional expense to the owner.

10. Replacements: Immediately replace any plant materials that die or are damaged. Lawns that do not grow shall be resodded. Replacements shall be made to the Specifications as required for original plantings.

11. Condition of Plantings at the End of the Maintenance Period:

PART 6 - All plant materials shall be live, healthy, undamaged, and free from infestations.

1. Groundcover, shrub areas, and other planting areas shall be free of all weeds (broadleaf and grass).

2. Plantings that do not conform to Specifications shall be replaced and brought to a satisfactory condition before final acceptance of the work can be made.

PART 7 - 3.12 EXISTING PLANT MATERIAL PROTECTION

B. Scope:

1. Protect from damage all trees and other vegetation to remain that occurs within the limits of construction work.

a. The Contractor shall be responsible and liable for all unauthorized cutting, destroying, and damaging of existing trees, shrubs and groundcovers, including damage due to careless operation of equipment.

b. The Contractor shall be responsible and liable for destroying or damaging of existing trees, shrubs, and groundcovers where the cause of loss or damage is due to a shutdown of existing irrigation under repair, replacement, or where improvements are to be done as part of the work specified in Section 02810, Irrigation and/or on the drawings.

c. Oil, gas, chemicals, or construction materials of any kind shall not be stored within the drip line of any existing tree.

d. Signs, wires, or any other type of obstruction shall not be attached to trees.

e. Trenching under the drip line of trees is to be avoided; if trenching is necessary, trenches are to be hand-dug, and major roots retained intact.

C. Maintenance:

1. In addition to normal maintenance as specified herein for new plant materials, work of this contract shall include supplemental feeding of existing trees to offset loss of root system as a result of excavation or new construction. Said supplemental watering and feeding shall consist of periodically injecting liquid fertilizer with a minimum 3-inch long probe operated by a 150 psi pressure system. The quantity of water and fertilizer shall be sufficient to offset the root loss suffered by the trees.

2. Pruning: Work shall consist of removal of all dead wood and removal of branches to clear new construction work and to provide clearance along roads and sidewalks from all plant materials designated to remain within the construction area. All materials removed from existing trees shall be removed from the site.

3. 3. Work shall be done by qualified tree specialists, and theyshall be present on the site when excavations and compactions are made near existing trees. The specialists shall recommend and provide any treatment, materials, and labor required to ensure the good health of the trees.

4. Existing plant materials adjacent to construction areas shall be maintained by the Owner.

D. Replacements and Damage:

1. Trees and shrubs killed or damaged by work of this Contract to the extent that, in the opinion of the District's Representative, they have lost their original form, shall be removed from the site and replaced in kind and size at no additional cost to the Owner.

a. The cost of trees that are impractical to replace in size shall be reimbursed to the Owner by the Contractor at the rate of 30 dollars ($30.00) per square inch of area of trunk cross section measured 18 inches above the ground.

b. Trees and shrubs damaged by construction, but in the opinion of the District's Representative still in acceptable condition, shall be immediately repaired by acceptable arboreal methods.

c. Groundcovers killed or severely damaged by construction shall be replaced in kind and size to the satisfaction of the District's Representative.

PART 8 - 3.13 GUARANTY

B. All trees, shrubs, groundcovers, and other plant materials shall be guaranteed to take root and grow and thrive for a period of l year after final acceptance of the work.

C. Any trees or other plant materials that die back and lose the form and size originally specified, shall be replaced, even though they have taken root and are growing after the die-back.

D. Within 15 days of written notification by the owner, remove and replace all guaranteed plant materials which, for any reason, fail to meet requirements of guaranty. Replacements shall be made to same specifications required for original materials and shall carry the same guaranty from the time they are replaced.

PART 9 - END OF SECTION

SECTION 32 96 00

TREE & PLANT PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Work under this section is subject to requirements of the Contract Documents including the GENERAL CONDITIONS, SPECIAL CONDITIONS, and sections under Division 1 - GENERAL REQUIREMENTS.

1.02 DESCRIPTION OF WORK

A. Preserve, protect, and trim existing trees and shrubs, and other vegetation indicated to remain.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Wound paint: Flintkote 'Treeheal' or District Approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Provide temporary fencing, barricades and guards as required to protect from all damage trees and other plants which are to remain. Erect prior to commencement of work and remove only after all work potentially injurious to trees and other plants is completed.

B. Protect all trees from stockpiling, material storage, vehicle parking, and driving within the tree drip line. Restrict foot traffic to prevent excessive compaction of soil over root system.

C. Protect root systems of existing trees, shrubs, and groundcovers from damage due to chemically injurious materials in solution caused by run-off and spillage during mixing and placement of construction materials, and drainage from stored materials.

D. Protect root system from flooding, erosion, excessive wetting, and drying resulting from de-watering and other operations.

E. Protect all existing plant material to remain against unnecessary cutting, breaking and skinning of roots and branches, skinning and bruising of bark.

F. Do not allow fires under and adjacent to trees or other plants which are to remain.

G. Engage a Consulting Arborist registered by the American Society of Consulting Arborists to direct removal of branches from trees and large shrubs which are to remain, if required to clear new construction and where indicated, and to direct tree root pruning and relocation work.

H. Where directed by Architect, extend pruning operation to restore natural shape of entire tree.

I. Cut branches and roots with sharp pruning instruments. Do not break, chop and mutilate.

J. Water trees and other vegetation that are to remain as necessary to maintain their health during the course of the work. Maintain a water schedule and document.

3.02 EXCAVATION AROUND TREES

A. Excavate within drip lines of trees only where indicated.

B. Where trenching for utilities is required within drip lines, tunnel under and around roots by hand digging. Do not cut main lateral roots and tap roots. Cut smaller roots which interfere with installation of new work. Use sharp pruning tools. Seal cut with wound paint.

C. Where excavating for new construction is required within drip lines of trees, hand excavate to minimize damage to root systems. Use narrow line spading forks and comb soil to expose roots. Relocate roots in backfill areas wherever possible. If large, main lateral roots are encountered, expose beyond excavation limits as required to bend and relocate without breaking.

D. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 6 inches back from new construction. Seal cut with wound paint.

E. Do not allow exposed roots to dry out before permanent backfill is placed. Provide temporary earth cover, pack with wet peat moss or 4 layers of wet untreated burlap and temporarily support and protect from damage until permanently relocated and covered with backfill. Water puddle to eliminate voids and air pockets.

F. Thin branching structure in accordance with national Arborists Association ‘Pruning Standards and Practices’ to balance loss to root system caused by damage or cutting of root system. Thinning shall not exceed 30% of existing branching structure.

G. The Contractor shall be responsible and liable for all unauthorized cutting, destroying, and damage of existing trees, shrubs and groundcover including damage due to careless operation of equipment, shut down of irrigation. Prior to the start of construction, the Contractor shall notify the Architect of any diseased or damaged trees within the area of work.

H. Oil, gas, chemicals, or construction materials of any kind shall not be stored within the drip line of any tree.

I. Signs, wires, or any other type obstruction shall not be attached to trees.

3.03 GRADING AND FILLING AROUND TREES

A. Maintain existing grade within drip line of trees unless otherwise indicated.

B. Lowering Grades: Where existing grade is above new finish grade shown around trees, carefully hand excavate within drip line to new grade. Cut roots exposed by excavation to approximately 3 inches below elevation of new finish grade.

C. Raising Grade: Permitted only as acceptable to Architect.

3.04 REPAIR AND REMOVAL OF TREES

A. Engage a Consulting Arborist to direct tree repair work. Repair trees damaged by construction operations in a manner acceptable to the Architect. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees.

B. Remove dead and damaged trees that are determined by Architect to be incapable of restoration to normal growth pattern.

3.05 REPAIR AND REPLACEMENT OF TREES, SHRUBS AND GROUND COVER

A. Repair shrubs and other vegetation damaged by construction operation in manner acceptable to the Architect. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged plants.

B. Remove and replace all dead and damaged plants up to 6 inches diameter which are determined by the Architect incapable of restoration to normal growth pattern.

1. Provide new shrubs of same size and species as those replaced or as acceptable to the Architect.

2. Plant and maintain as specified under Section 02490.

C. Ground covers killed or severely damaged by construction shall be replaced in kind and size to the satisfaction of the Architect.

3.06 COMPENSATION TO OWNER FOR TREES

A. Contractor shall pay the Owner the value of existing trees to remain that died or were damaged because of the Contractor's failure to provide adequate protection and maintenance, in accordance with the following schedule of values, using 'tree caliper' method (greatest trunk diameter measured 30 inches above ground) or by the method established in the most recent issue of the Guide for Establishing Values of Trees and other Plants, prepared by the Council of Tree and Landscape Architects:

1. For trunks up to:

7 inches	$2,400.00
8 inches	$3,400.00
9 inches	$4,400.00
10 inches	$5,200.00

11 inches		$6,200.00
12 inches		$7,200.00
13 inches		$8,200.00
14 inches		$9,200.00
15 inches		$10,000.00
16 inches		$11,000.00
17 inches		$12,000.00
18 inches and over, add for each caliper inch	$1,200.00	

END OF SECTION

SECTION 33 11 16

SITE WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for providing water service and distribution and modification to existing water mains and services as indicated. The extent of water distribution is indicated on the Contract Drawings and includes furnishing, installing, testing, and disinfecting permanent water supply piping and services as indicated.

B. Provide fire hydrants and services as indicated.

C. The jurisdictional water utility district shall provide water services to the water meters' points of connection for station facilities and landscape irrigation systems, and modifications to their existing water mains, as indicated on the Contract Drawings. The Design Builder shall be responsible for making all such arrangements. All work on the jurisdictional agency's facilities shall be in accordance with the agency's adopted standards and performed by the agency or their representative.

D. Domestic and Fire service facilities and their appurtenances are not to be sized and/or installed until that time the domestic and fire system requirements have been confirmed by the building District's Design Consultants and reviewed and approved by the jurisdictional Water Utility District.

1.02 RELATED SECTIONS

A. Section 31 23 00 - Trenching and Backfilling for Utilities

B. Section 32 80 00 - Irrigation

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

ASTM A36/ A36M	Specifications for Carbon Structural Steel
ASTM A126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A123	Specifications for Zinc Coated (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A197	Specifications for Cupola Malleable Iron
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM C33	Specifications for Concrete Aggregates

ASTM D1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

ASTM D1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80, and 120

ASTM D2564 Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping System

ASTM D3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM F439 Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

B. American Water Works Association (AWWA)

AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA C110 Ductile-Iron and Gray-Iron Fittings, three inches through 48 inches (75mm Through 1200mm), for Water and Other Liquids

AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151 Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C503 Wet-Barrel Fire Hydrants

AWWA C651 Disinfecting Water Mains

AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, four inches-12 inches

AWWA C905 Polyvinyl Chloride (PVC) Pressure Pipe, 14 inches-48 inches

C. Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

MSS SP-80 Bronze Gate, Globe, Angle and Check Valves

D. Water Utility District Standards

The jurisdictional water utility district's standard drawings and specifications.

1. Marin Municipal Water District

2. North Marin Water District

1.04 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

B. Manufacturer's product data for manufactured materials and equipment, including all valves and fire hydrants.

C. Shop drawings showing piping layout and pipe, valves, hydrants, and locations of tie-ins, buttresses, and thrust blocks.

D. Manufacturer's product data for manufactured materials and equipment, including all valves and fire hydrants.

1.05 SITE CONDITIONS

A. Excavations in which products will be buried shall be dry.

B. Coordinate the installation of water supply system with the jurisdictional water utility District.

PART 2 - PRODUCTS

2.01 BURIED PIPE AND FITTINGS

A. Requirements

Provide the types, sizes, and configurations of pipe, fittings, and miscellaneous materials and installation accessories as indicated.

B. PVC Pipe and Fittings, Three Inches and Smaller

1. Pipe: Polyvinyl chloride (PVC), ASTM D1785, Schedule 80, Type 1, Grade 1.

2. Fittings: ASTM D1784, socket weld, same material and schedule as pipe, or meeting requirements of ASTM F439, as applicable.

3. Joints: Socket welded with PVC solvent cement conforming to ASTM D564.

C. PVC Pipe and Fittings, Four Inches and Larger

1. Pipe: AWWA C900, SDR 18, Class 235 (AWWA C905, Class 235 for 14" and Larger) polyvinyl chloride (PVC) water pipe with bell and spigot ends and flexible ring joints.

2. Fittings: ASTM D1784, Type 1, Grade 1, polyvinyl chloride (PVC) fittings, Class 305, or meeting requirements or ASTM F439, as applicable.

3. Joints: ASTM D3139, gasketed bell joints with ASTM F477 gaskets.

D. Ductile Iron Pipe (DIP)

1. Piping: AWWA C151, thickness Class 50.

2. Fittings: AWWA C110.

3. Joints: Field Lok gaskets as manufactured by US Pipe, or equal, with copper jumper to provide electrical continuity. Mechanical, where indicated, in accordance with AWWA C111, with copper jumper to provide electrical continuity.

4. Polyethylene encasement for protection of pipes, valves, and fittings shall be furnished and installed in accordance with AWWA C105.

5. Provide inside pipe and fittings with 1/16 inch thick cement-mortar lining and an asphaltic seal coat in accordance with AWWA C104.

2.02 VALVES

A. Gate Valves

150 pound bronze, non-rising stem, wedge disc, threaded connection, conforming with MSS SP-80. (AWWA C509 and AWWA C550)

B. Pressure Reducing Valves

All bronze construction, spring-loaded, single-seated, suitable for tight shutoff under dead-end conditions. Provide with renewable composition seat discs, nylon inserted diaphragm, bolted spring chamber, and threaded connection. (AWWA C512)

C. Backflow Preventer

Provide device which is approved by the jurisdictional water utility company. As a minimum, backflow preventer shall be a reduced pressure principle assembly with two rising stem gate shut-off valves, two resilient seat ball-valve test cocks, and two replaceable resilient seat check valves. Backflow preventer shall be suitable for 175 psig operating pressure and 140 degrees F operating temperature and shall be of bronze construction with screwed inlet and outlet for three inch and smaller sizes and cast iron, epoxy coated construction with 150 pound flanged inlet and outlet for four inch and larger sizes. (AWWA C510 and C511)

2.03 FIRE HYDRANTS

A. Provide fire hydrants and related appurtenances as indicated. Fire hydrants shall comply with jurisdictional water utility district, as applicable.

B. Fire hydrants shall meet requirements of AWWA C503, as applicable, and shall be provided with a minimum of two discharge nozzles and additional pumper connection, meeting the nozzle sizes and pumper requirements of the jurisdictional fire department.

2.04 CONCRETE FOR THRUST BLOCKS

A. Provide Class 3000, 3/4 inch aggregate, concrete for all thrust blocks, with reinforcement where indicated or required.

2.05 MISCELLANEOUS METAL

A. Tie Rods

Stainless Steel, Type 316, threaded ANSI standard bolt thread both ends, diameter as required.

B. Rod Couplings

Malleable iron, ASTM A197, turnbuckle design, female threaded to mate with tie rods, 5/8 inch sizes to mate with both rods and mechanical joint bolts.

C. Pipe Clamps
For sizes 4 inches and larger, provide with malleable iron rod sockets. Provide washers in lieu of rod sockets where authorized conforming with ASTM A126, Class A, cast iron. Bolts and bolting shall conform with ASTM A307.

D. Exposed Metal

All exposed metal (bends, bolts, glands, rings) shall be wrapped with six inch pipe wrap (tape coat HD 30).

E. Bolt and Nuts

All bolt and nuts shall be Stainless Steel, Type 316, unless noted otherwise.

PART 3 - EXECUTION

3.01 MAINTAINING WATER SERVICES

A. Maintain water service and conduct operations at times selected to minimize duration and inconvenience of service interruption.

B. Water valves in service owned by the jurisdictional water utility District shall be operated only by personnel of that jurisdictional water utility district.

C. Except as specified otherwise herein, and where applicable, materials and construction methods shall be in accordance with the provisions of the jurisdictional water utility district standard drawings and specifications.

3.02 INSTALLATION

A. Installation Requirements

1. Excavating and backfilling, including bedding and compacting requirements, shall conform to Section 31 23 33 - Trenching and Backfilling.

2. Provide concrete thrust blocks for elbows, tees, valves, and appurtenances of buried piping. Thrust blocks shall be constructed as indicated.

3. Install piping true to line and grade, supported and guided to assure alignment under all conditions.

4. Install unions at each connection to valves.

5. Make change in line with fittings. Do not spring joints to effect change of direction.

6. Do not field cut pipe unless necessary. Make such necessary cuts by means of equipment designed for the purpose, ensuring a smooth square end.

7. For connection to existing pipe, provide pipe with suitable ends or adapters, after verification of size and type of existing pipe.

B. Valves

1. Install valves in accordance with the valve manufacturer's installation instructions.
2. Where valves are provided by the jurisdictional water utility District, provide suitable access for operation of valves.

3. If directed by District, alter typical valve manhole to suit actual conditions. Any alterations in valve manholes shall be operable from the street level. All operator nuts shall be plumb to the valve manholes.

C. Fire Hydrants (Private)

1. Provide fire hydrant installations as indicated. Installation shall conform with requirements of the jurisdictional fire department.

2. Provide necessary appurtenances and accessories as required to complete the installation.

D. Thrust Blocks and Harnessing

1. Provide for counteracting thrust caused by static and dynamic forces, including water hammer at bends, tees, reducers, valves, and dead-ends by installing harnessing as indicated or required. For other methods, submit details for approval of the District prior to use.

2. Provide concrete thrust blocks as indicated where harnessing is not practicable.

E. Water Service Connectors

Make water service connections, as indicated, in accordance with California Plumbing Code and the installation instructions of the service pipe and fittings manufacturer.

F. Acceptance Requirements

After installation of pipes, ends of pipes shall be either capped or plugged. No piping shall be buried before being inspected and tested.

3.03 TESTS

A. Protection from Flooding

Provide positive measures to protect exposed, installed pipe and compacted pipe bedding from flooding during testing.

B. Notice of Testing

1. Give two days notice of intention of testing to the District. The Design Builder will furnish, install, and operate pumps, gages, meters, and individual pipe connections to test openings.

2. Designate largest sections feasible for testing and sterilizing.

C. Testing Requirements

1. Prior to backfilling, isolate system by use of approved valves, caps and plugs, or other means.

2. Maintain such isolation throughout the performance of leakage and pressure testing.

3. Where valves are used for isolation, eliminate leakage through such valves if it occurs. Maintain new work isolated from existing water mains, except for test connections, until testing and sterilization have been completed.

4. For hydrostatic tests, provide approved caps and plugs in sections to be tested and remove them after testing.

5. Prevent leakage in pipes and fittings at openings. Temporarily block plugged and capped ends to prevent displacement.

6. Install water source connection for testing and isolated section.

7. Provide labor and materials required for leakage testing, including excavation for installation and removal of pumps, gages, meters, and water source connections.

8. Where leakage exceeds the District's standards, perform necessary corrective measures.

9. Remove and replace defective pipes, joints, fittings, valves and appurtenances. Reset such items if displaced.

D. Hydrostatic Tests

1. Perform hydrostatic tests in accordance with the District's requirements. All such tests shall be witnessed by the representative. The Design Builder shall be responsible for making all such arrangements.

2. Test the potable water system hydrostatically in sections to a pressure of at least 225 psi for not less than 15 minutes. Pressure test pipe before backfilling. Repair leaks and retest the system until the system is leak free. Use instruments calibrated by a quality laboratory. Test sequence shall be as follows:

a. Lines shall be fully flushed.

b. Lines shall be hydrostatically tested.

c. Lines shall be fully flushed.

d. Lines shall be fully disinfected.

3.04 SYSTEM DISINFECTION

A. Before final acceptance of the water supply system, each section of the new line shall be disinfected in accordance with AWWA C651. One of the following sources of disinfection shall be used:

1. Mixture of water and chlorine gas

2. Direct application of chlorine

3. Mixture of water and calcium hypochlorite or

4. Mixture of water and calcium chloride

B. Before disinfecting, flush the line thoroughly to remove dirt and extraneous material. Clean each section of the line between valves independently.

C. Retain the disinfectant solution in the pipe for at least 24 hours. Following this sterilization period, the residual chlorine content at the ends of the section and at other representative points shall be not less than five parts per million. Then, the line shall be drained and thoroughly flushed with water until the residual chlorine content is similar to that obtained from the existing water distribution system.

D. Take water samples and test in accordance with AWWA C651.

3.05 CONNECTIONS TO EXISTING MAINS

A. Following testing and sterilization, new water distribution lines shall be connected to existing mains as indicated. Each connection shall be made at a time and in a manner which will result in the least interruption of service.

B. All connections involving shut down of jurisdictional water utility's existing facilities shall be made under the immediate supervision of the jurisdictional water utility district. No member of the Design Builder's forces may operate any valve controlling the flow of water in the water utility's existing system.

C. The Design Builder shall make tie-ins to the existing system at a time which is convenient to jurisdictional water utility district, which may be in the evenings and on weekends.

D. All piping to be abandoned, as shown on the plans, is abandoned only when the pipe has been taken out of service, physically disconnected from the active water system, and has been sealed by the Design Builder.

E. The Design Builder shall seal all cut ends of the existing piping that are not connected to the new system by either installing temporary fittings on the existing pipe or by plugging the cut end with concrete extending two pipe diameters into the pipe. After the concrete placement, the pipe end shall be blocked with a two-inch thick redwood block.

END OF SECTION

SECTION 33 30 00

SITE SANITARY SEWERAGE SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for furnishing, installing, testing the site sanitary sewerage system in the ground and to a point outside the building wall as indicated.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfilling

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

ASTM D1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80, and 120
ASTM D2564	Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping System
ASTM D3139	Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

B. American Water Works Association (AWWA)

AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, four inch through 12 inch for Water Distribution

C. Sanitary Utility District Standards

Note that all work shall be performed and completed in accordance with the jurisdictional sanitary utility district's standard drawings and specifications. The Contractor shall be responsible for obtaining all such standards as applicable.

1.04 SUBMITTALS

A. Shop Drawings showing piping layouts, sizes, types, and cleanouts.

B. Respective manufacturer's product data for manufactured materials and equipment.

C. Equipment manufacturer's printed operating and maintenance instructions consisting of detailed parts list, recommended spare parts list, and complete operation and maintenance procedures.

D. Certified test reports of equipment, as applicable.

1.05 SITE CONDITIONS

A. Excavations shall be dry immediately before and after products are installed. Provide surfaces and structures to, and on, which sewerage products will be installed.

B. Coordinate the installation of the sewerage system with the jurisdictional sanitary district or utility District.

PART 2 - PRODUCTS

2.01 BURIED PIPE AND FITTINGS

A. Requirements

Provide the types, sizes, and configurations of pipe, fittings, and miscellaneous materials and installation accessories as indicated and required.

B. PVC Pipe and Fittings, Three Inches and Smaller

1. Pipe: Polyvinyl chloride (PVC), ASTM D1785, Schedule 80, Type 1, Grade 1.

2. Fittings: ASTM D1784, socket weld, same material and schedule as pipe.

3. Joints: Socket welded with PVC solvent cement conforming to ASTM D564.

C. PVC Pipe and Fittings, Four Inches and Larger

Pipe: ASTM D3034 (SDR 26), polyvinyl chloride (PVC) water pipe with bell and spigot ends and flexible ring joints.

2.02 CLEANOUTS

A. At grade, cleanouts shall have adjustable sleeve-type housing, threaded brass plug with countersunk slot, and cast iron frame and cover.

PART 3 - EXECUTION

3.01 PREPARATION

A. Excavations shall be free of water and extraneous material immediately before sanitary sewerage products are installed or placed. Bottoms of trenches shall have a six inch sand bed and shall be formed to support the bottom quadrant of the pipe and fittings. Should rock be encountered or should bedding material be unsuitable to support the products at design elevation, continue excavation to an elevation eight inches below the design elevation and backfill with clean sand.

B. Interior of pipe, pipe fittings, valves, drains, and cleanouts shall be cleaned of foreign substances before installation.

3.02 INSTALLATION

A. Install products where indicated. Remove and reinstall products that are disturbed after installation. Ends of products to which future connections will be made shall be either valved, plugged, or capped, and anchored.

B. Connections to existing facilities shall be made with fittings and short bends to suit the actual conditions; connect products in accordance with the product manufacture's installation instructions.

C. Pipe and fittings shall be set to line and grade as shown on the Construction Drawings.

3.03 INSTALLING PIPE

A. Protect pipe and fittings during handling to prevent damage.

B. Place, shape, and compact bedding material to receive barrel of pipe.

C. Start laying pipe at lowest point; lay true to line and grade indicated.

D. Install pipe to bear on bedding material along entire length.

E. Do not place the pipe on blocking material of any type.

F. Do not use wedges while installing the pipe.

G. Install pipe so that bells and grooves are on upstream end.

H. Align each section of pipe with adjoining section with uniform annular space between bell and spigot and so as to prevent sudden offsets in flow line.

