

WARNING: ALL INDIVIDUALS INTERESTED IN BIDDING ON THIS PROJECT MUST OBTAIN THE FINAL PLANS AND SPECIFICATIONS FROM THE DEPARTMENT MANAGING THE PROJECT OR AS OTHERWISE STATED IN THE ADVERTISEMENT FOR BIDS FOR THE PROJECT. DO NOT USE THE PLANS AND SPECIFICATIONS POSTED ON THE CLERK OF THE BOARD'S WEBSITE FOR BIDDING ON THIS PROJECT.



SAN BERNARDINO COUNTY

COUNTY OF SAN BERNARDINO

RANCHO CUCAMONGA COURTHOUSE 800MHz TOWER PROJECT

8303 HAVEN AVE, RANCHO CUCAMONGA, CA

PROJECT NUMBER: 5W13

RANCHO CUCAMONGA, CALIFORNIA

Table with 3 columns: PROJECT MANAGEMENT, ELECTRICAL ENGINEER, STRUCTURAL ENGINEER. Includes contact info for Paul De Armond, Keith Williams, and Rick M. Byrd.