I. As each section of pipe is laid, place sufficient bedding and backfill to hold it firmly in place.

J. Apply lubricant to rubber gasket (o-rings) immediately before joining pipe sections.

K. Keep interior of sewer clean as work progresses. Where small pipe sizes make cleaning difficult, keep suitable swab or drag in pipe and pull through each joint immediately after joining is completed.

L. Keep trenches and excavations free of water during construction and until backfilled.

M. When work is not in progress, securely plug ends of pipe and fittings to prevent extraneous matter from entering pipes and fittings.

N. Cut pipe ends which project into a sewer structure flush with the inside face of the structure and cover exposed pipe reinforcement with grout.

O. Where length of stub is not shown, install four foot length and seal free end with brick masonry bulkhead or approved stopper.

P. Obtain District's Design Consultant's approval before covering pipe.

Q. Where indicated, place additional bedding material around and over the pipe in lifts not exceeding six inches loose. Compact each lift before placement of next lift.

R. Accomplish compaction by methods which will avoid damage to pipe and which will not disturb its alignment and grade. The use of vibratory rollers is prohibited until compacted cover over pipe has reached three feet or half diameter, whichever is greater.

S. Connect sanitary sewerage system to existing public sanitary sewers in accordance with requirements of the jurisdictional authority.

3.04 PIPE CLEANOUTS

A. Cleanouts shall be the same size as the pipe up to and including four inches, and shall be four inches minimum for pipe sizes six inches and larger. Cleanouts for drainage pipe shall consist of a longsweep 1/4 bend or one or two 1/8 bends extended to the place indicated. Wall or accessible piping cleanouts shall be T-pattern, 90 degree branch drainage fittings having screw plugs. Cleanouts shall be provided at the base of each riser and shall consist of a wye pattern fitting with a screw plug.

3.03 TESTS

A. Testing Requirements

1. Conduct a mandrel test to ensure that the line is free of obstructions subsequent to the placing of intermediate backfill material over the line.
2. Upon completion of the test and determination that the line is free of obstructions, plug, cap or otherwise close the open end or ends of the installed piping to prevent the entrance of debris into the lines.
3. Supply all tools, equipment, and water necessary to make all tests.
4. Flush all sewer lines prior to testing and accumulated materials shall be removed at each manhole and no materials shall be allowed to enter the existing sewer system.
5. The Contractor shall be responsible for making all necessary arrangements with the jurisdictional sanitary utility District for performing and witnessing the required tests.

B. Sanitary Sewer Pipeline Tests

1. Perform air test on all installed sanitary sewer pipes upon completion of backfill.
2. Perform vacuum test on all manholes.
3. Hydrostatically test all installed sanitary sewer force mains.
4. Test all sewers 24” or less in diameter with low pressure.
5. Sewers with a diameter greater than 24 inches may be tested by visual inspection.

C. Low Pressure Air Test (Gravity Pipe)

1. Clean set sections of pipe to be tested before starting air test.
2. Plug pipe outlets with pneumatic plugs capable of resisting internal testing pressures without requiring external bracing.

3. Immediately following pipe cleaning and wetting, slowly supply air to plugged pipe until internal air pressure reaches 5 psi. Allow at least two minutes for temperature to stabilize before proceeding, except slowly add air to maintain a minimum of 4.5 psig but less than 5 psig pressure. While temperature is stabilizing, spray plugs, pipes, and hoses with soap solution and eliminate air leaks.

4. After temperature has stabilized, measure time required (10 minute min.) for pressure to drop of 1 psig so that the pressure at the end of the test is at least 3.5 psig. If measured time exceeds allowable time, pipe will not be accepted.

5. Time, in seconds, for pressure to drop from 4.5 to 3.5 psig shall be not less than the following; time for intermediate lengths shall be interpolated:

Length	Pipe Diameter, Inches						
Pipe (Ft)	8	10	12	15	18	21	24
25	18	28	40	62	89	121	158
50	35	55	79	126	178	243	317
75	53	83	119	186	267	364	475
100	70	110	158	248	356	485	634
125	83	138	198	309	444	595	680
150	110	165	238	375	510	595	680
175	123	193	277	425	510	595	680
200	141	220	317	425	510	595	680
225	158	248	340	425	510	595	680
250	176	275	340	425	510	595	680
275	194	283	340	425	510	595	680
300	211	283	340	425	510	595	680
350	227	283	340	425	510	595	680
400	227	283	340	425	510	595	680

D. Vacuum Test (Manholes)

1. Clean set manholes to be tested before starting vacuum test.

2. Plug manhole outlets with pneumatic plugs capable of resisting internal testing pressures without requiring external bracing.

3. Vacuum test head shall be positioned at the top of the casing including grade rings.

4. Test shall be 10 lbs for 60 seconds. Measure time required for pressure to drop to 9 lbs. If measured time exceeds allowable time, manhole will not be accepted.

5. Manholes showing greater than the allowable leakage shall be repaired and retested until a satisfactory leakage result is obtained.

6. Time, in seconds, for pressure to drop from 10 lbs to 9 lbs shall be not less than the following; time for intermediate lengths shall be interpolated:

Depth	Diameter		
	48”	54”	60”
<10’	20	23	26
10’	25	29	33
12’	30	35	39
14’	35	41	46

D. Hydrostatic Tests (Force Mains)

1. Force main testing shall be done after intermediate backfill has been placed and compacted but before final paving has been placed.

2. Repair any leaks which may develop resulting from or caused by the tests.

3. Fill lines with water and increase pressure to a 120% of the Total Dynamic Head of the system or fifty (50) psi whichever is greater.

4. Test shall be applied for not less than two (2) hours with zero leakage.

5. Use of air to test force mains is not permitted.

E. Visual Test Method

1. Slowly pull a television camera through sewer and inspect for visual leaks and cracks in pipe. Repair leaks, then re-inspect pipe. Submit tape of entire length of system to District for approval.

F. Joint Pressure Testing

1. Insert sealing packer with joint testing capability, into sewer line.

2. Place sealing packer around joint and pressure test joint. If a drop in air pressure occurs reseal the joint.

3. Repeat procedure for each joint.

G. Criteria for Acceptance

1. The section of sewer being tested will not be accepted if test results exceed allowable leakage to take less time than minimum holding time. If pipe proves to be unacceptable, immediately repair defective materials and workmanship. The

Contractor will not be permitted to change to another test if original test method reveals system has failed.

END OF SECTION

SECTION 33 40 00

SITE DRAINAGE SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Specifications for site and subdrainage and area runoff collection system and connection to existing storm drainage system as indicated.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfilling

B. Section 33 05 00 - Utility Structures

1.03 REFERENCES

A. American Society of State Highway and Transportation Officials (AASHTO)

AASHTO M252M	Specification for Corrugated Polyethylene Pipe
AASHTO M294M	Specification for Corrugated Polyethylene Pipe, 300 1200 mm

B. American Society for Testing and Materials (ASTM)

ASTM F667	Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings
ASTM F405	Standard Specification for Corrugated Polyethylene Pipe and Fittings
ASTM C76	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C. Marin County Uniform Construction Standards - May 2008

D. Caltrans Standard Specifications - Latest Edition

1.04 SUBMITTALS

A. Shop Drawings

Detailed drawings that indicate site drainage in plan and section, including relationship to other systems, interfaces, and drainage structures, connections, alignment, grade, bedding and backfill, and other pertinent data.

B. Product Data

Submit manufacturer’s product data for pipe and pipe connection materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe Connection Requirements

Ends of pipe shall be bell and spigot, except PVC Perp., to assure continuous alignment of pipe and leakproof joints.

B. Concrete Pipe (RCP)

Reinforced Pipe: ASTM C76, Class III; for pipe 15 inches in diameter and larger. “O” ring rubber gasket (ASTM C443)

C. High Density Polyethylene Pipe (HDPE)

Pipe: HDPE pipe conforming to ASTM D3212, or ASTM 1417 for pipe sizes 6 inch - 60 inch (ADS N-12 1B WT pipe or equivalent)

D. PVC Pipe (PVC)

Pipe: PVC Pipe shall conform to ASTM D-3034, SDR 26, Bell and Spigot rubber joints for pipe sizes 4” through 8”.

E PVC Perforated Pipe (PVC Perp)

Pipe: PVC Perforated Pipe shall conform to ASTM D-3034, SDR 26, solvent weld joints for pipe sizes 4”, 6” and 8”. Perforations shall be 2 rows of ½” holes on 5” centers, 120° apart.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE

A. Laying Pipe

1. Lay pipe to line and grade indicated. Bell and spigot type, lay bells in cross-cuts cut in trench. Lay pipe with the bell or grooved end uphill.

2. Prevent dirt from getting into pipe joints.

3. Remove pipe which is cracked, checked, spalled, or damaged from the work.

4. Clean interior of pipe of cement, dirt, and extraneous matte as the work progresses.

B. Pipe Joints

1. Pipe joints shall be made secure and watertight.

2. Employ appropriate equipment to draw the sections of the pipe tightly together.

C. Visual Test Method

1. Slowly pull a television camera through storm drain and inspect for visual leaks, separated joints and cracks in pipe and manholes. Repair leaks and joints. Replace cracked pipe. Re-inspect pipe. Submit tape of entire length of system to District for approval.

D. Backfilling

1. Piping shall not be covered with backfill material, until inspected, and approved by the District's Design Consultant.

2. After making up pipe joints, fill space between pipe and sides of trench with backfill material half-way up the pipe. Both sides shall be filled for full width of trench at same time and carefully compacted so as to hold the pipe in its proper position.

3. After pipe has been installed, inspected, and approved, place and compact backfill as specified in Section 31 23 33 - Trenching and Backfilling.

END OF SECTION

APPENDIX A

A-1: LEED - Owner's Project Requirements – Issued 12/01/17

A-2: LEEDv4 BD+C New Construction Checklist - Issued 12/01/17

A-3: LEED Guidance Summary - Issued 12/01/17

By Beyond Efficiency

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College of Marin, Indian Valley Campus - Bill and Adele Jonas Center: LEED v4 BD+C: New Constructions Preliminary Checklist

Prepared by Beyond Efficiency - Issued Dec 1, 2017

Y	?	N	Credit #	Credit Name			Possible Pts
0	1	0		Integrative Process			1

1	2	13	Location and Transportation		16
0	0		LTc1	LEED for Neighborhood Development Location	16
1	0	0	LTc2	Sensitive Land Protection	1
0	0	2	LTc3	High Priority Site	2
0	0	5	LTc4	Surrounding Density and Diverse Uses	5
0	0	5	LTc5	Access to Quality Transit	5
0	0	1	LTc6	Bicycle Facilities	1
0	1	0	LTc7	Reduced Parking Footprint	1
0	1	0	LTc8	Green Vehicles	1

4	3	3	Sustainable Sites		10
Y			SSp1	P_Construction Activity Pollution Prevention	Required
0	1	0	SSc1	Site Assessment	1
2	0	0	SSc2	Site Development - Protect or Restore Habitat	2
1	0	0	SSc3	Open Space	1
0	0	3	SSc4	Rainwater Management	3
0	2	0	SSc5	Heat Island Reduction	2
1	0	0	SSc6	Light Pollution Reduction	1

6	0	3	Water Efficiency		11
Y			WEp1	P_Outdoor Water Use Reduction	Required
Y			WEp2	P_Indoor Water Use Reduction	Required
Y			WEp3	P_Building-Level Water Metering	Required
1	0	0	WEc1	Outdoor Water Use Reduction	2
4	0	2	WEc2	Indoor Water Use Reduction	6
0	0	1	WEc3	Cooling Tower Water Use	2
1	0	0	WEc4	Water Metering	1

5	12	6	Energy and Atmosphere		33
Y			EAp1	P_Fundamental Commissioning and Verification	Required
Y			EAp2	P_Minimum Energy Performance	Required
Y			EAp3	P_Building-Level Energy Metering	Required
Y			EAp4	Fundamental Refrigerant Management	Required
0	4	2	EAc1	Enhanced Commissioning	6
4	4	0	EAc2	Optimize Energy Performance	18
0	1	0	EAc3	Advanced Energy Metering	1
0	2	0	EAc4	Demand Response	2
0	0	3	EAc5	Renewable Energy Production	3
0	0	1	EAc6	Enhanced Refrigerant Management	1

1	1	0	EAc7	Green Power and Carbon Offsets	2

Y	?	N	Credit #	Credit Name	Possible Pts
4	4	5	Materials and Resources		13
Y			MRp1	P_Storage and Collection of Recyclables	Required
Y			MRp2	P_Construction and Demolition Waste Management Planning	Required
0	3	2	MRc1	Building Life-Cycle Impact Reduction	5
1	0	1	MRc2	Building Product Disclosure and Optimization - Environmental Product Declarations	2
0	1	1	MRc3	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	0	1	MRc4	Building Product Disclosure and Optimization - Material Ingredients	2
2	0	0	MRc5	Construction and Demolition Waste Management	2
15	1	0	Indoor Environmental Quality		16
Y			EQp1	P_Minimum Indoor Air Quality Performance	Required
Y			EQp2	P_Environmental Tobacco Smoke Control	Required
2	0	0	EQc1	Enhanced Indoor Air Quality Strategies	2
3	0	0	EQc2	Low-Emitting Materials	3
1	0	0	EQc3	Construction Indoor Air Quality Management Plan	1
1	1	0	EQc4	Indoor Air Quality Assessment	2
1	0	0	EQc5	Thermal Comfort	1
2	0	0	EQc6	Interior Lighting	2
3	0	0	EQc7	Daylight	3
1	0	0	EQc8	Quality Views	1
1	0	0	EQc9	Acoustic Performance	1

3	3	0	Innovation			6
1	0		INc2	Innovation credit:	Mercury free lamps	1
1	0		INc3	Innovation credit:	PBT: lead, cadmium and copper	1
	1		INc4	Innovation credit:	Green education	1
	2	0	INc5	Innovation credit:	TBD potential pilot credit	1
1	0	0	INc2	LEED Accredited Professional		1

3	0	0	Regional Priority			4
1	0	0	RPc1	Regional Priority:	MRc5 C&D waste management	1
1	0	0	RPc2	Regional Priority:	WEc1 Outdoor water use reduction	1
1	0	0	RPc3	Regional Priority:	WEc2 Indoor water use reduction	1
0	0	0	RPc4	Regional Priority:		1

41	26	30	TOTALS	110

Certified: 40 to 49 points, Silver:50 to 59 points, Gold:60 to 79 points, Platinum:80 to 110

Regional Priority credits are bonus points that can be earned by meeting the point thresholds for the measures listed at right. Measures marked in purple above indicate they are earning regional prioty credits	**Regional Priority Credits**	**threshold points**
	Renewable Energy Production	2
	C&D Waste management	2
	Rainwater Management	1
	Cooling tower water use	1
	Outdoor water use reduction	2
	Indoor water use reduction	4

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College of Marin, Indian Valley Campus - Bill and Adele Jonas Center: LEED Guidance Summary

Prepared by Beyond Efficiency – Issued Dec 1, 2017

Required LEED v4 certification level is Silver (minimum 50pts). The Preliminary Checklist indicates 41 Yes and 26 Maybe points. The preliminary checklist is based on the Schematic Phase bridging documents and consultation with the SD team. Early in DD the design/build team will need to review the details of the LEED v4 BD+C: New Construction rating system and refine the checklist to determine a complete set of measures to get to the 50pt Silver threshold. It is recommended to have a 10% point cushion going into construction phase in case any of the measures fall through or are rejected by USGBC.
One of the critical elements to evaluate as early in DD is possible is the energy modeling performance for both LEED credits and Title 24 compliance.

How to use this guidance document:
Columns A-B: Yes/Maybe/NO -match the LEED checklist. Prerequisite credits are indicated as Y and must be completed. Prerequisites do not earn points. Points in the Green column are those that have been evaluated to be achievable (YES) based on Schematic Phase bridging plans/documents. Points in the Yellow (Maybe) column indicate measures that might be achievable but require further evaluation and design develop with reference to LEED requirements. Points in the Orange (NO) column indicate measures that are not achievable based on Schematic Phase Design/ Project Scope.
Column D: Credit # - abbreviation to refer to specific LEED measures. Capital letters refer to the credit category (e.g. Location and Transportation = LT, Sustainable Sites=SS). Lowercase "p" and "c" indicate if a measure is a mandatory prerequisite (p) OR a credit (c) that can earn points.
Column E: Design/Construction- indicates whether compliance with the prerequisite or credit is determined during the Design Phase and verified via calculations and information included in 100% CD documentation and supplemental LEED forms, or will need to be verified during the Construction Phase.
Column F: Discipline - indicates the primary design or construction discipline(s) responsible for implementing the requirements on the specific LEED measure.
Column G: LEED Credit Name- the official title of the measure in the LEED rating system. Names preceded with "P_" indicate the measure is a mandatory prerequisite.
Column H: Guidance - provides a summary of the status of the particular LEED measure, indicating why the measure was marked as Yes/Maybe/No and a brief description of what is needed to meet the requirements of the measure. There are more details to LEED compliance than can be conveyed in this document. The DD team will need to refer to the LEED reference guide for full details.
Row colors: Green- indicates minimal further effort is needed to meet measure requirements. **White-**indicates further documentation/design alterations are needed to verify measure requirements are being met. **Grey-** indicates measure requirements can not be meet and measures are no longer being considered.

A	B	C	D	E	F	G	H
Yes	**Maybe**	**No**	**Credit #**	**Des/Con**	**Discipline**	**LEED Credit Name**	**Guidance**
Minimum Program Requirements							
			Mpr 1	D	Arch	Minimum program requirements	LEED boundary: Identify boundary on plans as follows: 1) Extend the boundary ~20' beyond the extent of work boundary 2) Exclude Bldg 18 from LEED scope to simplify documentation process. The extended portion will include undisturbed green areas around site to assist with earning SSc3 and SSc 4 credits.
			Mpr 2	D	Arch/Owner	Minimum program requirements	Define occupancy numbers (Full Time, transient, visitors etc) required for consistency within all credits Transient/visitor based -Building 19: 300 seat banquet hall. (used for preliminary assessment of WEp2 and WEc3 indoor water use calculations).
0	1	0		D	Various Disciplines	Integrative Process	To earn credit do the following : 1)Very early in DD phase: Organize a 4 hour design charrette with project team 2) Prepare schematic energy model and discuss efficiency, health related goals for the project. 3) Modify OPR/BOD to indicate the assumptions.
1	2	13	Location and Transportation				
0	0	0	LTc1	D		LEED for Neighborhood Development Location	NA
1	0	0	LTc2	D	Arch	Sensitive Land Protection	Meeting requirement: Site on previously developed land.
0	0	2	LTc3	D	Arch	High Priority Site	Not meeting requirement. not in a historic district or national priority development site
0	0	5	LTc4	D	Arch	Surrounding Density and Diverse Uses	Not meeting requirement. Need surrounding density of 22000 square feet per acre for 1/4 mi radius
0	0	5	LTc5	D	Arch	Access to Quality Transit	Not meeting requirement. Need planned or existing local transport with 72 trips/weekday and 40/weekend- only 1 per hour via local transit authority
0	0	1	LTc6	D	Arch	Bicycle Facilities	Not meeting requirement. Needs bicycle network with bike parking
0	1	0	LTc7	D	Arch	Reduced Parking Footprint	To meet credit: Designate 5% of parking capacity to carpools: Calculations Needed: determine parking demand and LEED baseline- include parking outside of LEED boundary if it can be used by Jonas center visitors. LEED baseline: assembly hall 0.25 vehicle's/seat = 75 parking spaces

A	B	C	D	E	F	G	H
Yes	**Maybe**	**No**	**Credit #**	**Des/Con**	**Discipline**	**LEED Credit Name**	**Guidance**
0	1	0	LTc8	D	Arch	Green Vehicles	To meet credit: 1) provide preferred parking for Green vehicles for 5% of parking used by project. not to overlap with carpool spots 2) install EV charging equipment for 2% of parking used by project.
4	3	3	Sustainable Sites				
Y	0	0	SSp1	C	Civil	P_Construction Activity Pollution Prevention	Meeting requirement - same as City. See Erosion control plan.
0	1	0	SSc1	D	Civil/Arch	Site Assessment	To meet the requirement complete the following: 1) Site assessment report for Hydrology(floods, creeks, etc), climate, soils, human health effects(air quality), human use(views). Civil has completed topography and vegetation assessments. -SSc1_Site Assessment Worksheet_0.doc https://www.usgbc.org/resources/site-assessment-worksheet
2	0	0	SSc2	D	Civil/Arch	Site Development - Protect or Restore Habitat	Needs calculations. Use site boundary determined in Mpr 1 for the green areas restored and retained calculations. Need calculations and areas identified on plans for previously disturbed areas, preserved green space (40% minimum), and restored disturbed areas (30% minimum)
1	0	0	SSc3	D	Landscape	Open Space	Needs calculations. Use site boundary determined in Mpr 1 for the green areas restored and retained calculations. Need >25% of site area within LEED boundary to be vegetated.
0	0	3	SSc4	D	Civil	Rainwater Management	Not meeting requirement. Need to capture and store/percolate 95% of water on site. Stormwater control not a campus priority.
0	2	0	SSc5	D	Arch/Landscape	Heat Island Reduction	To meet credit requirement following changes are required: 1) ~12000 sf of hardscaping classified as "high SRI" (e.g.open grid pavers, paver SRI>28, shaded by trees or architectural devices, etc). 2) Roof types R1 and R2 to be high SRI finish. (3 yr aged SRI >65)
1	0	0	SSc6	D	MEP/landscape	Light Pollution Reduction	To meet the requirement complete the following: 1) Define lighting zone for the project 2) For the appropriate lighting zone, provide BUG rating of the lighting fixtures for uplight and lighting trespass as defined in IES TM-15-11, Addendum A.
6	0	3	Water Efficiency				

A	B	C	D	E	F	G	H
Yes	**Maybe**	**No**	**Credit #**	**Des/Con**	**Discipline**	**LEED Credit Name**	**Guidance**
Y	0	0	WEp1	D	Landscape	P_Outdoor Water Use Reduction	Will meet prerequisite via Ca WELO requirements. 1) Do calculations to reduce the project's landscape water requirement by at least 30% from the calculated baseline for the site's peak watering month.
Y	0	0	WEp2	D	MEP	P_Indoor Water Use Reduction	Meets mandatory requirement-via CalGreen Code. See WEc2 for additional comments
Y	0	0	WEp3	D	MEP	P_Building-Level Water Metering	Need to provide a separate water meter for Bldg 19 if Bldg18 is excluded from LEED project boundary
1	0	0	WEc1	D	Landscape	Outdoor Water Use Reduction	To meet the requirements complete the following: 1) In addition to WEp1, through drought tolerant /native plant species and efficient irrigation system reduce peak demand by 50% from the calculated baseline for the site's peak watering month. CA WELO should get project pretty close to this target. LEED calculation method is different than CA.
4	0	2	WEc2	D	MEP	Indoor Water Use Reduction	CalGreen code fixture earn 1pt. Encourage trying to get to 4pts (40% reduction from baseline) to earn bonus Regional Priority credit pt. 1) Will need to do calculations based on Mp1 occupancy numbers- preliminary estimates indicate a combination of waterless urinals, 1.1gpf toilets and 0.4gpm lav faucets should get to 40% reduction (4pts).
0	0	1	WEc3	D		Cooling Tower Water Use	Not meeting requirement. No cooling tower.
1	0	0	WEc4	D	Owner/MEP	Water Metering	Will meet requirements: Metering Bldg 19 and CA mandated irrigation submetering a should be sufficient to meet requirement - include submeter for 2 or more primary uses - (Irrigation, domestic hot water, HVAC etc)
5	12	6	Energy and Atmosphere				
Y	0	0	EAp1	C	Arch/MEP	P_Fundamental Commissioning and Verification	Engage CMx agent prior to 100% CD and develop commissioning plan for the project. Cmx agent to review OPR and BOD
Y	0	0	EAp2	D	Energy modeler	P_Minimum Energy Performance	To meet the requirements complete the following: minimum performance requirement of 5% over ASHRAE 90.1.2010 or T24 2013 and additional compliance requirements see EAc2
Y	0	0	EAp3	D	Arch/Owner	P_Building-Level Energy Metering	Must provide gas and electricity meters specific to Bldg 19 only.

A	B	C	D	E	F	G	H
Yes	Maybe	No	Credit #	Des/Con	Discipline	LEED Credit Name	Guidance
Y	0	0	EAp4	D	Owner/MEP	Fundamental Refrigerant Management	Meeting requirement. All existing HVAC equipment is being phased out.
0	4	2	EAc1	C	Owner/Arch	Enhanced Commissioning	Highly recommend doing this measure- ensure building operating as intended and a high value for meeting LEED silver. Add requirement to OPR, BOD and Specifications as appropriate To meet the requirement include the following in Cmx scope: 1. Review contractor submittals. 2. Verify inclusion of systems manual requirements in construction documents. 3. Verify inclusion of operator and occupant training requirements in construction documents. 4.Verify systems manual updates and delivery. 5. Verify operator and occupant training delivery and effectiveness and seasonal testing. 6. Review building operations 10 months after substantial completion and develop an ongoing commissioning plan.
4	4	0	EAc2	D	Arch/owner	Optimize Energy Performance	Recommend maximizing point sin this category as much as possible for long term building performance and to decrease the need to incorporate additional LEED credits. Energy Modeling was not done at Schematic Phase- points indicated are estimates To meet the requirements complete the following: Perform energy simulation to show annual cost savings over ASHRAE 90.1.2010 or T24 2013: Target at least 12%savings = 4pts. Every 2% increase in savings is 1pt.
0	1	0	EAc3	D	Owner/MEP	Advanced Energy Metering	Meeting requirement due to Title 24 load disaggregation rules. Refer to MEP BOD/Plans for energy meter and submeter categories. To meet credit do the following : 1)Submeter for end uses which use more than 10% 2) Energy meters should have the following characteristics: record consumption and demand, Use local area network, building automation system etc and remotely accessible. Record hourly data or less and reporting hourly, daily, monthly, and annual energy use.

A	B	C	D	E	F	G	H
Yes	**Maybe**	**No**	**Credit #**	**Des/Con**	**Discipline**	**LEED Credit Name**	**Guidance**
0	0	2	EAc4	D		Demand Response	No current goals for the Demand Response program in project. To meet the credit requirement do the following: Investigate if any Demand Response program is available from utility. If available engage in minimum 1 yr program to do the following: 1. Install interval recording meters with BMS integration which accepts external price or control signal. 2. Develop a comprehensive plan for shedding at least 10% peak demand from annual energy obtained through EAp2 3. Include the DR processes in the scope of work for the Cmx authority, including participation in at least one full test of the DR plan. If there is no DR program then do all of the above and contact local utility representatives to discuss participation in future DR programs.
0	0	3	EAc5	D		Renewable Energy Production	No current goals for the renewable system in project due to existing campus wide PV installation. To meet the credit requirement provide owned or leased PV system for 1%, 5% or 10% of total building energy cost for 1 pt, 2 pt or 3pt respectively determined from minimum energy performance credit.
0	0	1	EAc6	D	MEP	Enhanced Refrigerant Management	Not meeting requirement. Past experience has found that VRF systems rarely meet this requirement due to amount of refrigerant in the system.
0	0	2	EAc7	D		Green Power and Carbon Offsets	No current goals for purchasing green power and carbon offsets.
4	4	5	Materials and Resources				
Y	0	0	MRp1	D	Arch	P_Storage and Collection of Recyclables	Meeting requirement. Refer to plans for location of Trash/Recycle area at loading dock. To meet requirement do the following: Calculate daily/weekly waste generation quantities and waste bin storage capacity (yards) for different waste types.
Y	0	0	MRp2	C	Arch	P_Construction and Demolition Waste Management Planning	Construction credit : Refer to specification section 01 35 66 sustainability certification procedures -1.6.3 Waste tracking for details on waste management. Contractor shall submit a “C&D Waste management and Recycling Plan” to divert 75 percent of the construction waste generated by the project from landfill disposal.
0	3	2	MRc1	C	Arch	Building Life-Cycle Impact Reduction	Currently not pursuing this credit. To meet the credit requirement: Early in DD phase. Perform whole building life cycle assessment for new buildings and show 10% reduction from baseline in 3 impact categories like global warming potential, acidification of land and water resources, depletion of strastophere etc.

A	B	C	D	E	F	G	H
Yes	Maybe	No	Credit #	Des/Con	Discipline	LEED Credit Name	Guidance
1	0	1	MRc2	C	Arch	Building Product Disclosure and Optimization - Environmental Product Declarations	Construction credit : Early in DD phase determine if pursuing. Credit has multiple compliance paths: Option 1 is easiest and requires identification of 20 materials from 5 different manufactures with appropriate Environmental Product Declarations (life-cycle assessments of manufacturing process). Paints, flooring, and insulation are typical candidates. The same product can be counted for multiple Material Resource Credits if applicable.
0	1	1	MRc3	C	Arch	Building Product Disclosure and Optimization - Sourcing of Raw Materials	Construction credit : Early in DD phase determine if pursuing. Credit has multiple compliance paths: Option 2 is easiest and requires 25% of project material costs come from sustainable sources(e.g FSC wood, recycled content, bio-based). Structural materials, flooring, and insulation are typical candidates. The same product can be counted for multiple Material Resource Credits if applicable.
1	0	1	MRc4	C	Arch	Building Product Disclosure and Optimization - Material Ingredients	Construction credit : Early in DD phase determine if pursuing. Credit has multiple compliance paths: Option 1 is easiest and requires identification of 20 materials from 5 different manufactures with complete Material Ingredient Disclosures. Paints and flooring are typical candidates. The same product can be counted for multiple Material Resource Credits if applicable.
2	0	0	MRc5	C	Arch	Construction and Demolition Waste Management	Construction credit: Will meet credit due to mandatory local C&D waste ordinances. Contractor must divert at least 75% of the total construction and demolition material from landfills; diverted materials must include at least four material streams.
15	1	0	Indoor Environmental Quality				
Y	0	0	EQp1	D	MEP	P_Minimum Indoor Air Quality Performance	Meets requirement - CA Code. Refer to BOD for ASHRAE 62.1.2010 design requirements.
Y	0	0	EQp2	D	Owner/Arch	P_Environmental Tobacco Smoke Control	Meets requirement. Indicate on plans the locations of no smoking signs on the property.

A	B	C	D	E	F	G	H
Yes	Maybe	No	Credit #	Des/Con	Discipline	LEED Credit Name	Guidance
2	0	0	EQc1	D	Arch/MEP	Enhanced Indoor Air Quality Strategies	To meet credit: 1) Install permanent entryway systems 10 feet long at all regularly used entrances. Acceptable entryway systems include permanently installed grates, grilles, slotted systems that allow for cleaning underneath, rollout mats. Entry system can include inside and outside components to met 10ft length. 2) Provide MERV 13 filters on HVAC equipment.
3	0	0	EQc2	C	Owner/Arch/ GC	Low-Emitting Materials	Construction credit: Will meet requirement - equivalent to CalGreen Code Utilize CalGreen compliant Low VOC paints, adhesives, finishes, carpets.
1	0	0	EQc3	C	GC	Construction Indoor Air Quality Management Plan	Construction credit. Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building.
1	1	0	EQc4	C	GC	Indoor Air Quality Assessment	Construction credit. Option 1 (1pt): Contractor will Install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cfm outdoor air per square foot with internal temperature of at least 60¡F and no higher than 80¡F (27¡C) and relative humidity no higher than 60%. Option 2 (2pts): Conduct air quality testing post-constructions to document contaminant levels are below threshold.
1	0	0	EQc5	D	MEP	Thermal Comfort	To meet credit: 1) Design HVAC system to meet ASHRAE Standard 55–2010, Thermal Comfort Conditions for Human Occupancy, with errata. 2) Provide calculations as per ASHRAE 55-2010 Section 5.2, Methods for Determining Acceptable Conditions in Occupied Spaces:
2	0	0	EQc6	D	MEP	Interior Lighting	Meeting requirement by designing as per T24 requirements: Following are requirements of credit: 1. Individual lighting control. 2.light fixtures with luminance of less than 2500 cd/m2 between 45 and 90 degrees from nadir 3. light sources with CRI of 80 or higher 4. For 75% of connected light load, use light sources with rated life of 24000 hours 5. Direct overhead lighting for 25% or less connected load. 6. FOr 90% of regular floor area meet the reflectance as follows: 85% ceiling, 60% walls, 25% floor

A	B	C	D	E	F	G	H
Yes	**Maybe**	**No**	**Credit #**	**Des/Con**	**Discipline**	**LEED Credit Name**	**Guidance**
3	0	0	EQc7	D	Owner/Arch	Daylight	Likely to meet credit: Calculations required. To meet the requirement complete the following: 1. Provide manual or automatic glare control devices for regularly occupied spaces 2. Demonstrate through annual computer simulations that spatial daylight autonomy is achieved for at least 75% of regularly occupied floor area. Parameters is set to 300 lux for 50% of hours between 8 and 6. 3. And annual sunlight exposure 1000,250 (ASE1000,250) of no more than 10% is achieved
1	0	0	EQc8	D	Arch	Quality Views	Jonas Center qualifies. Show details on plans for the following: 75% of all regularly occupied floor area must have at least two of the following four kinds of views: ·· multiple lines of sight to vision glazing in different directions at least 90 degrees apart; ·· views that include at flora, fauna, any movement or no obstruction for 7.5 meters. ·· unobstructed views located within the distance of three times the head height of the vision glazing; and ·· views with a view factor of 3 or greater, as defined in “Windows and Offices; A Study of Office Worker Performance and the Indoor Environment.”
1	0	0	EQc9	D	Owner/Arch/ MEP	Acoustic Performance	To meet credit: 1) follow acoustic bridging document recommendations for HVAC background noise, Sound transmission, Reverberation Time, and Sound Reinforcement. 2) provide acoustic calculations at design phase or measure sound levels post-construction.
3	3	0	Innovation	up to 5 Innovation points can be earned - the measures listed below are ones that have been pre approved by USGBC for other projects and appear to be applicable to Jonas Center			
1	0	0	INc2	D	Arch/MEP	Mercury free lamps	To meet the requirement do the following: Provide Mercury free lamps (all LED's) in interior and exterior.
1	0	0	INc3	C	Arch/MEP/G C	PBT: lead, cadmium and copper	To meet the requirement do the following: Lead: use solder and flux to connect plumbing pipe on site that meets the California AB1953 standard, Cadmium: Specify no use of interior or exterior paints containing intentionally added cadmium. Copper : use mechanically crimped copper joint systems; or specify that all solder joints comply with ASTM B828 2002, and specify and use ASTM B813 2010 for flux.
0	1	0	INc4		Owner	Green education	To meet the requirement do the following: Provide signage on site highlighting green features in project, Provide a user manual, Organize a guided tour of a facility.
0	2	0	INc5			Innovation credit:	To be selected from list of innovation credits provided by USGBC
1	0	0	INc2	D		LEED Accredited Professional	Meets requirement for having LEED AP in the team.

A	B	C	D	E	F	G	H
Yes	**Maybe**	**No**	**Credit #**	**Des/Con**	**Discipline**	**LEED Credit Name**	**Guidance**
3	0	0	Regional Priority				
1	0	0	RPc1	C		MRc5 C&D waste management	Automatically qualify for meeting 2 pt in credit MRc5.
1	0	0	RPc2	D		WEc1 Outdoor water use reduction	Automatically qualify for meeting 2 pt in credit WEc1.
1	0	0	RPc3	D		WEc2 Indoor water use reduction	Automatically qualify for meeting 4 pt in credit WEc2.
0	0	0	RPc4 0				
41	26	30					

Certified: 40 to 49 points, Silver:50 to 59 points, Gold:60 to 79 points, Platinum:80 to 110

Beyond Efficiency

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College of Marin, Indian Valley Campus - Bill and Adele Jonas Center
Owner's Project Requirements – June 2017

Prepared by Beyond Efficiency – Issued Dec 1, 2017

1	OWNER + USER REQUIREMENTS		
	Project overview, primary purpose, functional requirements, etc.		**Specific Target**
1.01	Project history & motivation	Bill and Adele Jonas had been looking for a community center to call "home". Went through a few site-specific designs but weren't able to afford to build new, so approached COM about partnership.	-
1.02	Owner	College of Marin; joint public-private partnership with Rotary ($5mil endowment)	-
1.03	Ownership term	Indefinite; Rotary partnership is 75 years	-
1.04	Utilities	PG&E (natural gas + electricity), North Marin Municipal Water District; geothermal plants produce hot and cold water (600 wells, pumps in building 27); power plant 1 (not geothermal) will service Jonas and Building 17- gas boiler and chiller, built in 1974, highly inefficient	-
1.05	Population served	Greater community mainly. Rotary has rights to use once per month. Students may be served in the future for kitchen/dining services only, not banquet facility. Very small student population. Banquet capacity: 300.	
1.06	Onsite staff	n/a	-
1.07	Intended usage	Special events, perhaps walkup café or other uses in the future. COM would like to maximize income potential.	
1.08	Occupancy schedules	Not yet established. Rotary luncheons ~100 people; 2-3 events per year may spill over into evening. Banquet functions 300 seat capacity (rented): typ events expected to be late afternoon/evening. One outcome could be that food is prepared for students on campus on a daily basis, with outdoor seating.	
1.09	Tenant requirements	n/a	-

1.10	Transportation options	Remote, end of bus line, car-centric. Bicycling not anticipated as feasible mode of transport for most visitors.	
1.11	Aesthetics	Honor the natural setting, bring the outdoors in, integrate natural materials, emphasize daylight. This facility is to be "unmatched" in Marin County regarding level of commercial kitchen, event capacity, beauty etc.	
1.12	IT requirements	Multimedia for banquet facility	
1.13	Systems automation & maintenance	Would like this project to establish new facility standards; existing COM buildings are all different. Prioritize familiar, proven systems: durability and reliability prioritized over efficiency. Chillers over heat pumps: do maintenance at central location.	
1.14	Safety & security	Site lighting: it's a rural campus so needs special attention on pathways, but still be Dark Sky compliant. Other considerations regarding access points, etc.? Security cameras?	Exterior lighting: Dark Sky compliant. Meet LEED light Pollution credit
1.15	Accessibility	High priority, want to go beyond ADA. System of sloped walks based on 5% (rather than 8% ramps); interior: stage with ramp; kitchen operations considerations; gender neutral restrooms (bldg. 18), Jonas not sure	
1.16	Expected building lifetime	50 years; prioritize investment in aspects of building that are permanent or long-lived (foundation, structure, insulation, skin) over things that are swapped out multiple times over the building lifetime (lighting, carpet)	
1.17	Fire safety	Wildland Urban Interface (WUI) zone	
1.18	Resource efficiency	Would like to salvage wood from existing building(s) and incorporate into new facility, but not in a way that requires maintenance or is durability issue, reuse for structural purposes is possible but not required. Would need to be tested for structural reuse.	

1.19	Quality & durability	Durable products and components requiring minimal maintenance and long replacement cycles where appropriate. Roof: NO FLAT roofs. Modified butterfly design OK if trough is thoroughly detailed. Overhangs preferred but not required for rainwater (comes from the west) and solar management. Cladding: NO WOOD, maintenance issue. Windows may need to be safety glazing (laminated) because tempered windows have been getting distorted. No press board material to be used in any casework. 15 year roof warranty. Paint must be washable; matte preferred; countertop lavatories (not wall mount)	
1.20	Warranties	Longer warranty periods prioritized	
1.21	Future & resiliency considerations	Design for future flexibility in space usage. Incorporate monitoring or fault detection systems to alert staff of issues such as an offline central system or water leak? Consider warming climate impacts for envelope and mechanical systems design? Use potable rainwater storage to anticipate extreme drought or potable water emergency?	

2 FINANCIAL PERFORMANCE

	Utility cost goals, parameters for determining cost effectiveness of measures, income potential, etc.		**Specific Target**
2.01	Construction costs	$13.1M	
2.02	Operations & maintenance (O&M) costs	No maintenance headaches. Avoid firepits, water features, green roofs	
2.03	Financial assessment strategies	Does team have option to "spend more for better"? YES. Lifecycle-based return on investment (ROI) analyses rather than simple payback calculations prioritized; energy efficiency measures that make financial sense.	
2.04	Income potential	COM has rights to rent out; cooking classes?; weekend coffee counter?	
2.05	Incentives programs	Savings By Design - pursue	Pursue SBD incentives

3 BUILDING CODES + SUSTAINABILITY PROGRAMS

	Building codes and programs relevant to the project		Specific Target
3.01	DSA	Required	
3.02	Title 24 energy code	Required; 2016 code	
3.03	CalGREEN	Some requirements, others not required but will meet; 2016	Meet all CalGREEN nonres req.
3.06	Certifications	LEED BD+C NC (v4). LEED is important but building program takes priority. Silver certification - Marin CC design sustainability standards req. for new buildings	LEED v4 Silver certification for Jonas Center; Bldg 18 excluded

4 COMMUNITY SUSTAINABILITY

	Community-based/"beyond the building" environmental performance goals		Specific Target
4.01	Education	Leverage project as environmental education tool: rain chains, educational signage, connection to organic garden nearby. We tend to be early adopters & "live on the edge" a bit--e.g. Tesla $7M grant. We like to showcase our efforts.	
4.02	Community	Connect to community: kitchen classes, catering, food truck prep, start up businesses; master gardener's group; farmers' market in parking lot; public coffee counter during off-hours	
4.03	Nearby properties for shared amenities	Larger campus includes poo, recreational and classroom buildings. Students can attend classes at either campus (IV or Kentfield) and some classes only offered at one location. (2) geothermal plants.	
4.04	Site integration	20' creek setbacks, existing walking trails, large organic farm	
4.06	Stormwater management	Most flow in this watershed doesn't come from us. No stormwater management plan in place. Permeable paving possibly; no space for bioswales. No goal to prefilter stormwater before releasing into creeks.	

4.07	Construction pollution	Construction pollution minimized with best management practices that are customized to the property and effectively implemented	CalGREEN req.
4.08	Construction waste	Construction waste minimized with resource-efficient design approaches, careful material takeoffs, and reuse of waste materials where appropriate	75% C&D waste diversion per LEED credit
4.09	Operations waste	Operations waste minimized with onsite recycling facilities and compost program for organic farm	Meet LEED prerequisite for recyclables
4.10	Sustainable materials	Sustainable materials such as FSC Certified or reclaimed wood, recycled content materials, and rapidly renewable products preferred	Pursue LEED credits for environmental product declarations, material ingredients disclosure, and possibly raw materials sourcing
4.11	Low-toxicity materials	Materials with low VOC emissions,	Meet CalGreen and LEED low-emissions credit

5 ENERGY EFFICIENCY

	Energy performance goals for the whole building and individual systems		**Specific Target**
5.01	Energy model performance	Maximize energy credits to pave way to LEED Silver. Perform modeling to assess performance of various options with regard to heating and cooling loads, site energy and costs, code compliance margin, and projected incentives awards.	Perform energy simulation to show annual cost savings over ASHRAE 90.1.2010 or T24 2013: Target at least 12%saving per LEED method
5.03	Passive design principles	No unmitigated concrete or metal thermal bridges	
5.04	Peak heating & cooling loads	External window shading optimized for effective shading (reduce cooling loads & minimize comfort & glare issues) on south and west façades	
5.05	Fuel preferences	Electricity, except gas for comm'l kitchen	

5.06	HVAC	Strongly prefer centralized systems (single chiller, not multiple heat pumps) from maintenance perspective.	
5.07	DHW	Hot water from district plant (PP 1)	
5.09	Lighting	Try to maximize LEED credits: Interior Lighting and Daylight	Target LEED Lighting and Daylighting Credits
5.11	Zoning	Zone HVAC to anticipate banquet facility being curtained off for smaller events	
5.12	Controls	Building controls technician to be hired; also have 2 techs	
5.13	Server/IT rooms	Will have AV/IT room	
5.14	Electric vehicle charging	Incorporate into parking plans. Refer to LEED credits for determining quantity	
5.15	Renewable energy	None planned now, only main parking lot (canopies/carports) for large array. Provide solar-ready features as per T24 code.	
5.16	Backup power	Emergency egress-	
5.17	Systems commissioning	LEED prereq	Meet LEED and T24 Cmx prerequisites
5.18	Electric load disaggregation	Disaggregate lighting from plugs to facilitate electricity tracking. LEED Advanced Energy Metering and Title 24 are targets	Target LEED Advance Energy Metering credit
5.19	Benchmarking	Benchmark with ENERGY STAR Portfolio Manager or sim tool per LEED Energy use information sharing	Meet LEED Energy Metering prerequisite
5.20	Monitoring	Target LEED Enhanced Cmx measure, which requires 1yr tracking. Develop ongoing electricity monitoring program to allow for troubleshooting of problem equipment, controls or management practices; and support ongoing understanding of energy usage for continuous feedback and improvement.	Target LEED Enhanced CMx credit

6 WATER EFFICIENCY

	Water conservation goals for the whole building and individual systems		Specific Target
6.01	Indoor water use	Work with FISHNICK regarding kitchen water usage. Select fixtures with lower flow than CalGreen fixture requirements	Target LEED Indoor Water Credit- 40% reduction from LEED baseline
6.02	Outdoor water use	Minimize potable water usage. Prioritize native, drought-tolerant, fire-resistant planting palettes.	Target LEED Outdoor water reduction of 50% over baseline
6.03	Recycled water	Not available on sight. Purple pipe underway, will be brought to golf course ~1 mile away, will be brought to campus at some point but not currently sufficient supply to meet demand	
6.06	Submetering	Meet LEED Water metering prerequisites and credits- Jonas center separately metered. Landscape submetered	Target LEED Enhanced water metering credit

7 ENVIRONMENTAL QUALITY (EQ)

	Goals for each unique program space		Specific Target
7.01	Lighting, interior	Maximize LEED lighting credits.	
7.02	Lighting, exterior		
7.03	Lighting, security	Discussed, see other section	
7.04	Light pollution	Dark Sky compliance; light pollution minimized with appropriate fixtures, lumens and controls. Meet LEED requirement for Light Zone	Meet LEED requirement for light zone
7.05	Daylight	High priority; Enhance visual comfort in balance with energy performance, and coordinate with electric lighting system to minimize energy consumption.	Target LEED Daylighting credit
7.06	Views	Meet LEED credit for Access to Views in main occupied spaces	Target LEED Quality Views credit

APPENDIX B

Mechanical, Electrical, Plumbing, & Technology Basis of Design Dated November 21, 2017, 100% Schematic Design, By Glumac

Mechanical, Electrical, Plumbing, &Technology Basis of Design

College Of Marin Jonas Center

Prepared for

Brick
1266 66th St., Suite 1
Emeryville, CA 94608

November 21, 2017
100% Schematic Design

Job No. 01.17.00500

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PROJECT SCOPE

A. This project involves the renovation and expansion of two existing buildings on the College of Marin campus: Jonas Center (Building 19) and Building 18. Total square footage of both buildings is approximately 15,600.

B. Add Alternate #1: Interior renovation of Building 18. Base bid to include infrastructure and stub out for utilities for kitchen, restrooms, laundry, etc.

C. Add Alternate #2: Exterior scope for new connecting concrete walkway, associated guardrail and handrail.

CODES AND STANDARDS

Building codes and standards enforced by the Authority Having Jurisdiction including City of Novato code amendments:

A. 2016 California Building Code (CBC) based on 2016 International Building Code (IBC)

B. 2016 California Mechanical Code (CMC) based on 2016 Uniform Mechanical Code (UMC)

C. 2016 California Energy Efficiency Standards for Nonresidential buildings

D. 2016 California Electrical Code (CEC) based on 2014 National Electrical Code (NEC)

E. 2016 California Fire Code (CFC) based on the 2012 Uniform Fire Code (UFC)

F. 2016 California Plumbing code (CPC) based on the 2016 Uniform Plumbing Code (UPC)

G. 2016 California Green Building Code

H. Americans with Disabilities Act (ADA)

I. Division of the State Architect (DSA)

J. College of Marin District Standards

DIVISION 23 – HVAC

A. Outdoor design conditions:

1. Summer: 87°F DB/63°F WB (ASHRAE 0.4% or 0.5% depending on state)(ASHRAE 0.5%)

2. Winter: 25°F (ASHRAE median of extremes)

3. Climate Zone: 2

B. Indoor design conditions:

1. All conditioned areas:
   a) Cooling: 75°F+/-2°F
   b) Heating: 70°F +/-2°F

2. Exceptions:
   a) Elec. Rooms: 90°F +/-2°F maximum

3. Humidity control
   a) All areas, unless otherwise noted: none
   b) Data/telecom rooms: 20%-80% RH

C. Ventilation criteria:

1. All areas: 15 cfm/person or 0.15 cfm/sq.ft., whichever is greater.

2. Comply with California Building Energy Efficiency Standard.

3. Comply with Chapter 4 of CMC, Chapter 12 of CBC and ASHRAE 62.1.

<u>Building 19: Water-Cooled VRF</u>

The HVAC system for Building 19 will be comprised of a new water-cooled VRV heat recovery system with fan coil units for zone level heating and cooling. The HVAC system will consist of the following:

A. Two water-cooled VRV heat recovery systems (Daikin model RWEY) installed in the mechanical room. One 18-ton and one 12-ton. Provide new condenser water piping to units.

B. Horizontal indoor fan coil units (Daikin model FXMQ) will be installed under raised floor and above drop ceilings to provide conditioned air. Partially ducted return. Provide floor/ceiling access panels large enough for unit replacement. Provide field installed insulation for unit. Provide support blocks beneath fan coil unit where installed under floor. Additional VRV system components include:

1. VRF Branch Selectors
2. VRF DDC controller with iTouch Manager and BACnet interface.

3. Refrigerant piping between condensing unit, branch selector, and fan coil units with ¾" EPDM insulation for all piping.
4. Condensate piping from fan coil units to janitorial sink. May require condensate pumps.

C. Dedicated rooftop exhaust fan for each of the following:

1. Restrooms and janitors closet (Approx. 200 CFM)
2. Kitchen (Approx. 1,750 CFM)

D. One (1) water-cooled DOAS unit (Addison Model PRRW, Approx. 4,800 CFM) for ventilation air installed in the mechanical room. Provide 20 SF of louver (50% net free area).

1. Variable speed redundant fans.
2. DX coil for heating and cooling.
3. Dual compressors.
4. Equipment pad and vibration isolation.

E. Two gravity relief louvered penthouses. Greenheck Model WRH with motorized damper interlocked with DOAS unit.

Building 19 Air Distribution

In general, supply air will be provided by overhead diffusers. However, supply air to the banquet hall perimeter zones will be provided by underfloor distribution and linear bar grilles. Underfloor ductwork will require the following:

1. Title 24 compliant insulation.
2. Provide vapor barrier on underfloor ductwork.
3. Provide watertight sealant on all flanges and screw heads.

Building 18 Water-Cooled VRF

For this option, the HVAC system for Building 18 will be comprised of a new water-cooled VRV heat recovery system with fan coil units for zone level heating and cooling. The HVAC system will consist of the following:

A. One (1) 6-ton water-cooled VRV heat recovery system (Daikin model RWEY) installed in the mechanical room. Provide new condenser water piping to unit.

B. Four (5) cassette type indoor fan coil units (with outside air connection) will be installed above through ceilings to provide conditioned air. Provide field installed insulation for unit. Additional VRV system components include:

1. VRF Branch Selectors
2. VRF DDC controller with iTouch Manager and BACnet interface.
3. Refrigerant piping between condensing unit, branch selector, and fan coil units with ¾" EPDM insulation for all piping.

4. Condensate piping from fan coil units to janitorial sink. May require condensate pumps.

C. Dedicated rooftop exhaust fan for each of the following:

1. Restrooms and janitors closet (Approx. 100 CFM)
2. Kitchen (Approx. 7,000 CFM)
3. Dishwashing room (Approx. 200 CFM)

D. One (1) make-up air unit (Addison Model PRRW Approx. 6,300 CFM) for kitchen make up air installed in the mechanical room. Provide 25 SF of louver (50% net free area).

1. Variable speed redundant fans.
2. DX coil for heating and cooling.
3. Dual compressors.
4. Equipment pad and vibration isolation.

<u>AV Equipment Cooling</u>
Per the AV Systems Engineering Report – 50% SD by Shalleck Collaborative, inc. dated June 16, 2017, the AV equipment in the Banquet Hall AV Closet will generate 2kW of cooling load. An exhaust fan with louvered door intake as recommended by the report will be sufficient to cool the room. A dedicated WSHP can be provided if additional cooling capacity is required.

DIVISION 22 - PLUMBING

A. The design includes the following notable features, but is not limited to this scope. Contractor is responsible for reviewing all contract documents and coordinating with all disciplines.

1. Provide and install new plumbing fixtures at locations as shown on the architectural plans. Rough-in, install and make final connections to all plumbing fixtures.

2. Domestic cold water system: Existing water service and distribution piping to be demolished. New domestic cold water services and distribution piping will be provided for building 18 and Jonas Center from the city water main. Metered service will be provided to the building potable water system at a point five (5) feet from each building. New distribution piping system will be provided to serve the new production and banquet kitchens, laundry, lounge, restrooms, janitor closet and back of house spaces. Pipe sizes to be determined)

3. Domestic hot water system: Existing domestic hot water equipment and piping distribution system to be demolished and removed. New domestic hot water heaters and piping system will be provided to serve building 18 and Jonas Center, for the new production and banquet kitchens, laundry, lounge, restrooms, janitor closet and back of house spaces. (Location and number of hot water heaters, type and sizes to be determined)

4. Natural gas system: Existing gas meter and piping to be demolished. New gas service and gas meter assembly with seismic gas shut-off valve to be provided for building 18 and Jonas Center, for the kitchens, laundry and or the water heaters. (Pipe sizes and water heater fuel to be determined)

5. Sanitary waste and vent system: Existing sanitary waste and vent piping to be demolished and removed. (Except the underground waste mains to be capped below floor and to be abandoned) New sanitary waste and vent system will be provided to serve building 18 and Jonas Center, for the new production and banquet kitchens, laundry, lounge, restrooms, janitor closet and back of house spaces. Building drains and building sewers, to five (5) feet outside building. (Pipe sizes to be determined)

6. Grease waste system: New grease interceptors and or grease traps, and grease piping system will be provided for the production and banquet kitchens in Building 18 and Jonas Center. Grease interceptor for Building 18 to be located outside at the parking lot. Grease trap for Jonas Center to be located inside the kitchen per food service consultant correspondence. (Grease interceptor and grease trap locations, sizes and pipe sizes to be determined)

7. Storm drainage system: Existing storm drainage gutter and downspout system and piping for building 18 to remain and to be reused. Modify existing storm drain system to suit new architectural layout as required, and modify existing design to comply with C3 for storm water management. Provide and install new roof drains as indicated on the architectural drawings for Jonas Center. New design to comply with C3 for storm water management.

B. Outdoor design conditions (for insulation and gas firing criteria):

1. Winter: 30 °F (ASHRAE 0.2%, Novato, CA)
2. Elevation: 370 ft.

C. Water supply:

1. Minimum available water pressure (static): TBD psi.
2. Cold water pipe sizes: 2 inches for each building. (TBD)
3. Cold water meter size: TBD inches (minimum)
4. Cold water demand: TBD gpm (design total)

D. Domestic hot water:

1. Domestic hot water supply temperature: 140 °F (Kitchens & Laundry)
2. Domestic hot water recirculation temperature: 120°F.
3. Above this temperature the recirculating pump will be off.
4. Domestic hot water heater set point temperature: 140°F
5. Domestic hot water supply temperature: 120 °F (Public areas & restrooms)
6. Domestic hot water recirculation temperature: 110°F
7. Above this temperature the recirculating pump will be off.
8. Domestic hot water heater set point temperature: 120°F
9. Domestic incoming cold water temperature: 50°F (used for water heater sizing)

E. Sanitary sewer:

1. Building sewer sizes: 4” inches at 2% slope for each building.
2. Total capacity TBD drainage fixture units
3. Connected load TBD drainage fixture units

F. Storm drain:

1. Rainfall intensity 1.5 inches/hour (per local ordinance)

2. Storm drain pipe size: TBD inches at 1% slope.

G. Natural gas service:

1. Gas provider: Pacific Gas & Electric Company
2. Delivery of low pressure gas: TBD inches water column
3. Delivery of medium pressure gas: TBD psi
4. Maximum demand: TBD cubic feet per hour.

H. Seismic:

1. Anchorage and restraints must be coordinated with structural engineer and authority having jurisdiction.

I. The plumbing system includes the following sustainable design features:

1. Ultra-low flow water flow of 1.28 gallon per flush at each toilet.
2. Ultra-low flow water flow of 1/8 gallon per flush at each urinal, with the option of utilizing waterless urinals.
3. Electronic sensor type lavatory faucets for reduced water flow at 0.5 gpm.
4. High efficiency domestic hot water heaters.

GENERAL SPECIFICATIONS OF PLUMBING MATERIALS

A. All new hot & cold water piping will be Type “L” hard drawn copper tubing with wrought copper fittings. Lead free soldered, continuously insulated and labeled every 20 ft. and once in every room. Valves will be included for code minimum, tenant unit shut off and located strategically for maintenance purposes.

B. All new above grade waste and vent piping and fittings will be no-hub service weight cast iron.

C. All new below grade waste and vent piping and fittings will be no-hub epoxy coated service weight cast iron pipes by Newage Casting.

D. All new storm drain piping and fittings will be no-hub service weight cast iron.

E. All new gas piping shall be schedule 40 black steel pipe, threaded joints, with welded fittings above 2”.

F. All condensate drain pipes to be type L hard drawn copper tubing with wrought copper fittings.

G. All hot and cold water, and condensate drain piping shall be insulated.

H. All aspects of the plumbing system shall comply with the lead free Ordinance AB 1953. (California Health and Safety Code section 116875)

I. All exposed plumbing fixture pipes to be protected per ADA requirements.

DIVISION 21 - FIRE PROTECTION

A. Existing conditions: Building 18 does not have a sprinkler system. Building 19 (Jonas Center) is partially protected by an automatic fire sprinkler system consisting of a 3" fire water main. Sprinkler serve the corridors and public areas only. Existing system to be demolished and replaced with a new fully automatic sprinkler system.

B. Provide and install new automatic fire sprinkler system for Building 18 and the new Jonas Center.

C. Fire protection system to be by the design build contractor and the installation shall be in accordance with applicable codes, City of Novato Fire Protection District, and California State Fire Marshal requirements.

D. Fire protection system installation shall be done by licensed C-16 contractor. The fire protection contractor shall be the engineer of record for the automatic sprinkler system.

E. Fire Protection contractor to provide a complete and functional fire sprinkler system with approvals from all authorities having jurisdiction on the project. Including design and installation. Any information including in this BOD is for reference only and it is the responsibility of the design/build contractor to well verse in the requirements of the authorities having jurisdiction and the City of Novato in which the system will be installed. It is the sole responsibility of the designer to provide and install an approved system meeting the requirements of the local codes, and officials.

DIVISION 26 – ELECTRICAL

A. The scope of work shall include all power, lighting, lighting controls, equipment connections, fire alarm, and testing of all electrical equipment and systems. All labor, materials, equipment, and services necessary shall be furnished to construct and install complete and operational, the building electrical system.

   1. Power distribution shall include transformers, feeders, and distribution panels.

   2. Branch circuit distribution shall include all power and lighting panelboards, conduit, wiring, and devices.

   3. Lighting system and controls shall comply with 2016 Building Energy Efficiency Standards.

B. Electrical Distribution System

   1. Buildings 18 and 19 are currently served at 480V, 3-phase power from Power Plant #1, located adjacent to the pool complex. The intent is to continue to feed the buildings from the existing source. A new breaker shall be provided at Power Plant #1 along with a new feeder to serve the renovated buildings.

   2. Provide the following distribution equipment to serve the buildings:

      a. 600A, 480/277V Main Distribution Panel (MDP) with 600A main. The MDP shall be rated as service entrance equipment and will be located in the main electrical room in Building 18, adjacent to the loading dock. The MDP will be fed from Power Plant #1 and will feed the following equipment:

      b. 100A, 480/277V Lighting Branch Panelboard.

      c. 100A, 480/277V Branch Panelboard to serve HVAC loads.

      d. 112.5kVA step-down transformer to serve 120/208V loads. The transformer will serve a 400A, 120/208V Distribution Panel which will feed the following equipment:

      e. 150A, 120/208V Branch Circuit Panelboard to serve receptacle loads in Building 19. The panelboard will be located in Building 19.

      f. 225A, 120/208V Branch Circuit Panelboard to serve kitchen loads.

   3. Electrical Equipment

      a. All equipment shall have copper bussing and be fully rated; series rating is not allowed.

4. Conductors and Cables

    a. All conductors to be copper complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

    b. Feeders: solid for No. 10 AWG and smaller; stranded for No 8. AWG and larger.

    c. Branch Circuits: solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

    d. Insulation to be type THHN/THWN-2, minimum 75 degrees C. Feeders sized Number 2 AWG and above shall be type THW, 75 degrees C, or THHN, 90 degrees C.

5. Metal-clad Cable, Type MC

    a. All conductors to be copper complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

    b. Ground conductor to be insulated.

    c. Insulation to be type THHN/THWN-2.

    d. Use of MC Cable is not allowed in all areas with an exposed ceiling.

6. Advanced energy metering: provide submetering of each load type (lighting, receptacles, HVAC).

C. Electrical Grounding System

1. The National Electrical Code (NEC) mandates certain grounding practices for electrical systems. These include systems for the electric utility, on-site power generation and distribution and other separately derived systems. This consists of copper ground conductors, ground buses and ground rods. A copper building main reference ground bus will be provided in the main electrical room (Building 18). It will connect to the main distribution panel, to the main incoming water line, to the UFER grounding electrode, to building steel and to the neutral point of all local transformers.

2. Provide ground conductors in all feeders.

3. Equipment (Safety) Ground: The NEC requires all electrical equipment to be grounded and all metallic piping, structure or other equipment which may accidentally be energized and become a safety hazard, be bonded to the same electrical grounding system. The objective of these requirements is to provide safe operating conditions by reducing the difference of voltage potential between any two metal parts that are likely to be energized to as little as practicable.

D. Equipment Connections

1. Connections will be made for all mechanical equipment. All large motors will be wired for 480V, 3-phase power. All small motors will be wired for 208V or 120V, 1-phase power.

2. All feeders to mechanical equipment will utilize stranded conductors and fed from dedicated mechanical panel.

3. Provide 120V power connections to motorized shades in Banquet Hall, Offices, and Conference Rooms.

4. Provide 120V power connection to fire place.

5. Audio Visual Power

    a. (4) 120V, 20A dedicated circuits (standard building power) for AV equipment rack.

    b. (2) 120V, 20A dedicated circuits (standard building power) for projection screen and projector.

E. Convenience Power Outlets

1. Convenience power outlets shall be provided to meet all applicable codes and standards. Convenience outlets will be provided every 50’ on center throughout the space.

2. The maximum number of convenience outlets on one circuit will be six. Maximum loading of lighting branch circuits will be 60% (i.e., 12 amps).

3. Dedicated circuits will be provided for telephone board, and specialty areas, as required.

4. Include the following:

    a. Tamper-proof and GFCI type receptacles where required by code.

    b. 20A, weatherproof, GFCI type receptacle on roof and exterior walls within 25’ of all mechanical and plumbing equipment.

    c. 20A, weatherproof, GFCI type, flush-mounted receptacle on exterior walls near each building entry.

    d. Floor boxes in Banquet Hall.

    e. All switches and receptacles will be labeled with panel and circuit number.

    f. Ground fault circuit interrupting (GFCI) devices will be provided as required by Code, and specifically within all exterior locations and near sources of water or other liquids.

g. Controlled receptacles in conference rooms, private offices, and lobby as required by the 2016 Building Energy Efficiency Standards (T24).

F. Electrical Studies

1. Contractor shall perform short circuit and arc-flash studies for electrical distribution system to determine final short circuit rating of equipment and to provide PPE labeling as required by code.

G. Lighting and Controls

1. Energy efficient LED light fixtures will provide the space with comfortable, beautiful, and functional illumination. The design goal for the lighting is to decrease the operating costs due to wattage per square foot, increase the quality of lighting, and increase the ease of user controllability. Provide LEDs rated at 50,000 hours of operation with replaceable boards for ease of maintenance in the future.

2. Refer to Appendix A for lighting fixture recommendations for each space.

3. The lighting design will use the Illuminating Engineering Society (IES) recommended lighting levels for each type of space.

i.	General Offices	30 to 40 fc
ii.	Banquet Hall	40 to 50 fc
iii.	Lounge	30 fc
iv.	Kitchen	50 fc
v.	Corridors	10 fc
vi.	Restrooms	15 to 20 fc
vii.	Changing Rooms	20 fc
viii.	Storage Rooms	15 to 20 fc
ix.	Electrical/Mechanical Rooms	15 to 20 fc

4. Lighting control system shall use a combination of control relay control panel (with time clock and photocell functions) and local occupancy/motion sensors (ultrasonic/infrared type).

5. Basis of design product for lighting controls will be Wattstopper DLM system, fully networked and tied into BACNet IP based BMS system.

6. The lighting design will use only LED source lighting fixtures which are to be compatible with the 0-10v dimming control system.

7. All areas shall be provided with lighting controls to meet the 2016 Building Energy Efficiency Standards. This includes:

a. Occupancy sensors in offices 250 SF or smaller, storage rooms, and janitor rooms.

b. Partial on/off occupancy sensors in corridors.

c. Automatic daylighting control.

d. Dimming in enclosed spaces larger than 100 SF and with a connected general lighting load greater than 0.5 W/SF.

e. Demand Response: Lighting controls shall be capable of receiving and automatically responding to demand response signals to at least 15% of total building lighting load. Lighting shall be dimmed in a uniform light level reduction or in non-essential spaces with load adding up to the required reduction.

f. Provide all necessary Title 24 documentation on plans as well as all commissioning of lighting control systems as required to obtain final occupancy.

8. Light fixtures designated for emergency egress illumination shall be connected to centralized battery inverter.

H. Emergency Power

1. Provide 8kW, 277V, single-phase battery inverter to serve as back-up power to emergency egress lighting. Inverter to contain output breakers to serve loads.

2. Provide generator hook-up near loading dock for portable generator connection. Generator size is to be determined based on loads selected by the District to be on generator back up.

I. Solar Ready

1. Provide solar zone(s) on roof that is unshaded and free of obstructions to serve as a suitable place for future solar panels.

2. Total solar zone to be no less than 15% of the total roof area; approximately 3,000SF for this project. The solar zone design must comply with access, pathway, and spacing requirements as specified in Title 24, Part 9 or in any requirements adopted by the local jurisdiction.

3. Indicate location for future inverters and metering equipment for future solar electric system.

4. Indicate pathway for routing of conduit from solar zone(s) to the point of interconnection with the electrical service.

DIVISION 27 – TELECOMMUNICATIONS

A. The Technology low voltage systems for the College of Marin Campus: Jonas Center (Building 19) and Building 18, California. are designed to meet and exceed the IT Standards, applicable codes and industry standards (listed below). Our Technology Integration approach focuses on delivering a state of the art user experience while maximizing IP convergence efficiency. Our systems design approach allows for the Jonas Center (Building 19) and Building 18 staff to better manage their inside plant by including strategies that allow for future growth and scalability of systems. Ease of management systems will allow for monitoring of IP systems from a simple PC dashboard platform, hand-held device or wireless tablet.

B. Standards

- BICSI TDMM (Telecommunications Distribution Methods Manual), 13th Edition
- BICSI Outside Plant Design Reference Manual, 5th Edition
- ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
- ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
- ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard
- ANSI/TIA/EIA-569-D Commercial Building Standard for Telecommunications Pathways and Spaces
- ANSI/TIA/EIA-606-B Administration Standard for the Telecommunications Infrastructure of Commercial Building
- ANSI/TIA/EIA-607-B Commercial Building Grounding and Bonding Requirements for Telecommunications
- ANSI/TIA/EIA-758-B Customer-owned Outside Plant Telecommunications Infrastructure Standard

C. Telecommunications

1. Telecommunications – Outside Plant OSP:

   a. The outside plant work includes underground conduit system supporting various service providers' systems like voice, data and video connectivity from the street level to the building MDF/MPOE (main point of entrance).

2. Intra-building Infrastructure

   a. The project has been designed with a IDF room to allocate the IT/Data equipment and infrastructure backbone to support the network speed and reliability for the LAN and WLAN connectivity throughout the buildings.

   b. This traditional switched network architecture is based on 3- layer system: core, distribution and access. This traditional Ethernet architecture is based on the distribution of rack mounted network switches in IDF room.

c. The networked switched architecture relies mainly on a copper and fiber optic cable backbone, connectivity and horizontal distribution via CAT 6 structured cabling.

3. Horizontal Pathways

   a. An 18" wide cable ladder rack within the telecommunications rooms is mounted both horizontally and vertically to form a continuous runway. Outside the telecommunications spaces pathways are via deck mounted J-Hooks, with cable bundles no greater than 50.

   b. Conduits for Low Voltage copper: are used on two conditions: hard lid ceilings where the distance extends over 5'; and when the cable is permanent in an area that will not be accessible. Additionally, conduit is used from inside the wall. No conduit is less than 1" diameter. Conduits for Fiber Optics: Conduits carrying fiber optic cables will contain a multi-cell conduit liner, to future additional fiber to be pulled into the occupied conduit.

4. Horizontal Cabling

   a. Horizontal cabling is category 6 end-to-end solution (from a sole manufacturer). Each dedicated Ethernet data port (at the outlet) for each required location is routed from data outlet jack back to the designated IDF / MDF closet. All horizontal station cables fed from an IDF room. Horizontal cabling is terminated on a keystone jack at the outlet and the patch panel.

5. Work Station Outlet Distribution

   a. Workstations – (2) cables per workstation (Offices).

6. Floor boxes – (4) cables per data faceplate at each floor box,

7. Wireless Access Wi-Fi – (2) category 6 cables per access point.

8. BMS, Access Control, Fire Alarm, Network Lighting Control System, Network CCTV Camera System, Irrigation & other miscellaneous building systems: (2) cables per data faceplate, faceplates as required to support respective system topology.

9. CCTV Camera: (1) cable per plenum rated data "biscuit" termination device.

10. Emergency Blue Phones - (2) cables per location.

11. Coaxial outlets – TBD.

12. Phone outlets – (1) Cat 6 cable per outlet

13. Additional analog phone lines for – fire alarm systems, security systems, BMS controls.

14. Wireless LAN

    a. The standard wireless outlet should be a 2-port/cable configuration. The outlet placements shall be placed in a condensed format to support an 802.11ac Wi-Fi Standard throughout, as well as support the Bring Your Own Device (BYOD for HSIA guest access) environment of the facility. Power over Ethernet (POE) technology will be utilized to provide power to the WAP units. Local electrical outlets will not be necessary. Outlet jacks may have specific colors per use and configuration which shall be coordinated with the IT group.

    b. As a base guideline, we are providing (1) WAP per 1,000 sq. ft. Further detailed considerations will be made per building and room designs as well as user quantity and traffic.

15. Security

    a. The video surveillance system will consist of IP cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment. It will be capable of networking for remote monitoring by designated Jonas Center (Building 19) and Building 18 staff and provide reliable communication to campus police.

    b. Data storage will be sized and calculated for 90 days of storage space with high definition recording, or higher as required. Cameras will be located at the following spaces:

        i. Entry
        ii. Loading Dock
        iii. Kitchen
        iv. Prefunction Space
        v. Common Areas (Hallways, Building Entrance, Perimeters)
        vi. Building Perimeter

    c. The ACS (access control system) will include all necessary hardware, initial database programming, floor terminal controllers, door smart terminal interface panels, door alarm/status sensing devices, access cards, card readers, exit request push-button stations, step-down power supply transformers, conduit, wire and cable, communication devices (modems) required to enable the building to communicate with and receive data from the existing campus central station.

    d. The central control panel shall have a network card to allow connection to the Jonas Center (Building 19) and Building 18 network. Security system wiring shall be segregated from other systems. The central control panel shall be located in the IDF room and include a hinged, lockable cover.

16. ADA Compliant Assistive Listening System:

    a. The infrastructure for an Assistive Listening System (ALS) will be installed in the Banquet Hall. The ALS will be a mid-range infrared system that ensures participants in the banquet hall to receive direct and clear communication of the messages and clear sounds separating the background noise. The system works from a transmitter in the podium/ stage area to an emitter (for sound amplification) installed at the ceiling of the hall or high wall to provide a clear and unobstructed signal to the portable receivers in the floor area.

17. Refer to Audio Visual Narrative for additional scope of work for Division 27.

DIVISION 28 – FIRE ALARM

A. A multiplexed fire alarm system will be provided, which will include the fire alarm control panel (FACP) flush or semi-flush mounted enclosure. FACP to include spare circuits, points and power supplies equal to 120% of the total required.

B. Fire Alarm Control Panel: Mounted and located as required by the Owner and local AHJ, must include annunciation and status indicators for all initiating, indicating, signaling, and power circuits on the system. All indicators to be visible through the FACP doors, which will be locked at all times and can be opened only by authorized personnel.

C. Fire Alarm Central Station: All necessary equipment for notifying direct central station or Fire Department notification of all system alarm conditions will be provided.

D. Fire Alarm Devices: Horns and Strobes to achieve the required decibel level throughout the building will be provided. Strobes in combination with other required devices in each designated ADA residential unit will be provided.

E. Pull stations within reach of every stair door on every level of the building will be provided. Additional stations shall be provided so that no point is more than 200 feet from any pull station. Pull stations will be mounted at 48" AFF to operable portion of device.

F. Duct Smoke Detectors: For HVAC units in excess of 2,000 CFM a duct smoke detector in the supply system, downstream of the filter in all air-handling system on each floor at the point of entry into the common return and in all air-handling systems will be provided. All detector housings to incorporate a built-in test station. A remote alarm indicator for all detectors hidden from view will be provided.

G. Ceiling mounted heat detectors will be provided in the electrical rooms and as otherwise required by Code and the local AHJ.

GLUMAC
engineers for a sustainable future™

APPENDIX A: LIGHTING FIXTURE CUTSHEETS

L1: BANQUET HALL PENDANTS

Rev: 2016/04/20

CP3970 – OMNIENCE™
Aircraft Cable

VISA LIGHTING

Type: Project:

VisaLighting.com/products/Omnience

Fill in shaded boxes using information listed below

Order Code:	CP3970		–								
	MODEL	A SOURCE		B VOLTAGE	C FINISH	D DIFFUSER OPTION	E OPTION(S)	F OAH

A simple drum form provides sophistication in a wide range of spaces. This direct pendant fixture has a tailored minimal design while providing general and functional ambient light. Options for dimming, additional 10% uplight, or specialty diffusers are available. Pendants can be mounted on sloped ceilings up to 45°.

DIMENSIONS

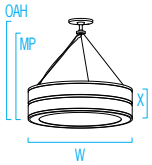
W = Width OAH = Overall Height
X = Body Height MP = Stem Accent Midpoint

OAH is the distance (in inches) from the bottom of the fixture to the ceiling plane. Example - OAH(36) indicates an overall fixture height of 36".
MP is the distance (in inches) from the bottom of the fixture to the bottom of the Stem Accent Junction.

F ⚠ OAH must be specified

W	26"	(660 mm)
OAH	24"	(610 mm)
X	6-3/4"	(171 mm)
MP	20-1/2"	(521 mm)

Structural blocking required
(see detail on page 2)



A SOURCE (Select one) B VOLTAGE (Select one)

MVOLT fixture accepts 120 through 277 input voltage
LED Sources are dimmable 0-10V to 10% and are 85CRI, within 3-step MacAdam

	LED Sources	CCT	Delivered Lumens	Power (Watts)	Voltage
•	**L30K**	3000K	8800	139	**MVOLT**
	L35K	3500K			
•	**L40K**	4000K			

Fluorescent Sources		Voltage
4F39	39W long twin tube, 2G11 base	Select **MVOLT, 120V** or **277V**

C FINISHES (Select one)

See page 2 for color chart

Powder Coat Painted Finishes (Standard)

AG7038	Agate Grey	**CVBL**	Cove Blue	**GW9002**	Grey White	**PB1035**	Pearl Beige
BMAT	Bronze Matte	**CW9001**	Cream White	**HTHR**	Heather	**RUST**	Rust
BRNZ	Bronze	**GLIM**	Glimmer	**JB9005**	Jet Black	**SUNG**	Sungold
BSIL	Blade Silver	**GSIL**	Graphite Silver	**OBRZ**	Old Bronze	**TW9016**	Traffic White

D DIFFUSER OPTIONS (Select one)

Diffuser is matte white acrylic if no option is selected

	IRP	Impact resistant polycarbonate lens
•	**VKMD**	Vara Kamin's Moon Drops©
•	**VKMM**	Vara Kamin's Morning Melody©
•	**VKPG**	Vara Kamin's Priscilla's Garden©
•	**VKSS**	Vara Kamin's Summer of Sundays©

Available only with L40K source

E OPTIONS (Multiple Selections Allowed)

⚠ Option availability may be interdependent with Voltage, Source or Other Options

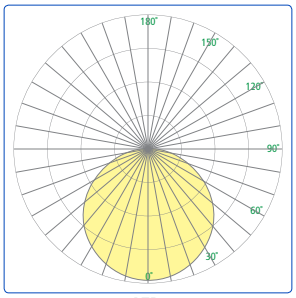
•	**DIM(A)**	Advance Mark 10 fluorescent dimming, specify 120V or 277V
•	**DIM(EB)**	Lutron EcoSystem digital link fluorescent dimming
•	**DIM(L)**	Lutron 3-wire fluorescent dimming
	FUSE	Fluorescent fusing, specify 120V or 277V
	IEM	Integral emergency battery pack for fluorescent, specify 120V or 277V
	UP10	Lensed aperture in housing produces approximately 10% uplight (not available with **IEM** option)
	XPS	Express 10 day shipping. Items marked with a bullet (•) are not available with **XPS**

XPS LED ETL Listed 5 Year Warranty

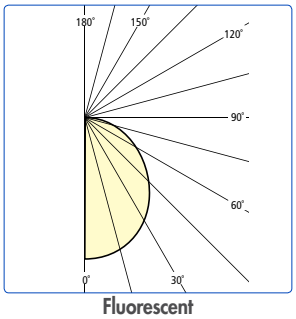
CP3970 – OMNIENCE™
Aircraft Cable

VISA LIGHTING

Photometrics

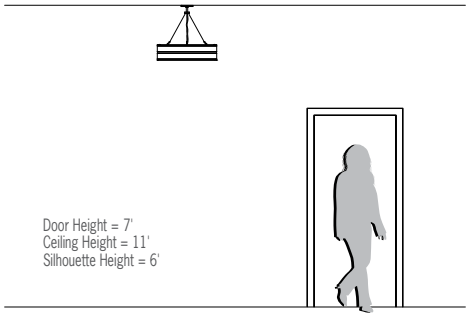


LED



Fluorescent

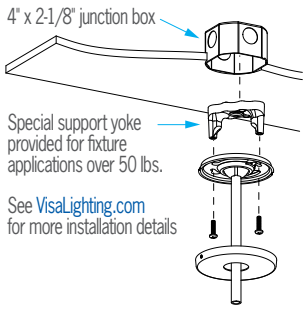
Relative Scale Drawing



Technical Information

- Integral power supply for LED
- Modular design for replacement of LED source and power supply
- High power factor electronic ballast for Fluorescent
- Easy tool-less relamping
- Mounts over 4" octagonal 2-1/8" deep electrical junction box (by others) to structural blocking (by others) with provided hardware for ceiling slopes up to 45 degrees from horizontal
- Rolled extruded aluminum housing with upper perforations to provide a luminous glow to reduce ceiling contrast
- 1/8" thick Lumieo™ white acrylic diffuser with matte finish
  - 55% transmission efficiency
  - UV stable
- Optional specialty diffuser materials available, including Vara Kamin's Impressions of Light® images, which are replicated from Vara Kamin's original works of art
- Optional 1/8" thick impact resistant polycarbonate clear lens cover
- No VOC powder coat paint finish
- ETL listed for damp locations (not suited for exterior applications)

Structural Blocking Detail



Specify color code when ordering. For accurate color matching, individual paint and finish samples are available upon request
For additional information see VisaLighting.com/materials-finishes

Painted Finishes (Standard)

TW9016
Traffic White (RAL9016)

CW9001
Cream (RAL9001)

GW9002
Grey White (RAL9002)

JB9005
Jet Black (RAL9005)

AG7038
Agate Grey (RAL7038)

HTHR
Heather

CVBL
Cove Blue

BSIL
Blade Silver

GSIL
Graphite Silver

GLIM
Glimmer

SUNG
Sungold

BRNZ
Bronze

OBRZ
Old Bronze

BMAT
Bronze Matte

PB1035
Pearl Beige (RAL1035)

RUST
Rust

CYLINDER
CY3

L2: BANQUET HALL & LOUNGE SUPPLEMENTAL LIGHTING

AND FRONT OF PLATFORM LIGHTING

CYLINDER LED LUMINAIRE
ADJUSTABLE SURFACE MOUNT

Aimable 3.24" diameter 7.4" tall LED for ceiling or wall mount. Perfect for applications having no plenum recess depth is available. Toolless hot-aim up to 90° tilt and 357° rotation. Available in 80+, 90+, 97+ CRI & Warm Dim. Delivered lumen range of 552lm to 2261lm. Lucifer Lighting developed proprietary field changeable optics available in 15°, 25°, 40° & 60° beams. Dry / Damp and Wet location.

Designates Quick Ship Product. Add "-QS" at end of model number for quantities up to 100 to ship within 5 days.

PERFORMANCE

80+ CRI PERFORMANCE (40° OPTIC)

LED Configuration	Delivered Lumens lm	Power Consumption W	Luminous Efficacy lm/W
80C-25A	1488	24	62
80C-38A	2261	41	55

90+ CRI PERFORMANCE (40° OPTIC)

LED Configuration	Delivered Lumens lm	Power Consumption W	Luminous Efficacy lm/W
90C-20A	1230	24	52
90C-31A	1868	41	45

97+ CRI PERFORMANCE (40° OPTIC)

LED Configuration	Delivered Lumens lm	Power Consumption W	Luminous Efficacy lm/W
97C-19A	1121	24	47
97C-28A	1704	41	41

WARM DIM 90+ CRI PERFORMANCE (40° OPTIC)

LED Configuration	Delivered Lumens lm	Power Consumption W	Luminous Efficacy lm/W
90W-11A	552	15	36

ORDERING INFORMATION - CYLINDER

CY3 - [ ] - [ ] - [ ] - [ ] [ ] [ ] - [ ] - [ ] - [ ]

CY3 ADJUSTABLE

CONFIGURATIONS
- AD Standard 60°
- 9D Max 90° Tilt [1]
- AS Standard 60° Shallow Canopy [2]
- 9S Max 90° Tilt Shallow Canopy [1,2]

RATING
- 1 Dry / Damp
- 2 Wet [1]

FINISH
- WH White (Powder Coat)
- BK Black (Powder Coat)
- AB Architectural Bronze (Powder Coat) [3]
- MA Machined Aluminum (Natural Aluminum with Clear Coat) [4]
- CF Custom Finish [5]

CRI / LED
- 80C 80+ CRI
- 90C 90+ CRI
- 97C 97+ CRI
- 90W 90+ CRI

SOURCE LUMEN
- 25A 2480lm
- 38A 3768lm
- 20A 2050lm
- 31A 3114lm
- 19A 1869lm
- 28A 2840lm
- 11A 2700lm

CCT
- 1 2700K
- 2 3000K
- 3 3500K
- 4 4000K
- 0 Warm Dim

OPTIC
- 1 15° [6]
- 2 25°
- 3 40°
- 4 60°

POWER SUPPLY
- CA1 120-277V 50Hz/60Hz 0-10V Analog
- CE1 120V 50Hz/60Hz Electronic ELV Reverse Phase
- RMT Remote Driver (See Remote Power Supply, see page 2) [7]

EFFECT DEVICES
- 0 No Lens [4,6]
- 1 Linear Spread Lens [4,6]
- 2 Honeycomb Louver [4,6]
- 3 Clear Glass Lens [6]
- 4 Soft Focus Lens
- 5 Frosted Glass Lens
- 6 Frosted Soft Focus Lens
- 7 Frosted Linear Spread Lens [4]
- 8 Spread Glass Lens [6]

[1] Only available with powder coat finishes
[2] Remote power supply only
[3] Subject to increased lead time
[4] Dry / Damp locations only
[5] Powder coat only, no plated finishes; custom finishes assigned unique suffix upon receipt of order, consult factory for additional cost
[6] Not available with 90W-11A Warm Dim
[7] Reduces delivered output up to 12% on all lumen packages, 14% on warm dim
[4] Dry / Damp locations only
[6] Not available with 90W-11A Warm Dim

MOUNTING OPTIONS - SELECT ONLY ONE (SEE PAGE 3 FOR MOUNTING PROVISION DETAILS)

ROUGH-IN
Concealed mounting plate

☐ **CY2/3-JBMP**

OR

FINISH-OUT
3" or 4" j-box surface mount kit

☐ **CY2/3-SMK-** [ ] - [ ]

J-BOX
- 3/0 3" j-box
- 4/0 4" j-box

FINISH
- WH White
- BK Black
- AB Architectural Bronze
- MA Machined Aluminum

OR

FINISH-OUT
Ceiling mount j-box for 1/2" EMT conduit (Dry / Damp location only)

☐ **CY3-CMJB-2I-** [ ]

FINISH
- WH White
- BK Black
- AB Architectural Bronze

OR

FINISH-OUT
Ceiling mount j-box for 3/4" EMT conduit (Dry / Damp location only)

☐ **CY3-CMJB-2I-1T-** [ ] - **3/4**

FINISH
- WH White
- BK Black
- AB Architectural Bronze

CONDUIT
- 3/4 3/4" conduit

[PH] +1-210-227-7329
[FAX] +1-210-227-4967

[DATE OF REV: 042117]

BORDEN LIGHTING

L3: LOUNGE BAR PENDANTS

Design Sustainability Value

CUSTOM GALLERY - CEILING/PENDANT

PROJECT: Cavallo Point Lodge at Fort Baker
ARCH: Architectural Resources Group
INT DES: Brayton Huges
LT DES: ALD, David Malman
SPEC No: 3D-2340 (2008)

This new hotel combines new construction and adaptive reuse of an old military facility. The hand-blown glass pendants provide both sparkle and ambient light for the bar. To minimize penetration of the pressed metal ceiling, the cords hang from a separate support tube.

Borden also made fixtures for the new hotel rooms. See the Wall Mounted section of the Application Gallery.

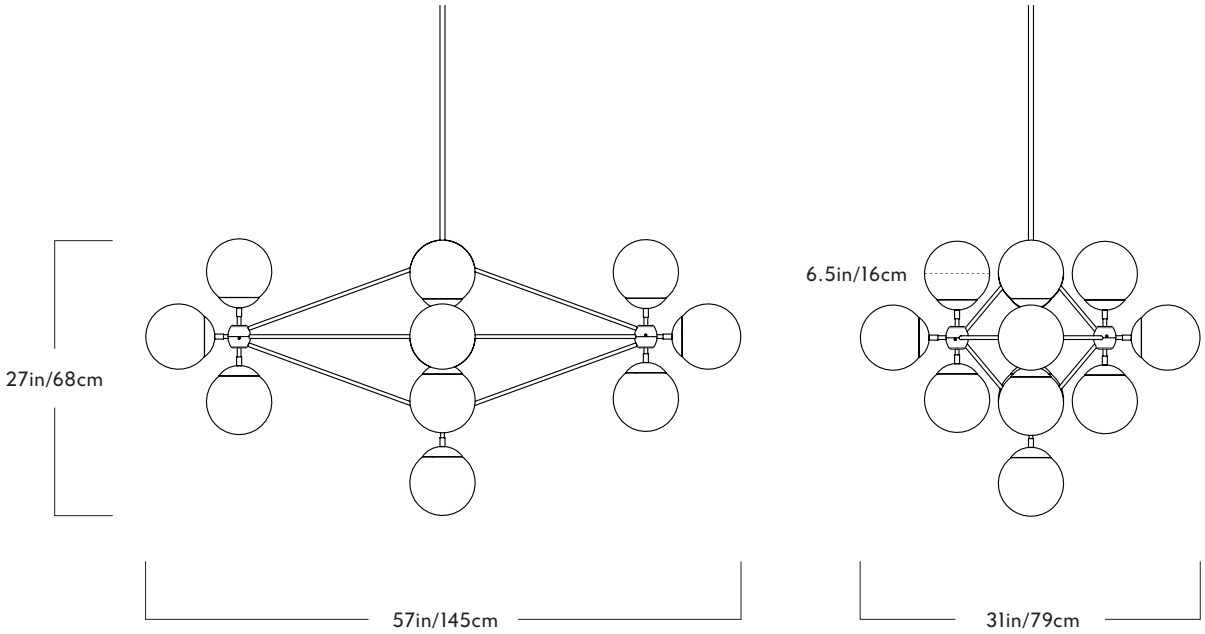
Click here to see drawing

999 Montague St • San Leandro, CA 94577 • ph 510.357.0171 • fax 510.357.3832 • www.bordenlighting.com

Roll & Hill

L4: LOUNGE
DECORATIVE PENDANT

32 33rd Street, Unit 10, Brooklyn, NY 11232
T +1 718 387 6132 F +1 718 387 6104
www.rollandhill.com



Modo

Chandelier - Diamond, 13 Globes

Series
Modo

Product
Chandelier - Diamond, 13 Globes

Dimensions
L 57in/145cm x W 31in/79cm x H 27in/68cm

Weight
19lb/8.6kg or 25.5lb/11.6kg (with cream globes)

Materials
Machined aluminum, glass

Finishes
Black, bronze, polished nickel, brushed brass

Glass Colors
Smoke, clear, cream

Suspension
1/2-inch aluminum stem in matching metal finish. 35-inch length included with lamp. 96-inch length available for additional cost. Stem length can be adjusted on site.

Canopy
5-inch round in matching metal finish

Certifications
UL, cUL (120V) CE, CB (240V)

120V/240V Illumination
Socket: E26/E27
Bulb: 13 x 25 Watt half-silver G25 or 13 x 40 Watt A19 (with cream globes)
Wattage: 325 Watts or 520 Watts (cream)
Lumens: 455 Lumens (smoke), 1300 Lumens (clear), 1625 Lumens (cream)
Color Temperature: 2300 Kelvin (smoke), 2500 Kelvin (clear), 2200 Kelvin (cream)
Dimming: Triac or ELV

LED Alternative
Socket: E26/E27
Bulb: 13 x 4 Watt G25 half-silver or 13 x 5 Watt A19 LED (with cream globes)
Wattage: 52 Watts or 65 Watts (cream)
Lumens: 1170 Lumens (smoke), 3510 Lumens (clear), 2340 Lumens (cream)
Color Temperature: 2500 Kelvin (smoke), 2700 Kelvin (clear), 2600 Kelvin (cream)
Dimming: ELV

Designed by Jason Miller, 2009

4.5" ROUND LED DOWNLIGHT

L5: CENTER OF PLATFORM RECESSED DOWNLIGHTS

L45
LED

CATALOG #:

TYPE

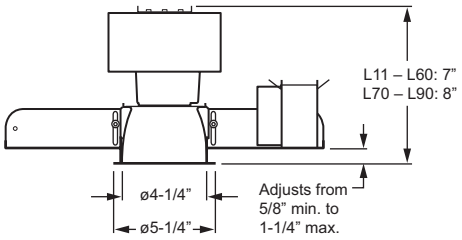
PROJECT:

NOTES:

EXAMPLE: L45 - L40C/835 - CS/M - OPTIONS - DIM - 120

L45	L40C/835	CS/M		OPTIONS	DIM	120
SERIES	LUMEN PACKAGE	CRI & CCT	REFLECTOR FINISH / DIST.	OPTIONS	DRIVER	VOLTAGE

CROSS SECTION



Pan Size: 12" x 16-1/4"
Ceiling Cutout: ø4-3/4"

FEATURES

- Rated for >55,000 hours at 70% lumen maintenance (L70).
- Module lumens from 1100 to 9000.
- 2700K, 3000K, 3500K, or 4000K color temperatures, minimum 80 or 90 CRI.
- LED module and driver accessible from below ceiling plane for ease of maintenance (up to 4000 lumens).
- Optional system-integrated emergency LED driver available.
- Optional wet location under covered ceiling available when specified with __/CAL or __/CGS option.
- Finned, extruded aluminum, passive heat sink dissipates heat for superior thermal management.
- Delivers quality illumination in a small 4.5" aperture.
- Integral pan throat field-adjusts to accommodate ceilings up to 1-1/4" thick.
- Self-flanged aluminum reflector offers maximum optical performance and provides crisp, clean installation without unsightly light leaks.
- Adjustable hanger brackets for bar hangers standard.
- Sturdy one-piece pan construction.
- This fixture is proudly made in the USA.

ORDERING INFORMATION

SERIES

L45	4.5" Round Downlight

LED PACKAGE

Nominal lumens based on CS reflector color and W distribution.
See page 2 for fixture performance data.

EXAMPLE: L40C/835				
LUMEN PACKAGE	NOMINAL LUMENS	MINIMUM CRI	MINIMUM CCT	AVERAGE SYSTEM WATTAGE
L11C	1000	**8** = 80 **9** = 90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K	15
L15C	1100			19
L20C	1500			26
L30C	2200			35
L40C	2800			39
L50C [1]	3100			51
L60C [1]	3500			64
L70C [1]	4200			62
L80C [1]	5800			72
L90C [1]	5900			80

[1] Available with DRV or DIM driver options only. Top access required for driver maintenance.

REFLECTOR FINISH

CS	Clear semi-specular (standard)
CG	Champagne gold
GD	Gold
PW	Pewter
SG	Satin-glow
SPC	Clear specular
STR	Straw
WH	Painted white reflector, textured (cannot be used with __/CAL or __/CGS)
WT	Wheat

DISTRIBUTION [1]

W	60° Wide
M	40° Medium
N	30° Narrow

OPTIONS

EM/12W	12-watt emergency battery (top access required)
EM/7W	7-watt emergency battery (top access required)
MWT	Matte white trim
AC/CAL	Accent cone with clear acrylic lens (wide distribution only)
MB/CAL	Micro-baffle with clear acrylic lens (wide distribution only)
AC/CGS	Accent cone with clear glass lens (wide distribution only)
MB/CGS	Micro-baffle with clear glass lens (wide distribution only)
LAD	Acrylic luminous disk (CS reflector only)
LADO	Acrylic luminous disk open (CS reflector only)
LAR	Acrylic luminous ring (CS reflector only)
WET/CC	Wet location, covered ceiling listed (when specified with __/CAL or __/CGS options).
WW	Wall wash (wide distribution only; not available with sloped adapter options, AC, MB, AC/___ or MB/___)

DRIVER

Additional dimming drivers available, see Technical Info.

DRV	Driver prewired for non-dimming applications
DIM	10% dimming driver prewired for 0-10V low voltage applications

VOLTAGE

120	120V
277	277V

[1] Beam angle/distribution does not account for options/accessories such as accent cone with lens, wall wash, acrylic accent rings, or alternate reflector finishes. Actual beam angle/distribution may vary. Consult factory with complete model number for approximate values.

L6: PLATFORM OPEN CEILING DOWNLIGHTS

6" LED CYLINDER

LC6

LED

CATALOG #:

TYPE:

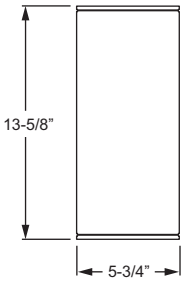
PROJECT:

NOTES:

EXAMPLE: **LC6** - **L40C/835** - **WHT** - **CS/M** - **OPTIONS** - **CM** - **DIM** - **UNV**

SERIES	LUMEN PACKAGE	CRI & CCT	HOUSING FINISH	REFLECTOR COLOR	DIST.	OPTIONS	MOUNTING	DRIVER	VOLTAGE
LC6	L40C	835	WHT	CS	M	OPTIONS	CM	DIM	UNV

CROSS SECTIONS



L11C – L15C Shown
Max. Weight: 8 lbs

FEATURES

- Self-flanged aluminum reflector prevents light leaks and is available in assorted colors.
- Standard cylinder colors are bronze, black, white, or silver aluminum (must specify when ordering).
- Custom colors available.
- Rated >50,000 hours at 70% lumen maintenance (L70).
- Minimum 80 CRI; 2700K, 3000K, 3500K, 4000K CCT.
- All-aluminum cylinder components dissipate heat for cooler operation.
- This fixture is proudly made in the USA.

ORDERING INFORMATION

SERIES

LC6 6" LED Cylinder

LED PACKAGE

Nominal lumens based on CS reflector color and W distribution.
See page 2 for fixture performance data.

EXAMPLE: L40C/835				
LUMEN PACKAGE	NOMINAL LUMENS	MINIMUM CRI	MINIMUM CCT	AVERAGE SYSTEM WATTAGE
L11C	1000	**8** = 80 **9** = 90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K	15
L15C	1100			19
L20C	1500			26
L30C	2200			35
L40C	2800			39

HOUSING FINISH

For custom color options, visit the LC6 at hew.com.[1]

ALUM	Satin silver aluminum
BLK	Textured black
BRZ	Textured bronze
NKL	Smooth nickel
SLV	Textured silver
WHT	Textured white

REFLECTOR COLOR

CS	Clear semi-specular (standard)
CG	Champagne gold
GD	Gold
PW	Pewter
SG	Satin-glow
SPC	Clear specular
STR	Straw
WT	Wheat
WH	Painted white reflector, textured

DISTRIBUTION [2]

W	60° Wide
M	40° Medium
N	30° Narrow

OPTIONS

EM drivers not available.
See page 3 for cord options and mounting details.

LAD	Acrylic luminous disk
LADO	Acrylic luminous disk open
LAR	Acrylic luminous ring

MOUNTING

See page 3 for cord options and mounting details.

CM__	Adjustable aircraft cable mount, 24" length standard (48" and 96" lengths available). Canopy painted white unless specified otherwise. Must specify cord, see page 3. **Example:** 24" cable = **CM24**
PM__	Pendant mount (specify length in 1" increments, minimum 4"), see back. Canopy and pendant match fixture housing color unless specified otherwise. **Example:** 24" pendant = **PM24**.
SM	Surface mount to octagonal J-box
QM	Quick installation canopy surface mount
WM	Wall mount
HM__	Hub mounting, specify length of arm (2"-6"). Hub ordered separately, see page 4 for details. **Example:** 3" arm = **HM03**

DRIVER

Additional dimming drivers available, see Technical Info.

DRV	Driver prewired for non-dimming applications
DIM	10% dimming driver prewired for 0-10V low voltage applications

VOLTAGE

120	120V
277	277V
UNV	120-277V

[1] For custom colors other than RAL, manufacturers' code plus two swatches (minimum 1" square) required.

[2] Beam angle/distribution does not account for options/accessories such as accent cone with lens, acrylic accent rings, or alternate reflector finishes. Actual beam angle/distribution may vary. Consult factory with complete model number for approximate values.

4.5" SQUARE LED DOWNLIGHT

L7: HALLWAYS/RESTROOMS/ CHANGING ROOM BLDG 19

LSQ45
LED

CATALOG #:

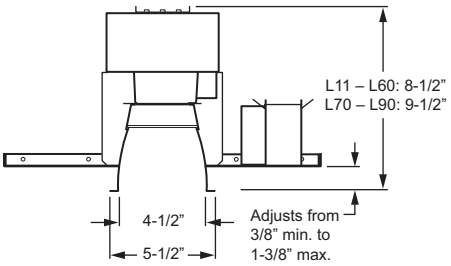
PROJECT:

NOTES:

EXAMPLE: **LSQ45** - **L40C/835** - **OPTIONS** - **NB** - **DIM** - **120**

SERIES	LUMEN PACKAGE	CRI & CCT	OPTIONS	MOUNTING	DRIVER	VOLTAGE

CROSS SECTION



Pan Size: 12-3/16" x 16-1/4"
Ceiling Cutout: 5-1/16" square

FEATURES

- Rated for >55,000 hours at 70% lumen maintenance (L70).
- Module lumens from 1100 to 9000.
- 2700K, 3000K, 3500K, or 4000K color temperatures, minimum 80 or 90 CRI.
- LED module and driver accessible from below ceiling plane for ease of maintenance (up to 4000 lumens).
- Optional system-integrated emergency LED driver available.
- Finned, extruded aluminum, passive heat sink dissipates heat for superior thermal management.
- Delivers quality illumination in a small 4.5" aperture.
- Integral pan throat field-adjusts to accommodate ceilings up to 1-3/8" thick.
- Self-flanged aluminum reflector offers maximum optical performance and provides crisp, clean installation without unsightly light leaks.
- Sturdy one-piece pan construction.
- This fixture is proudly made in the USA.

ORDERING INFORMATION

SERIES

LSQ45	4.5" Square LED Downlight

LED PACKAGE

See page 2 for delivered lumens and fixture performance data.

EXAMPLE: L40C/835				
LUMEN PACKAGE	NOMINAL LUMENS	MINIMUM CRI	MINIMUM CCT	AVERAGE SYSTEM WATTAGE
L11C	600	**8** = 80 **9** = 90	**27**=2700K **30**=3000K **35**=3500K **40**=4000K	15
L15C	700			19
L20C	900			26
L30C	1300			35
L40C	1700			39
L50C [1]	2300			51
L60C [1]	2500			64
L70C [1]	3000			62
L80C [1]	4200			72
L90C [1]	4300			80

[1] Available with DRV or DIM driver options only. Top access required for driver maintenance.

OPTIONS

EM/12W	12-watt emergency battery (top access required)
EM/7W	7-watt emergency battery (top access required)
MWT	Matte white trim
WW	Wall wash

MOUNTING

HB	(2) Hanger brackets with (2) bar hangers (rigid bar mounting)
NB	(2) Nailer bars (wood joist mounting)
TB	(2) T-bar hangers (grid ceiling mounting)

DRIVER

Additional dimming drivers available, see Technical Info.

DRV	Driver prewired for non-dimming applications
DIM	10% dimming driver prewired for 0-10V low voltage applications

VOLTAGE

120	120V
277	277V

L8: RESTROOM VANITIES

TC - RATED | LED | BUY AMERICAN ACT OF 2009 COMPLIANT

FINELITE

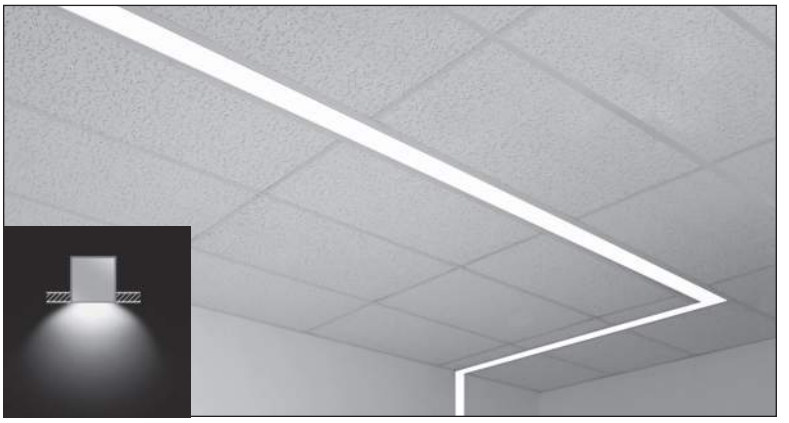
High Performance 4" Aperture (HP-4) - Recessed

Date

Project

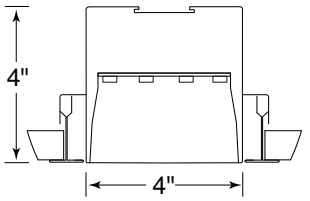
Type

Comments



DESCRIPTION

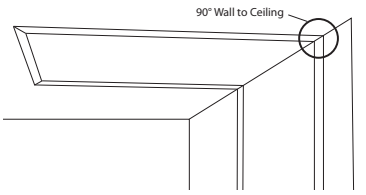
High Performance 4" Aperture Recessed (HP-4 R) is a patented, linear LED luminaire. HP-4 R is the first recessed linear LED luminaire to feature On-Grid™ mounting for standard lengths, making installation quick and easy.



Flush Diffuser (Standard)

DIMENSIONS & DIFFUSER

Glare-free experience is attained with mid-power LEDs and a precise diffuser to eliminate pixelation.



MITERED ANGLES

Fully illuminated corners have internal secondary diffusers to ensure against light leaks. Custom angles are available.

Tailored Lighting
10 working days

TAILORED LIGHTING

Any length greater than 2', in increments down to 1/16" (± 1/32") and 90° mitered corners in a single plane.

ORDERING GUIDE

Sample Number: HP-4 R - 32' - S - 835 - F - 120V - SC - C1 - OBO

HP-4 R [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Finelite **Series HP-4 R**
Length (Minimum **2'**, increments accurate to 1/16th" (± 1/32"), standard)
Light Output (**S** - Standard, **B** - Boosted Standard, **H** - High, **V** - Very High)
LED CRI/CCT (**830** - 80 CRI min, 3000K, **835** - 80 CRI min, 3500K,
840 - 80 CRI min, 4000K, **930** - 90 CRI min, 3000K,
935 - 90 CRI min, 3500K, **940** - 90 CRI min, 4000K
Downlight Diffuser Option (**F** - Flush (standard))
Voltage (**120V**, **277V**)
Circuiting (**SC** - Single Circuit)[1]
Mounting (**C1** - 1" T-Bar, **C2** - 9/16" T-Bar, **C3** - screw slot, **C3F** - flush screw slot, **VF** - Visible Flange,
C2T - 9/16" tegular, **C1T** - 1" tegular, **SF** - Spackle Flange, **TZ6** (C1, C2, C2T, C3, C3T) - tech zone 6")
Integrated Sensor (**OBO** - Occupancy Sensor, **OBD** - Daylight)

[1] Contact factory for switching options.

Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

Finelite, Inc. • 30500 Whipple Road • Union City, CA 94587-1530 • 510 / 441-1100 • Fax: 510 / 441-1510 • www.finelite.com

STATIC LED TROFFER

L9: PRODUCTION & BANQUET KITCHEN/DISHWASHING/DRY STORAGE/LAUNDRY/BLDG 18 HALLWAY

50 STATIC

LED

CATALOG #:

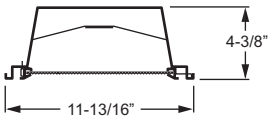
PROJECT:

NOTES:

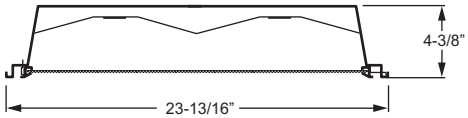
EXAMPLE **50 G - S 2 4 - L130/840 - S AF12125 - OPTIONS - DIM - UNV**

SERIES	CEILING TYPE	FIX. STYLE	NOM. W.	NOM. L.	LUMEN PACKAGE	CRI & CCT	DOOR FRAME	SHIELDING	OPTIONS	DRIVER	VOLTAGE
50	G	S	2	4	L130/840		S	AF12125	OPTIONS	DIM	UNV

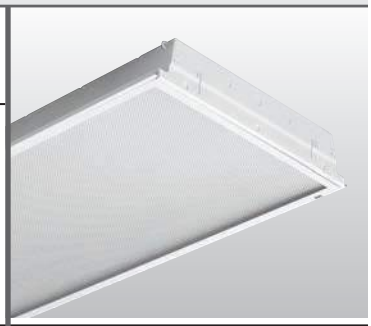
CROSS SECTIONS



1x4



2x2 | 2x4



ORDERING INFORMATION

SERIES

50	Static LED Troffer (no air handling)

CEILING TYPE

G	NEMA Type "G"
F	NEMA Type "F"

FIXTURE STYLE

S	Full door frame–no reveal

NOMINAL WIDTH

1	1' (4' length only)
2	2'

NOMINAL LENGTH

2	2' (2' width only)
4	4'

LED PACKAGE

EXAMPLE: L130/840			
LUMEN PACKAGE	NOMINAL LUMENS	MINIMUM CRI & CCT	AVERAGE SYSTEM WATTAGE
1x4			
L20	2,000	**830** = 80 CRI, 3000K **835** = 80 CRI, 3500K **840** = 80 CRI, 4000K **850** = 80 CRI, 5000K	22
L45	4,500		47
L65	6,500		76
2x2			
L20	2,000	**830** = 80 CRI, 3000K **835** = 80 CRI, 3600K **840** = 80 CRI, 4000K **850** = 80 CRI, 5000K	19
L41	4,100		47
L62	6,200		76
2x4			
L35	3,500	**830** = 80 CRI, 3000K **835** = 80 CRI, 3600K **840** = 80 CRI, 4000K **850** = 80 CRI, 5000K	34
L60	6,000		56
L90	9,000		94
L130	13,000		151

Nominal lumen output based on 3500 CCT. Actual lumens may vary +/-5%, see fixture performance table on page 2. Additional LED lumen packages available, see options.

DOOR FRAME

S	White flat steel
F	White flat aluminum
R	White regress aluminum
SB	Black flat steel
FB	Black flat aluminum
RB	Black regress aluminum

SHIELDING

AF12125	Frosted acrylic, pattern #12, .125" thick
A12125	Clear acrylic, pattern #12, .125" thick
A19156	Clear acrylic, pattern #19, .156" thick
PC12187	Polycarbonate, pattern #12, .187" thick

OPTIONS

For color options, visit the 50 LED online at hew.com.

For flexible whip options, see Technical Info.

EM/10W	10-watt emergency battery (120-277V only)
DG	Double gasket (flat aluminum door only)
TG	Triple gasket (flat aluminum door only)
EQCLIPS	Earthquake clips (4 per fixture)
(L__)	Additional lower lumen packages available. Specify in increments of 100 nominal lumens. Option must be specified with next higher lumen package. **Example:** 8,500 nominal lumens = 50G-S24-L90/850-**(L85).**
WET	UL/CUL listed for wet location under covered ceiling (flat aluminum door only).
CP	Chicago Plenum (CCEA)

DRIVER

Additional dimming drivers available, see Technical Info.

DRV	Driver prewired for non-dimming applications
DIM	10% dimming driver prewired for 0-10V low voltage applications

VOLTAGE

120	120V
277	277V
UNV	120-277V
347	347V (not available with EM drivers)

FEATURES

- Frosted prismatic lens provides pleasing diffused light without LED pixelation.
- Multiple dimming protocols available.
- Minimum 80 CRI; 3000K, 3500K, 4000K, or 5000K CCT.
- Fully-enclosed spring-loaded cam latches allow years of hassle-free maintenance.
- T-slot steel hinge ensures positive retention when door is opened.
- Deep reinforcement ribs provide added strength.
- Rolled-edge channel adds superior strength.
- Integral T-bar clips quickly secure fixture to structure. (2x2 and 2x4 only)
- Rated for direct contact with insulation.
- Fully gasketed door minimizes contaminants.
- All parts painted after fabrication to facilitate installation, increase efficiency, and inhibit corrosion.
- This fixture is proudly made in the USA.

L10: OFFICE/CONFERENCE ROOM

LED BUY AMERICAN ACT OF 2009 COMPLIANT

FINELITE

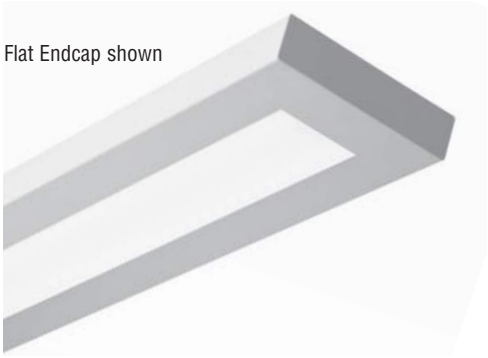
Series 16 LED Indirect/Direct - 2E, 3E, & 4E

Date

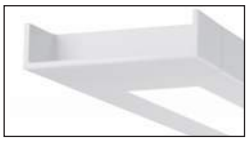
Project

Type

Comments



Flat Endcap shown



Extended Endcap

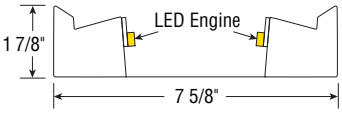
Signal White is standard finish

DESCRIPTION

Series 16 LED is a low profile rectilinear form scaled to blend into any interior architecture and is available with three light engine models - 2E, 3E, and 4E. The luminaire uses mid-power LEDs for long life and enhanced performance.

LIGHT ENGINES

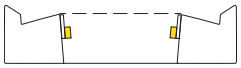
2-Engines



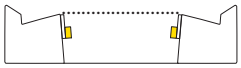
OPTIC & DISTRIBUTION RATIO OPTIONS

Open

Frosted Top Optic (FTO)

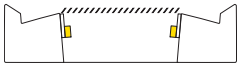


Clear Top Optic (CTO)



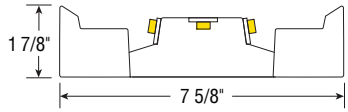
Distribution Ratios

Total Direct Optic (TDO)

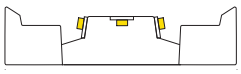


10%↑/ 90%↓ 30%↑/ 70%↓
20%↑/ 80%↓ 40%↑/ 60%↓

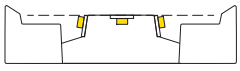
3-Engines



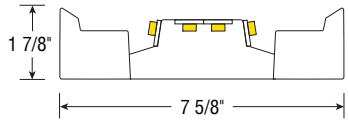
Open



Frosted Top Optic (FTO)

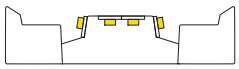


4-Engines



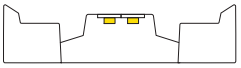
Available with factory presets in 3000, 4000, and 5000 lumens.

Distribution Ratios



10%↑/ 90%↓ 30%↑/ 70%↓
20%↑/ 80%↓ 40%↑/ 60%↓

Total Direct Optic (TDO)



NARROW LED STRIP

L11: ELECTRICAL/MECHANICAL /IDF/STORAGE/TRASH

75
LED

CATALOG #:

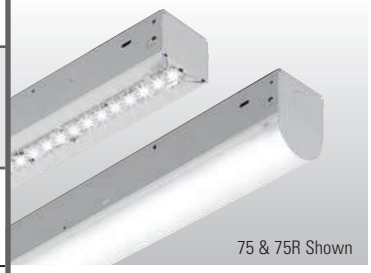
TYPE:

PROJECT:

NOTES:

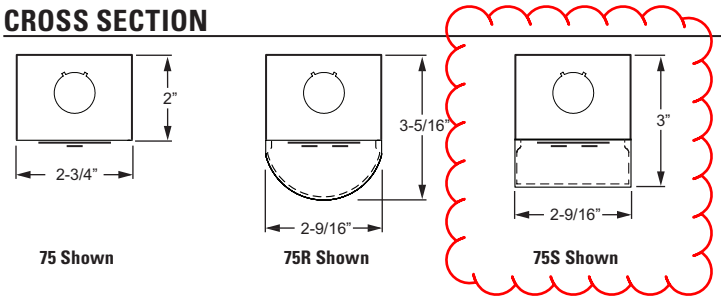
EXAMPLE: **75** - **4** - **L85/840** - **OPTIONS** - **DIM** - **UNV**

75	4	L85/840	OPTIONS	DIM	UNV
SERIES	NOMINAL LENGTH	LUMEN PACKAGE / CRI & CCT	OPTIONS/ ACCESSORIES	DRIVER	VOLTAGE



75 & 75R Shown

CROSS SECTION



75 Shown **75R Shown** **75S Shown**

FEATURES

- Small fixture profile allows inconspicuous placement in coves or confined spaces.
- Round and square lensed fixtures provide a clean look for architectural environments.
- Row applications produce continuous light with minimal interruption between fixtures.
- Diffuse acrylic lens on 75R and 75S enhances uniformity and minimizes glare.
- Variety of mounting accessories for surface and suspended applications.
- 3000K, 3500K, 4000K, or 5000K CCT.
- Special reflectors are available to provide precise light distribution (75 only).
- This fixture is proudly made in the USA.

ORDERING INFORMATION

SERIES

75	Narrow LED Strip
75R	Round Lens LED Strip
75S	Square Lens LED Strip

NOMINAL LENGTH

2	2′ (Actual length 22-1/2″)
4	4′ (Actual length 44-5/8″)
8	8′ (Actual length 89-1/4″)

LED PACKAGE

Example: L85/840			
LUMEN PACKAGE	**NOMINAL LUMENS**	**MINIMUM CRI & CCT**	**WATTAGE**
2′			
L15	1,500	**830** = 80CRI, 3000K **835** = 80CRI, 3500K **840** = 80CRI, 4000K **850** = 80CRI, 5000K	12
L20	1,900		20
L30	2,900		24
L40 [1]	3,800		33
4′			
L30	3,200	**830** = 80CRI, 3000K **835** = 80CRI, 3500K **840** = 80CRI, 4000K **850** = 80CRI, 5000K	23
L50	5,500		44
L65	6,600		49
L85 [1]	8,500		73
8′			
L60	6,500	**830** = 80CRI, 3000K **835** = 80CRI, 3500K **840** = 80CRI, 4000K **850** = 80CRI, 5000K	43
L100	10,900		77
L130	13,200		97
L170 [1]	17,000		146

Nominal lumen output based on 4000 CCT. Actual lumens may vary +/-5%. See specific photometric tests.

[1] Available with 75 only.

OPTIONS

C2_	Two circuit quick-connect wiring harness (See Technical Info for complete quick-connect offering.)
EM/10WLP	Low-profile 10-watt emergency LED battery (4′ and 8′ only; must specify 120V or 277V)
EM/10W REMOTE	Remote mount 10-watt emergency LED battery (2′ only; must specify 120V or 277V)

ACCESSORIES (ordered separately)

See page 4 for special reflectors, ordered separately.
Aircraft cable accessories available, see page 4.

WG-7511-LED	11-gauge white powder coat wireguard (available with 75 only)
WG-7514-LED	14-gauge white powder coat wireguard (available with 75 only)
315	1-1/2″ ceiling spacer
VBY	(2) Y-hangers
VBY-2	(2) Y-hangers and (2) 2′ chains
RA-75	Row aligner (required when mounting with aircraft cables)

DRIVER

Additional dimming drivers available, see Technical Info.

DRV	Driver prewired for non-dimming applications
DIM	10% dimming driver prewired for 0-10V low voltage applications

VOLTAGE

120	120V
277	277V
UNV	120-277V
347	347V (not available with EM drivers)

L12: EXTERIOR ROOF OVERHANG DOWNLIGHT

LED Ceiling-mounted downlights - narrow beam

Type:
BEGA Product:
Project:
Voltage:
Color:
Options:
Modified:

Housing: One piece die-cast aluminum for direct attachment to a 3 1/2" or 4" recessed octagonal wiring box using a mounting strap. Die castings are marine grade, copper free (≤ 0.3% copper content) A360.0 aluminum alloy.

Enclosure: Tempered clear glass, retained by a one piece, die-cast aluminum frame. Frame is secured by threading into luminaire housing. Fully gasketed for weather tight operation using a molded silicone rubber gasket.

Electrical: 26W LED luminaire, 31 total system watts, -30°C start temperature. Integral 120V through 277V electronic LED driver, 0-10V dimming. LED module(s) are available from factory for easy replacement. Standard LED color temperature is 3000K with an >80 CRI. Available in 4000K (>80 CRI); add suffix K4 to order.
Note: LEDs supplied with luminaire. Due to the dynamic nature of LED technology, LED luminaire data on this sheet is subject to change at the discretion of BEGA-US. For the most current technical data, please refer to www.bega-us.com.

Finish: All BEGA standard finishes are polyester powder coat with minimum 3 mil thickness. Available in four standard BEGA colors: Black (BLK); White (WHT); Bronze (BRZ); Silver (SLV). To specify, add appropriate suffix to catalog number. Custom colors supplied on special order

CSA certified to U.S. and Canadian standards, suitable for wet locations. Protection class IP65

Weight: 5.1 lbs.

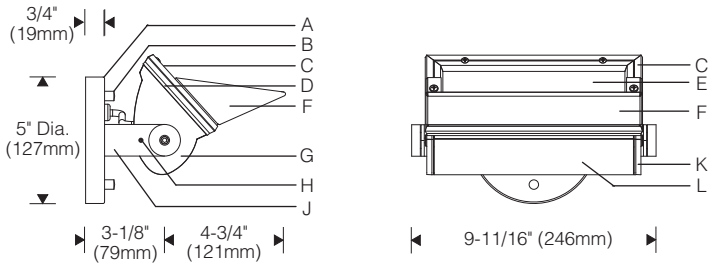
Luminaire Lumens: 1805
Tested in accordance with LM-79-08

	Lamp	β	A	B
66978	26W LED	21°	7½	6⅛

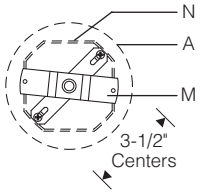
β = Beam angle

L13: EXTERIOR OVERHANG UPLIGHT BLDG 19

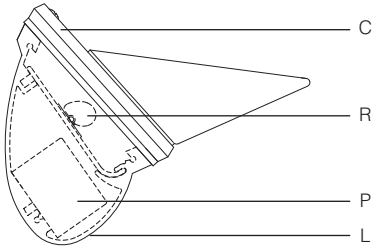
E Mount 1:8 Scale



Canopy



Components Inside Housing 1:4 Scale



X Mount

VCS cantilever with 30" setback available; see ordering information and Accessories section.

Specifications

- **A** Aluminum canopy
- **B** Chrome cap nuts
- **C** Mitred extruded aluminum door frame
- **D** Silicone gaskets
- **E** Micro-prismatic tempered glass lens with holographic film
- **F** Aluminum cutoff visor
- **G** Die-cast end plates
- **H** Locking set screw
- **J** Aluminum yoke
- **K** Aluminum reveal plates (black)
- **L** Extruded aluminum heat sink/housing
- **M** Pivoting hanger bar
- **N** Recessed outlet box (by others)
- **P** Integral constant current driver
- **R** Field serviceable light engine with **fraqtir**™ asymmetric optic

Optic Assembly:

Two-piece extruded aluminum heat sink housing and light engine. Exterior heat sink anodized for maximum emissivity. Removable interior extrusion treated to maximize thermal conductivity. Precision formed asymmetric optical light bar of high temperature, water-clear acrylic. Tempered micro-prismatic glass lens with elliptical distribution holographic diffuser; maximizes lateral distribution without disturbing asymmetric forward throw.

Finish:

Painted surfaces – 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish.

Extruded aluminum heat sink/housing, canopy, yoke, door frame and decorative end plates are finished in semigloss white. All luminaire hardware – stainless steel. All mounting hardware – zinc or cadmium plated.

Mounting:

Canopy mounts over recessed outlet box.

Cantilever ordered separately; specify **X** mount.

Electrical:

Integral electronic HPF constant current driver. Leads exit housing through silicone coated fiberglass sleeving, enter canopy through strain relief for supply connections in recessed outlet box (by others). 60" (1.5m) leads provided for **X** mount. For complete driver specifications, see website, reference document **MA-1303**.

Standard:

UL listed or CSA certified for dry locations, consult factory for damp location rating. 5 year warranty, maximum ambient temperature 45°C (113°F).

Features

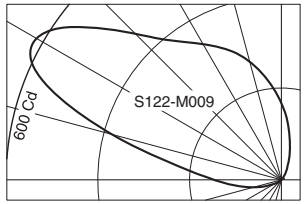
- *The classic **elliptipar** look using advanced LED optics*
- *Die-cast end plates join at articulated black reveals; machined aluminum knobs – no exposed fasteners*
- *All joints are gasketed – keep dirt and moisture out, prevent light leaks, maintain performance*
- *Non-corrosive aluminum and stainless steel construction*

SC 3.0

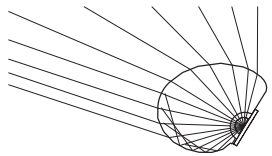
Performance

***fraqtir** technology uses a combination of refraction and total internal reflection, creating a distribution of light ideal for illuminating surfaces uniformly. Glare is minimized while light delivered to the target is maximized, resulting in high application efficiency.*

*For photometric and lumen maintenance reports, visit **thelightingquotient.com***



L90(10k) > 60,000 hrs @ 25°C per TM-21



elliptipar® with fraqtir™ LED

 U.S. Patent 8,465,190; foreign patents pending

LUMILEDS The Brighter Choice

LED lighting facts LED Product Partner

To form a Catalog Number

S 1 2 2 - [3] - [4] - [5] - [6] - [7] - [8] - [9] - [10]

Project: _____

Type: _____

1 Source

S = Solid state (LED)

2 Style

122 = Small indoor LED with integral driver

3 Drive Current/Light Output

L009 = 9 LEDs @ 350mA (557 lumens, 10W)
M009 = 9 LEDs @ 700mA (1015 lumens, 21W)
Based on 3000K/80+ CRI. **Click here** for scaled performance table.
Note: 0350 and **0700** codes are discontinued.

4 Mounting

E = External yoke on canopy
X = External yoke for use with accessory cantilever or pendant mounting assembly (order separately)

5 Finish

02 = Semigloss white housing, end plates, door frame, yoke and canopy
99 = Custom RAL or computer matched color to be specified, consult sales representative

SC 3.1

6 Voltage/Driver

Electronic Driver	*Electronic Dimming Driver**
8 = 120-277V	**M** = 120-277V

*Dimming range refers to % power input, % light output will vary.
Refer to Driver Information document MA-1303

7 Option

00 = No options
V0 = Cutoff visor

8 Destination Requirement

0 = UL listed or CSA certified for U.S.
J = UL listed or CSA certified for Canada

9 Color Temperature

27 =	2700K, 80+ CRI	**2H** =	2700K, 90+ CRI
30 =	3000K, 80+ CRI	**3H** =	3000K, 90+ CRI
35 =	3500K, 80+ CRI		
40 =	4000K, 80+ CRI	**4L** =	4000K, 70+ CRI

Note: Additional CCT and CRI options are available; consult factory.

10 Dimming**

00 = Non-dimming
TE = LighTech line voltage dimming 100-10% power (trailing edge/reverse phase/ELV dimming controls by others)
ZX = 0-10V analog dimming 120-277V input, dimming range 100%-5%, 0-10V controls by others

REMOTE DRIVER Option:

L2 = Lutron Hi-lume LTE 120V input only, dimming range 100%-1%, compatible 2-wire dimming controls by others
LH = Lutron Hi-lume L3D 120-277V input, dimming range 100%-1%, Lutron 3-wire dimming controls by others
L3 = Lutron Hi-lume L3D EcoSystem 120-277V input, dimming range 100%-1%, EcoBus dimming controls by others
EL = eldoLED SOLOdrive 120-277V input, 0-10V analog gamma corrected dimming 100%-0.1% power (controls by others). Operates up to 4 luminaires; consult factory to specify.

**Dimming range refers to % power input, % light output will vary.
Refer to Driver Information document MA-1303

Example

S122-M009-E-02-M-00-0-3H-TE

Small indoor LED, extruded aluminum heat sink/housing, yoke, door frame and decorative end plates finished semigloss white. Integral 120-277V, 700mA dimming driver compatible with line voltage trailing edge/reverse phase/ELV dimming controls by others, dims to 10% power, UL listed or CSA certified for U.S., dry location. 3000K, 90+ CRI.

700 mA (3000K) output

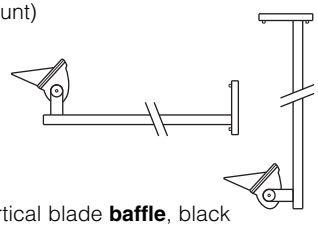
Accessories

Order separately. See Accessories Section for specifications.

VCS [ ] **30** [ ] = **Cantilever**, 30" (760mm) setback (**X** mount)

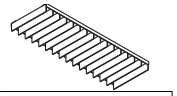
[ ] = **0** = U.S.
J = Canada

[ ] = **02** = Semigloss white
99 = Custom color



AEGV [ ] **000** = External vertical blade **baffle**, black for lengthwise shielding

[ ] = **2** = 25° shielding
4 = 45°



elliptipar® with fraqtir™ LED

elliptipar *from* **The Lighting Quotient**
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **thelightingquotient.com**

L14: PARKING LOT LIGHTING

PHILIPS

GARDCO

Site & Area

SlenderForm

Round post top

Project:

Location:

Cat.No:

Type:

Qty:

Notes:

Philips Gardco SlenderForm luminaires combine LED performance excellence and advanced LED thermal management technology with a distinct styling to provide outdoor area lighting that is both energy efficient and aesthetically pleasing. SlenderForm is defined by its high performance, sleek low profile design and rugged construction. The advanced LED optical systems provide IES Types II, III, IV and V distributions. Surge protection included with all SlenderForm luminaires.

Ordering guide

example: SFRP-APD-T3-4-80LA-4853-NW-120-AR-NP-PCR5

Prefix	Controls	MTP	Mounting[5]	Optical Sytem[6]	Wattage	LED Temp	Voltage	Ring	Finish	Options
SFRP- SlenderForm Round Post Top luminaire	**—** Standard luminaire **DIM** 0-10V Dimming **APD**[1] Automatic Profile Dimming **APD-MRI**[2,3] Auto Profile Dimming with Motion Response Override Luminaire mounted sensor **MRI**[2,3] Motion Response at 50% low, fixture mounted sensor	**—** (blank) **MTP**[4] Module Thermal Protection	**T3** Mounts to 3" x 4" Tenon (standard) **T2** Mounts to 2 3/8" x 4" Tenon	**Standard Optic Position** **2** Type 2 **3** Type 3 **4** Type 4 **5W** Type 5 Wide **5M** Type 5 Medium **BLC** Backlight Control **2BL** Type 2 with backlight (less shield) **Optic Rotated Left (90°)** **LCL**[7] LEED Corner Left **Optic Rotated Right (270°)** **2-270** Type 2 **3-270** Type 3 **4-270** Type 4 **BLC-270** Backlight Ctrl **2BL-270** Type 2 with backlight (less shield) **LCR**[7] LEED Corner Right	**150 mA** **25LA-4815** **350 mA** **55LA-4835**[1] **70LA-6435** **90LA-8035** **530 mA** **80LA-4853** **105LA-6453** **130LA-8053** **700mA** **110LA-4870** **140LA-6470**	**CW** Cool White 5,700 K 70 CRI (nominal) **NW** Neutral White 4,000 K 70 CRI (nominal) **WW**[8] Warm White 3,000 K 70 CRI (nominal)	**120** 120V **208** 208V **240** 240V **277** 277V **347** 347V **480** 480V **UNV** 120-277V 50hz/60hz **HVU** 347-480V 50hz/60hz	**AR** Ring painted to match housing **ORBRP** Optional Painted Ring Bronze paint **ORBLP** Optional Painted Ring Black paint **ORWP** Optional Painted Ring White paint **ORNP** Optional Painted Ring Natural paint **OROC** Optional painted ring - Optional Color. Specify optional color or RAL (ex: OC-LGP or OC-RAL7024) **ORSC** Optional Painted Ring - Special Color Specify. Must supply color chip. Requires factory quote.	**BRP** Bronze Paint **BLP** Black Paint **WP** White Paint **NP** Natural Paint **OC** Optional Color Specify optional color or RAL (ex: OC-LGP or OC-RAL7024) **SC** Special color Specify, must supply color chip. Requires factory quote.	**LF**[9] Line Fusing **LFC**[9] Line Fusing for Canada **PC**[9,10] Photocell with Receptacle (Includes PCR5 receptacle) **PCB**[9,10] Photocell Button **PCR5**[11,12] Photocell Receptacle only with 2 dimming connections **PCR7**[12,13] Photocell Receptacle only with 2 dimming and 2 auxiliary connections **DL**[14] Diffusing Lens **CLR**[14] Clear Glass Lens **POLY**[14] Polycarbonate Lens (1 yr warranty on lens) **BD**[15] Bird Deterrant Spike Kit (field installed only)

1. Available 120V–277V only.
2. Available 120V or 277V only.
3. MRI and APD-MRI luminaires include an integral motion sensor.
4. MTP types limited to LED Wattages utilizing 530 mA (80LA,105LA,130LA) or 700 mA (110LA,140LA) only.
5. Mount to a round pole with 4" O.D. for a smooth transition.
6. See page 4–5 for details on optic orientation prior to ordering.
7. Available with 90LA-6435 and 130LA-8053 only.
8. Consult factory for lead times on Warm White.
9. Must specify input voltage with LF, LFC, PC, and PCB options.
10. Not available in 480V. Provide specific input voltage.
11. Works with 3-pin or 5-pin NEMA photocell/dimming device.
12. If ordered with DIM, APD, MRI, MR50, APD-MRI, APD-MRO, dimming will not be connected to NEMA receptacle.
13. Works with 3-pin or 5-pin NEMA photocell/dimming device and auxiliary connections are not connected (for future use only).
14. Reduces performance.
15. Kits consist of 25 injection molded plastic bird deterrent spikes.

SFRP SlenderForm LED luminaire

Round post top

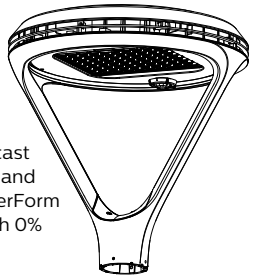
SlenderForm Accessories (order separately)

FS1R-100 MR hand held programmer

For use with 'MRI' motion response when field programming is required.
For use with MRI and APD-MRI only. If desired, only one is needed per job.

Description

Philips Gardco SlenderForm luminaires combine LED performance excellence and advanced Philips Gardco LED thermal management technology with a distinct styling to provide outdoor area lighting that is both energy efficient and aesthetically pleasing. SlenderForm is defined by its high performance, sleek low profile design and rugged construction. The die cast aluminum housing has a maximum profile of just 3.67". The advanced LED optical systems provide IES Types II, III, IV and V distributions. All LED wattages utilize high performance Class 1 LED systems. The luminaire features a state of the art integral thermal control system to maximize LED performance and life, and to extend component life. The door frame is die cast aluminum. Luminaires are finished with a fade and abrasion resistant TGIC powdercoat. All SlenderForm luminaires provide full cutoff performance, with 0% lumens at or above 90° above nadir.



LED Wattage and Lumen Values

Order Code (standard units)	Array Quantity	Total LEDs	LED Current (mA)	Average System Watts[1]	LED Selection	Initial Lumens[2]					
						2 Type 2	**2BL** Type 2 with Backlight	**3** Type 3	**4** Type 4	**5M** Type 5 Medium	**5W** Type 5 Wide
25LA	48	48	150	25	NW	2,352 (s)	2,477 (s)	2,287 (s)	2,169	2,579 (s)	2,538
55LA	48	48	350	53	NW	4,942 (s)	5,203 (s)	4,804 (s)	4,759 (s)	5,419 (s)	5,313 (s)
70LA	64	64	350	69	NW	6,549 (s)	6,896 (s)	6,367 (s)	6,307	7,182 (s)	7,041
90LA	80	80	350	84	NW	7,997 (s)	8,420 (s)	7,775 (s)	7,701 (s)	8,769 (s)	8,597 (s)
80LA	48	48	530	80	NW	7,103 (s)	7,479 (s)	6,905 (s)	6,671	7,788 (s)	7,824
105LA	64	64	530	105	NW	9,414 (s)	9,912 (s)	9,152 (s)	9,076	10,322 (s)	10,108
130LA	80	80	530	128	NW	11,494 (s)	12,102 (s)	11,174 (s)	10,945	12,603 (s)	12,494
110LA	48	48	700	107	NW	8,874 (s)	9,343 (s)	8,627 (s)	8,522 (s)	9,730 (s)	9,567 (s)
140LA	64	64	700	140	NW	11,761	12,383	11,434	11,294	12,896	12,679

1. System input wattage may vary based on input voltage, by up to +/- 10% , and based on manufacturer forward voltage, by up to +/- 8%.
2. Lumen values based on photometric tests performed in compliance with IESNA LM-79.
(s). Data is scaled based on tests of similar, but not identical, luminaires.

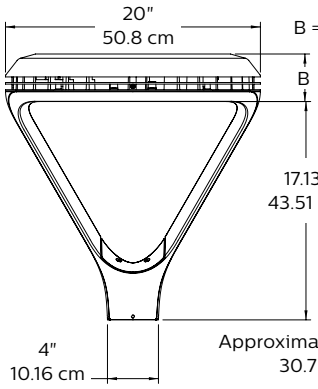
Dimensions – Post Top Luminaire (SFRP)

Effective Projected Area ft² / m²

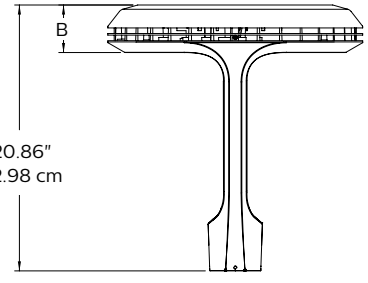
Type	Single
SFRP	0.80 / 0.075

Approximate Motion Sensor Placement on MRI and APD-MRI luminaires.

Front View



Side View



Approximate Luminaire Weight:
30.7 Lbs (13.93 Kg)

L15: STAIR STEPLIGHT

Recessed wall luminaires with directed light

Type:
BEGA Product:
Project:
Voltage:
Color:
Options:
Modified:

Housing: Constructed of die-cast aluminum with integral wiring compartment. Mounting tabs provided. Die castings are marine grade, copper free (≤ 0.3% copper content) A360.0 aluminum alloy.

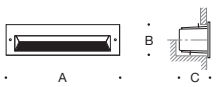
Enclosure: One piece die-cast aluminum faceplate. Clear tempered glass; .125" thick, machined flush to faceplate surface. Faceplate is secured by two (2) flush, socket head, stainless steel captive screws threaded into stainless steel inserts in the housing casting. Continuous high temperature, molded silicone rubber gasket for weather tight operation.

Electrical: 5.6 W LED luminaire, 7.5 total system watts, -25° C start temperature. Integral 120 V through 277 V electronic LED driver, 0 -10 V dimming. The LED and driver are mounted on a removable plate for easy replacement. Standard LED color temperature is 3000K (available in 4000K; add suffix K4).
Note: Due to the dynamic nature of LED technology, LED luminaire data on this sheet is subject to change at the discretion of BEGA-US. For the most current technical data, please refer to www.bega-us.com.

Finish: All BEGA standard finishes are polyester powder coat with minimum 3 mil thickness. Available in four standard BEGA colors: Black (BLK); White (WHT); Bronze (BRZ); Silver (SLV). To specify, add appropriate suffix to catalog number. Custom colors supplied on special order.

UL listed for US and Canadian Standards, suitable for wet locations and for installation within 3 feet of ground. IC rated. Protection class: IP65.

Luminaire Lumens: 155
Tested in accordance with LM-79-08



		Lamp	A	B	C
22 382	ADA	5.6 W LED	6⅝	2¾	3¼

BEGA-US 1000 BEGA Way, Carpinteria, CA 93013 (805) 684-0533 FAX (805) 566-9474 www.bega-us.com

L16: BENCH STRIPLIGHTS

iQ LED TAPE LIGHT **3528 CHIP SERIES**

iQ67 3.2 W/ft: WET RATED

Q-Tran's iQ67 flexible LED tape light is wet listed and available in multiple color temperatures ranging from 2500K – 4000K. The 3.2 W/Ft utilizes the 3528 chip, can come in a 30' reel, has cut points of 1.97", can be cut to length in the field or cut to length at the Q-Tran factory. The lumen output of this LED makes it perfect for most exterior or interior application where a coated LED is required.

iQ67 -		- 35 -	90 -	3.2 -	
iQ Series	Color Temp	Chip	CRI	Watts Per FT	Length

FEATURES

- LED life time - 40,000 hours
- Operating temperature: -4ºF ~ +113ºF
- Suitable for dry, damp or wet locations
- Non-Ferrous Material
- 1.97" cut points
- Field cuttable
- 3 year warranty

iQ67-25-35-90-3.2
Max Run / Reel Length: 30ft* | Color Temp: 2500K | Voltage: 24VDC
CRI: 90+ | LM: 79 | WattsPer Ft: 3.2 | Lumens Per Ft: 254

iQ67-27-35-90-3.2
Max Run / Reel Length: 30ft* | Color Temp: 2700K | Voltage: 24VDC
CRI: 90+ | LM: 79 | WattsPer Ft: 3.2 | Lumens Per Ft: 277

iQ67-30-35-90-3.2
Max Run / Reel Length: 30ft* | Color Temp: 3000K | Voltage: 24VDC
CRI: 90+ | LM: 79 | WattsPer Ft: 3.2 | Lumens Per Ft: 285

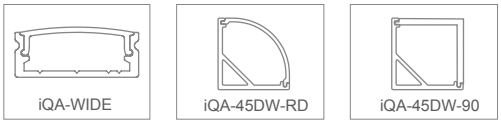
iQ67-35-35-90-3.2
Max Run / Reel Length: 30ft* | Color Temp: 3500K | Voltage: 24VDC
CRI: 90+ | LM: 79 | WattsPer Ft: 3.2 | Lumens Per Ft: 296

iQ67-40-35-90-3.2
Max Run / Reel Length: 30ft* | Color Temp: 4000K | Voltage: 24VDC
CRI: 90+ | LM: 79 | WattsPer Ft: 3.2 | Lumens Per Ft: 305

*Maximum length for one run of iQ67 LED 3.2. Individual Power supply cut sheets will provide max distance/loads per power supply.

NOTE: Q-Tran offers multiple LED Chip offerings based upon size and pitch,each utilizing its own binning. Utilization of multiple outputs within the same chip family will ensure flawless color matching and similar overall diffusion.

COMPATIBLE EXTRUSIONS



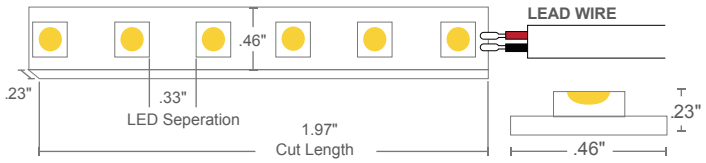
NOTE: Can be used in wet locations.

COMPATIBLE POWER SUPPLIES

Interior Applications
- QJB & QJBL
- Q6M-DC & DC+CAP
- QTM-eLED, QTM-DC & DC+CAP
- iQ-PH

Exterior Applications
- QOM-eLED, QOM-DC & DC+CAP
- Q-SET-eLED & Q-SET-mLED
- Q-HEX-Mini-DC
- iQ-PH

DIMENSIONS



NOTE: Cut marks of LED tape allows for changes in the field.

3.2 watts per foot = cut every 1.97"

Lead wire comes standard on all LEDs in 18" (20/2 AWG)

Intertek

RoHS COMPLIANT

2016.V02

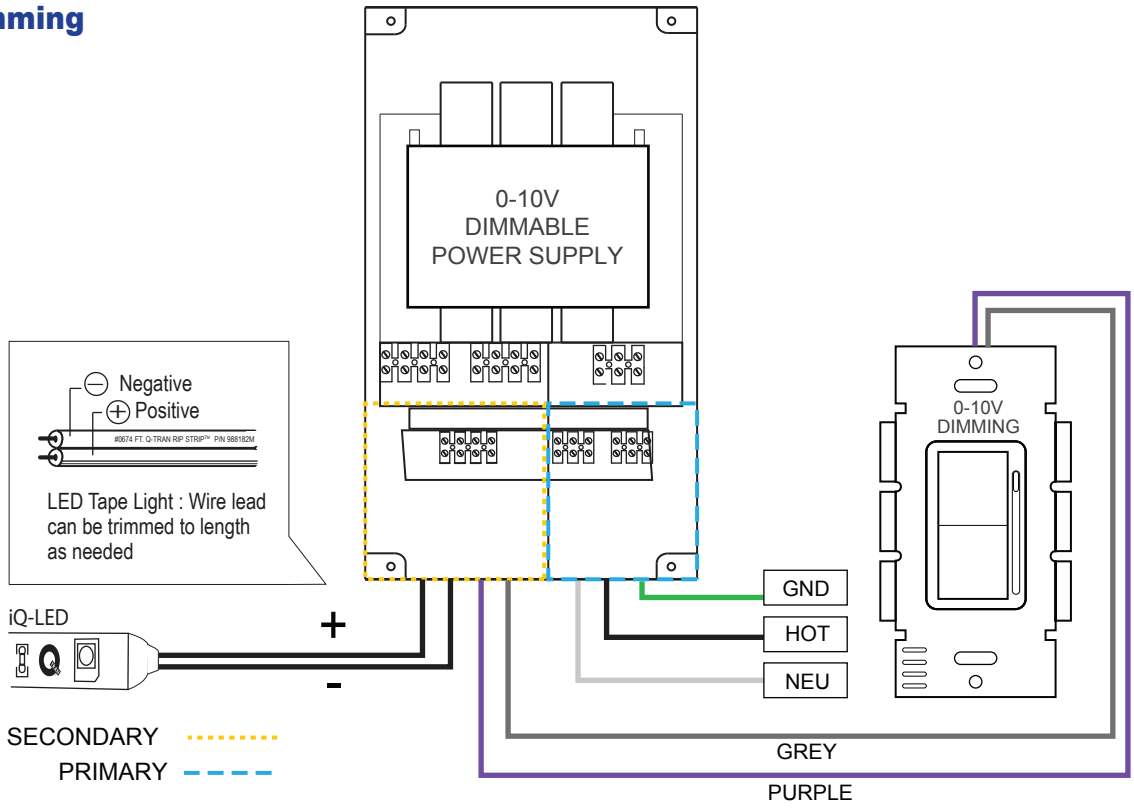
PROJECT NAME	DATE	COMPANY	TYPE	NOTE

iQ LED **TAPE LIGHT**

COMPATIBLE POWER SUPPLIES

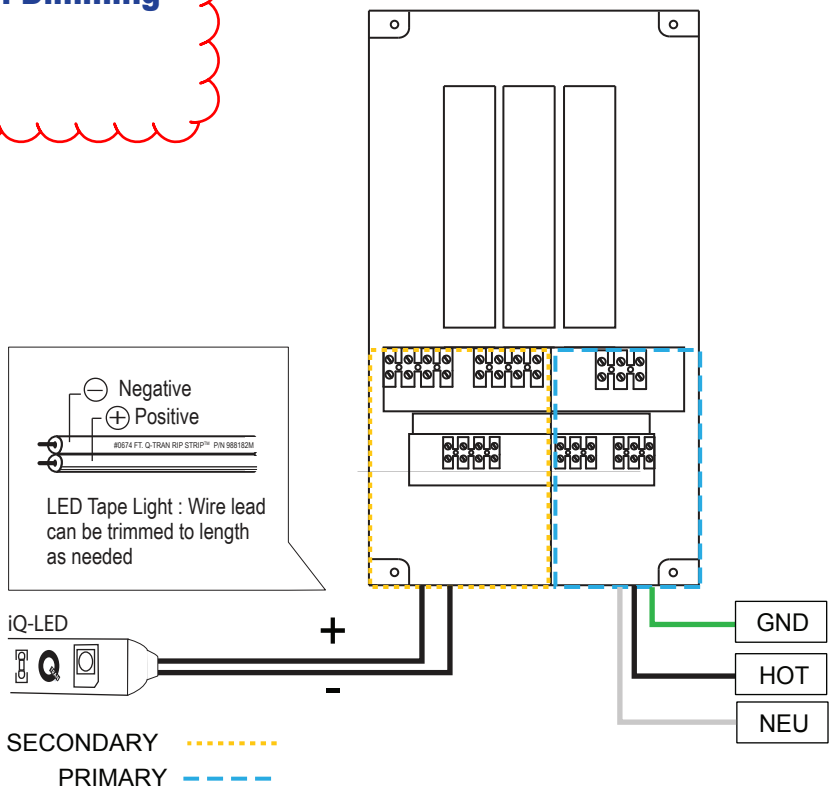
Electronic 0-10V Dimming

QTM for interior
QOM for exterior



Electronic Driver Non-Dimming

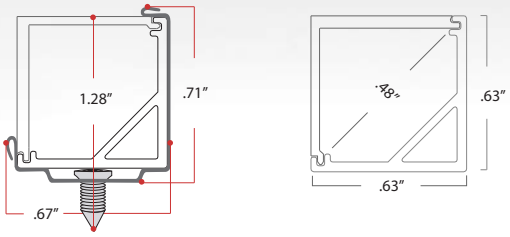
QTM for interior
QOM for exterior

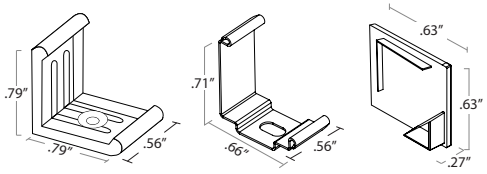


iQ LED **EXTRUSIONS**

45DW-90

DIMENSIONS

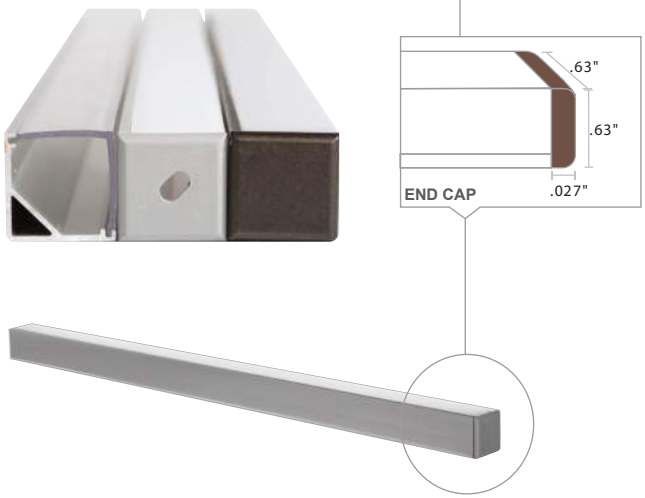




CLIPS

END CAP

*The clip works for both 45DW-90 and 45DW-RD extrusion.



iQA-45DW-90 : Profile Aluminum Extrusions

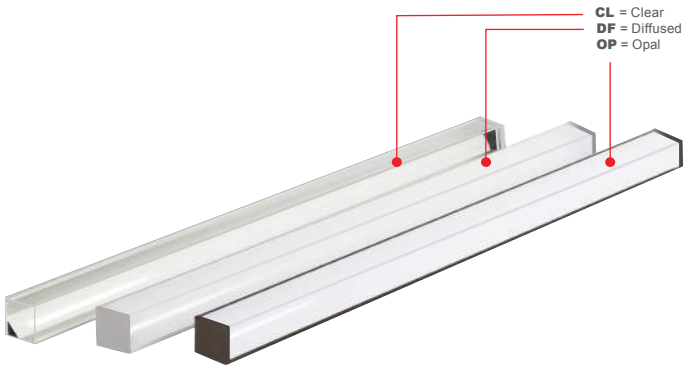
Max Length	: 98.25 in
Color	: Satin (ST), Bronze (BZ), Black (BK)
Material	: Anodized Aluminum
Cover Options	: Clear (CL), Diffused (DF), Textured (TX), Opal (OP)
Fits	: iQ20, iQ54, iQ65, iQ67, iQ68

ORDERING GUIDE

iQA	-	45DW-90	-		-		-	
Category		Model		Finish		Lens		Length

- Finish : **ST** = Satin **BZ** = Bronze **BK** = Black
- Lens : **CL** = Clear **DF** = Diffused **TX** = Textured **OP** = Opal
- Length : Max = 98.25"

NOTE: Custom colors available upon request.



2017.V01

PROJECT NAME	DATE	COMPANY	TYPE	NOTE

TYPE: _____

CATALOG #: _____

_____

NOTES: _____

X: Throughout

Prestige™ X40 Series

Edge-Lit Recessed Ceiling-Mount Only Exit Sign

Design upgrade: introducing new features

1. Easier installation: component-free back-box can be installed in advance, like a regular junction box
2. 20 – 30% less power consumption: max. 1.4W (AC-only) and max. 2.3W (Self-Powered)
3. Bi-color LED pilot light allows visual diagnostic without the need to open the unit (self-test and diagnostic option)
4. Listed by the Underwriting Laboratories UL Listed
5. Also available with white LEDs for custom-design legends: pictograms, special wording, etc. (Ask your sales representative)

Features

- Designed to achieve superior visual clarity and performance with an LED light source. High brightness red or green LEDs transmit light directly into both ends of a unique U-shaped panel. LED sensitive inks are formulated to provide a rich color in red or green
- Clear acrylic panel provides optimum light transmission. Illumination is 100% in both AC and emergency mode
- Clear acrylic panel is silkscreened and computer engraved. Computer engraving is used to crisply define each letter and chevron. LED sensitive inks are formulated to provide a rich color in red or green. Choice of legend background: clear (for single face), white or mirror (for single or double face signs)
- Rugged cast brushed aluminum trim plate (optional colors available).
- Low energy consumption LED lamps consume less than 2.3W per sign, single or double face, AC-only or Self-Powered
- Available with sealed maintenance-free Nickel-Cadmium batteries.
- Fully automatic charger circuitry offers two-wire universal 120 to 277VAC input, temperature compensated charger, solid state transfer, low voltage battery disconnect, and brownout protection
- Self-test and silent diagnostics are optional on all Self-Powered models. Diagnostics are programmed to ensure product readiness and reliability by continuously monitoring every critical function of the unit. The unit is self-tested for one minute every 30 days, 30 minutes every 60 days and 90 minutes annually. When a fault is detected the pilot light will change color from green to red and flash following a particular code, identifying the cause: battery, charger circuitry, or LED lamps
- Designed to fit integrally with a 20 gauge steel back box. Each unit includes a bar hanger kit
- Prestige LED Series signs are unaffected by the vibrations, ambient temperature swings and typical power surges detrimental to standard exit light sources
- UL924 Listed
- 5-year limited warranty
  Detailed warranty terms located at: www.emergi-lite.com/usa/files/EL_Warranty.pdf

Power Consumption Chart

Model	AC Specs		DC Specs	
AC-only	120 to 277VAC, 60Hz	Less than 1.4W	–	–
AC/DC-remote	120 to 277VAC, 60Hz	Less than 1.4W	6 to 24VDC	Less than 1.4W
Self-Powered	120 to 277VAC, 60Hz	Less than 2.3W	Ni-Cd battery	Min. 90 minutes
Self-Powered diagnostic	120 to 277VAC, 60Hz	Less than 2.3W	Ni-Cd battery	Min. 90 minutes

Suggested Specification

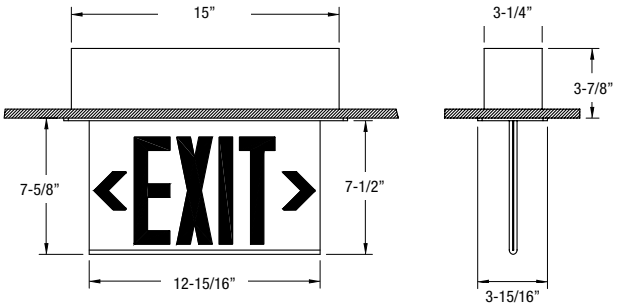
Supply and install the **Emergi-Lite® Prestige™ X40 series** of recessed edge-lit exit signs. The unit shall come standard with a flat trim plate of die-cast aluminum with _____ finish, a back box of 20-gauge galvanized steel, and a hardware kit including two 27-inch adjustable bar hangers for back box installation between ceiling joists. The back box shall be provided with conduit knockouts at the top, back and end.The unit shall have the trim plate snap and lock in the housing with torsion spring retainers, thereby eliminating any visible screws or hardware. The legend shall be printed on a clear acrylic panel.The panel shall have a U-shape and the legend letters shall have the contour engraved by laser.

The light source shall be long-life light-emitting diodes (LED) and shall provide even illumination in normal and emergency operation. Red LED technology shall be ALINGAP. The unit shall operate with a two-wire universal AC input voltage of 120 to 277Vac at less than 2.3 Watts. The edge-lit sign in a self-powered configuration shall use a sealed Nickel-Cadmium battery and shall stay illuminated during emergency operation for at least 90 minutes upon AC failure. When specified, the self-powered unit shall include self-test and silent diagnostic functions, managed by a micro-controller: it shall execute automatic tests for one minute every 30 days, 30 minutes every 60 days and 90 minutes annually. A diagnostic circuit shall continuously monitor the performance of the battery, charger module and LED lamps. When a fault is detected the pilot light shall change color from green to red and flash with a specific code. The red light is steady-on in case of battery disconnect; it will flash with one blink for battery failure, two blinks for charger failure and four blinks for LED lamp failure. A label with the diagnostic legend shall be visible next to the pilot light. The edge-lit sign shall be tested by the Underwriting Laboratories and listed to the UL924 standard.

The unit shall be **Emergi-Lite®** catalog number _____.

Dimensions

Dimensions are approximate and subject to change.



Accessories (order as a separate item)

DESCRIPTION	
Special wording	Contact your sales representative
DESCRIPTION	
Two 27-inch adjustable bar hangers*	TBH

* Bar hangers supplied with unit, order as replacement only

Arrow (Chevron) Designation

Arrow Right (R) | Arrow Left (L) | Double Arrow (D) | Arrow Right & Left (RL) Represents each side of a double face panel.

*Wording and chevrons not to scale. For illustration purposes only.

Backbox (order as a separate item)

DESCRIPTION	SUFFIX
Backbox kit flat trim	BBKTR-E

How to Order

HOUSING	SERIES	FACES	DESIGNATION	LEGEND COLOR	BACKGROUND COLOR	ARROWS	OPTIONS	LEGEND SIZE
Blank= Brushed aluminum **W**= White **B**= Black **PB**= Polished brass **CH**= Polished chrome **BR**= Bronze	**LX**= AC **LSNX**= Self-Powered	**40**= Less panel **42**= Single face **43**= Double face	**N**= New design	**R**= Red **G**= Green	**C**= Clear (single face only) **W**= White **M**= Mirror	**Blank**= No arrow **L**= Arrow left **R**= Arrow right **RL** = Right & left (double face) **D**= Double arrow **UA**= Universal field installed arrows	**Blank**= No option **-AD**= Advanced Diagnostics (non-audible) **-FA**= Fire Alarm **-DC**= AC/DC remote 6-24 VDC **-2CKT**= Two circuit, AC only **-FZ**= Flasher & buzzer (Self-Powered only) **-NEX**= Nexus® Wired **-NEXRF**= Nexus® Wireless	**Blank**= 6" EXIT legend **-8**= 8" EXIT legend (red only) **-LP**= Panel shipped separately **-X**= Back box shipped separately

Example: **WLSNX42NRWR-AD**

APPENDIX C

C-1: Jonas Center AV Systems Engineering Report- 100% SD
Dated November 21, 2017,
by The Shalleck Collaborative Inc.

C-2: 100% SD – Jonas Center AV Systems Narrative,
Dated November 21, 2017,
by The Shalleck Collaborative Inc.

C-3: 100% SD – Jonas Center AV Systems Budgets – 100% SD
Dated November 21, 2017,
by The Shalleck Collaborative Inc.

COM – Jonas Center
AV Systems Engineering Report- 100% SD
November 21, 2017

The following report outlines the AV systems electrical and mechanical requirements for the COM – Jonas Center project. The engineering information below covers the major engineering accommodations required. Further specific detail and engineering criteria will be developed during design.

1. Electrical Engineering Criteria

AV Electrical

Scope

The system will be installed in its entirety under Div. 27. The Electrical Engineer is responsible for designing and documenting all power related systems including specifying the conduit size and route, back boxes, and all junction boxes etc.

AV System Power Requirements

Banquet Hall

Electrical:	(4) Four 120V, 20A dedicated circuits. Standard building power.
Location:	AV Equipment rack (exact location TBD)
Electrical:	(2) Two 120V, 20A dedicated circuits. Standard building power.
Location:	Projection screen and Projector location (exact location TBD)

AV Low-Voltage Conduit

All AV low-voltage wiring shall be in dedicated metal raceway to provide EMI/RFI and mechanical isolation. This includes conduit run within concrete slabs. Division 26 is required to install the conduit and backboxes, per our drawings and specifications.

The low-voltage portion of the AV system will comprise a significant amount of EMT conduit. The AV system is divided into five signal groups, which EACH requires its own conduit raceway:

A: Mic Level
B: Line Level
C: Video & Communications Level
D: Loudspeaker Level
E: Empty

Additional AV Requirements

The AV system may require a contact closure from the fire alarm control panel. The electrical engineer and division 26 is responsible to get and deliver this to the AV equipment rack.

Cable TV (if applicable):
Banquet Hall: Provide CATV outlet at AV rack.

Data: All: Provide one standard copper data drop at each AV rack.

2. Mechanical Engineering Criteria

General
The heat generated by systems within our area of responsibility are predominantly from audio amplifiers (variable load depending on use).

AV Systems

AV rooms should be kept at 70-degrees Fahrenheit, with 60% relative humidity.

Banquet Hall - AV Closet (location TBD)

Equipment Load:

Average:	2.0 kW
Type:	Audio & Video Equipment
Recommend:	Exhaust Fan w/ Louvered Door intake

END OF REPORT

Com – Jonas Center
AV Systems Narrative
November 21, 2017

This report includes AV systems for the following spaces:

Banquet Hall

AV Systems

1. **Banquet Hall**

Audio System

The room will be designed for audio amplification of playback devices, such as laptop computers or media players, as well as voice reinforcement, using a wireless microphone system. In addition, wired connection points shall be located at the platform area. Ceiling speakers will be zoned appropriately for use with or without the operable partition deployed. A wireless assistive listening system will be provided, complete with receivers necessary to satisfy current ADA and code requirements.

Video System

A video projector & motorized screen shall be provided, located above the platform area.

The screen will be sized appropriately for viewing from the back of the banquet hall. The video system shall use a digital system for transport and routing of audio video and audio signals. The projector will be ceiling mounted above the seating area. The projector shall typically be 16:10 ratio.

Digital portable computer (laptop or tablet) connections shall be available. Additionally, rack-mounted playback devices, such as computers, DVD/Blu-Ray, and other media players as necessary shall be provided.

Control System

The room will utilize a touchscreen-based control system. The control system will be network-enabled, to allow remote control from an IT help desk, if desired.

The AV system will be able to send preset recall signals to the master control units for window shades and lighting so these components can be controlled via one cohesive system.

Utility / Other

At the presenter's area, hardwire connections for AV, data & power connection shall be provided for lectern connections.

Specialized electrical power and/or dedicated grounding systems are not anticipated.

Equipment will be in an AV equipment rack located at the platform area, with sufficient cooling to meet anticipated heat load.

<end of report>

TRANSMITTAL / MEMO

Project:	COM – Jonas Center		
Date:	November 21, 2017	*Via:*	e-mail
		Fax:	
To:	Mattison Ly, LEED AP Brick Inc. 1266 66th St. #1 Emeryville, CA 94608	*Tel:*	
From:	Scott Krenzke		
Re:	AV Systems Budgets – 100SD	*# of pgs. including cover:*	

Below are listed the budget recommendations for production systems within the COM – Jonas Center Project. Please use these figures in the total project estimate. It is important to note that not all sections represent a complete and installed cost. The Cost Estimator who is responsible for electrical costs will need to include AV systems infrastructure and installation that normally falls under Division 26– Electrical. Those needs are outlined in the engineering report.

The recommendations below are listed in 2017 dollars and do not include General Contractors mark-up and general conditions or overall contingencies.

1. Banquet Hall

AV Systems – Section 27 41 16 **$85,000**
Comprehensive system to include wiring infrastructure, fixed HD video projection, 16:10 aspect ratio motorized roll-down projection screen, video switching, video sources including a blu-ray player, voice/music amplification and playback with automatic microphone mixer, loudspeakers zoned for operable partition use, wireless microphones, FM assistive listening, wire, pull and system integration and installation.
Related Exclusions: Electrical work including all line voltage connections (complete), and providing and installing all low-voltage conduit and backboxes required by the AV system.

2. Miscellaneous Aspects To Be Included By Cost Estimator In Other Sections

Electrical & Mechanical Accommodations - As indicated in the engineering report

END OF REPORT

APPENDIX D

Final Acoustical Recommendations- Bridging Documents – R1 College of Marin Indian Valley Campus Jonas Center (Bldg. 19) and renovation of existing Building 18, November 28, 2017,

by Wilson Ihrig

28 November 2017

Mattison Ly, LEED AP
Project Architect
brick
1266 66th Street, Suite 1
Emeryville, CA 94608
Email: mly@brick-inc.com

Subject: Final Acoustical Recommendations- Bridging Documents – R1
College of Marin Indian Valley Campus Jonas Center (Bldg 19)
and renovation of existing Building 18

Dear Ms. Ly:
This letter presents our final set of recommendations suitable for a 100% SD/Bridging Docs stage.

Acoustical Performance Criteria

Reverberation times

Banquet Hall	1.0 to 1.2 seconds at 500 Hz. Bass ratio 1.3 max
Conference Rooms	< 0.6 seconds at 500 Hz, 1,000 Hz and 2,000 Hz.
Private offices	< 0.6 seconds at 500 Hz, 1,000 Hz and 2,000 Hz.
Lounge	0.5 to 0.8 seconds at 500 Hz

Sound reinforcement system – Banquet Hall

STI (or STIPA)	≥ 0.6
Sound pressure Level	≥ 70 dBA
Coverage	+/- 3 dB at 2,000 Hz throughout space

Mechanical system noise

Mechanical systems operation to result in noise levels, expressed as Noise Criteria (NC) levels, not greater than the following:

Banquet Hall	NC 30
Lobbies	NC 35
Lounge	NC 35
Corridors	NC 40
Executive and private offices	NC 30
Conference rooms	NC 30
Production kitchen	NC 40
Banquet Kitchen	NC 35
Bathrooms	NC 40

Plumbing systems noise

Noise from plumbing systems, including those associated with mechanical systems shall not exceed the NC levels indicated above for continuous noises and the following for short-term noises such as those caused by restroom fixtures and their associated waste lines:

Banquet Hall	40 dBA $L_{max, slow}$
Executive and private offices	35 dBA $L_{max, slow}$
Conference rooms	35 dBA $L_{max, slow}$

Exterior noise

Provide all necessary mitigation of facility-generated noise such as that produced by outdoor mechanical equipment to comply with the requirements of the County of Marin Noise Sub-Element of the General Plan in its latest revision.

Construction-related noise

During construction, comply with the requirements stated in the County of Marin Municipal Code, Noise Ordinance, contained under Section 6.70.030.(5), titled *Construction Activities and Related Noise*.

Acoustical Construction and Materials

Banquet Hall

Shades/Blinds

- Recommended shades to have a Noise Reduction Coefficient (NRC) of not less than 0.5
- Appropriate products include
  - MechoSystems AcoustiVeil Dimout (http://www.mechoshade.com/shadecloth/acoustiveil.php)
  - Sound Management Group SoundElite Acoustical Blinds (http://soundmanagementgroup.com/products/acoustical-blinds/#gallery)
  - DFB Acoustical Roller Shade Fabric (www.dfbsales.com)
  - Phifer Basinc 3%, Style 2500 or Performance+ SheerWeave fabrics (www.phifer.com)
  - or approved equal
- Actual area to cover and material TBD by D/B team after computer modeling of space to meet the reverberation time goal.

Ceiling

- Wood slats to be no wider than 6".
- Provide a minimum 25% open area by spacing slats appropriately
- Lay 1" thick black faced duct liner boards or mats directly on top of the wood slats. Appropriate products include
  - OCF QuietR (www.owenscorning.com)
  - JM LinAcoustics (www.jm.com)
  - CertainTeed ToughGuard (www.certainteed.com)
  - Thermafiber SAFB (www.thermafiber.com) with an open weave black fabric below, as it is not black.
- Actual area to cover and material TBD by D/B team after computer modeling of space.

- At the Platform Space, ceiling to be covered for approximately 50% of the area with acoustic clouds. Appropriate products include:
    - Conwed (conweddesignscape.com/products/clouds)
    - G&S Cloud diffusers (www.gsacoustics.com)
    - or approved equal

Walls

- Recommend replacing 50% of the proposed Stone Cladding with sound absorbent material having an NRC of approximately 0.7. Actual area to cover and material TBD after by D/B team computer modeling of space.
- At the Platform Space, side walls to be lined with sound absorbing panels having an NRC of approximately 0.7 to 0.9 for between 30% and 50% of their area.

Corridors leading to Banquet Hall

Ceilings

- Perforated GWB for the entire ceiling surface area with minimum NRC of 0.7
  Appropriate products include:
    - CertainTeed Gyptone
    - GypSorb (www.gypsorb.com)
    - VOGL by Pyrok (www.pyrok.com/products-brands)
    - or approved equal
- Alternatively, install a T-bar system with acoustical tiles having the minimum NRC. No maximum, as the corridors are areas meant to serve as sound locks.

Doors

- Provide solid-core wood or metal doors with STC ratings of not less than 40. All hardware to be provided by the same manufacturer as a package with a guaranteed acoustical performance STC rating. Appropriate suppliers include:
    - Noise Barriers (www.noisebarriers.com)
    - Overly Doors (www.overly.com)
    - Jamison Doors (www.jamisondoor.com)
    - or approved equal
- Doors to be fitted with automatic closing mechanism so as to minimize open time

Walls separating offices from each other and from hallway

Type A2 (shown in blue in Acoustical Floor Plan sheet)

- Minimum STC 45 rating
- Provide a staggered-stud configuration with 6” plates (if wood) or runners (if metal) and 2x4” wood or 3-5/8” metal studs.
- Fit R-13 batts in cavity
- 5/8” Type C or X GWB. One layer on each side
- Fully caulk at the perimeter. Specific caulking details to be provided later.

Walls separating bathrooms from hallway and from Lounge

Type A3 (shown in red in Acoustical Floor Plan sheet)

- Minimum STC 55 rating

- Either provide a double wall construction or a separate plumbing "skin" wall for mounting of water fixtures so as to minimize plumbing noise from reaching the Banquet Hall through the corridor walls. 1" gap between stud rows.
- Provide also at Loading Dock to Office separation.

Kitchen ceiling

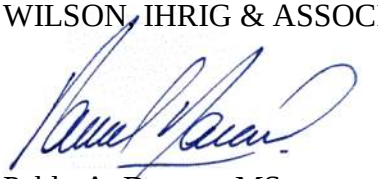
- Line at least 50% of the ceiling with sanitary-type acoustical panels having an NRC of not less than 0.7. Appropriate products include:
    - MBI SanPan (www.mbiproducts.com)
    - G&S Clean Panels (www.gsacoustics.com)

Lounge

- Provide perforated GWB Ceiling panels or a T-bar system with acoustical tiles as recommended above for the corridors

* * *

WILSON, IHRIG & ASSOCIATES, INC.



Pablo A. Daroux, MS
Principal

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APPENDIX E

Renderings, Dated December 1, 2017,
by Brick

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

AERIAL VIEW
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

FOOTBRIDGE FROM PARKING LOT
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

VIEW FROM FOOTBRIDGE
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

SLOPED WALK TO PREFUNCTION
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

AERIAL VIEW CLOSE UP
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

VIEW AT DROP-OFF
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

STAIR TO PRE-FUNCTION
12/01/17

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indian valley campus, novato ca

BANQUET HALL
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

BANQUET HALL
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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

SMALL GATHERING
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LOUNGE PERSPECTIVE
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LOUNGE INTERIOR
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LOUNGE INTERIOR
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VIEW OF COVERED WALK
12/01/17

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COLLEGE OF MARIN IVC JONAS CENTER & BLDG 18 ALTERATIONS

indian valley campus, novato ca

VIEW FROM CREEK
12/01/17

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Architectural Quality

Architectural Quality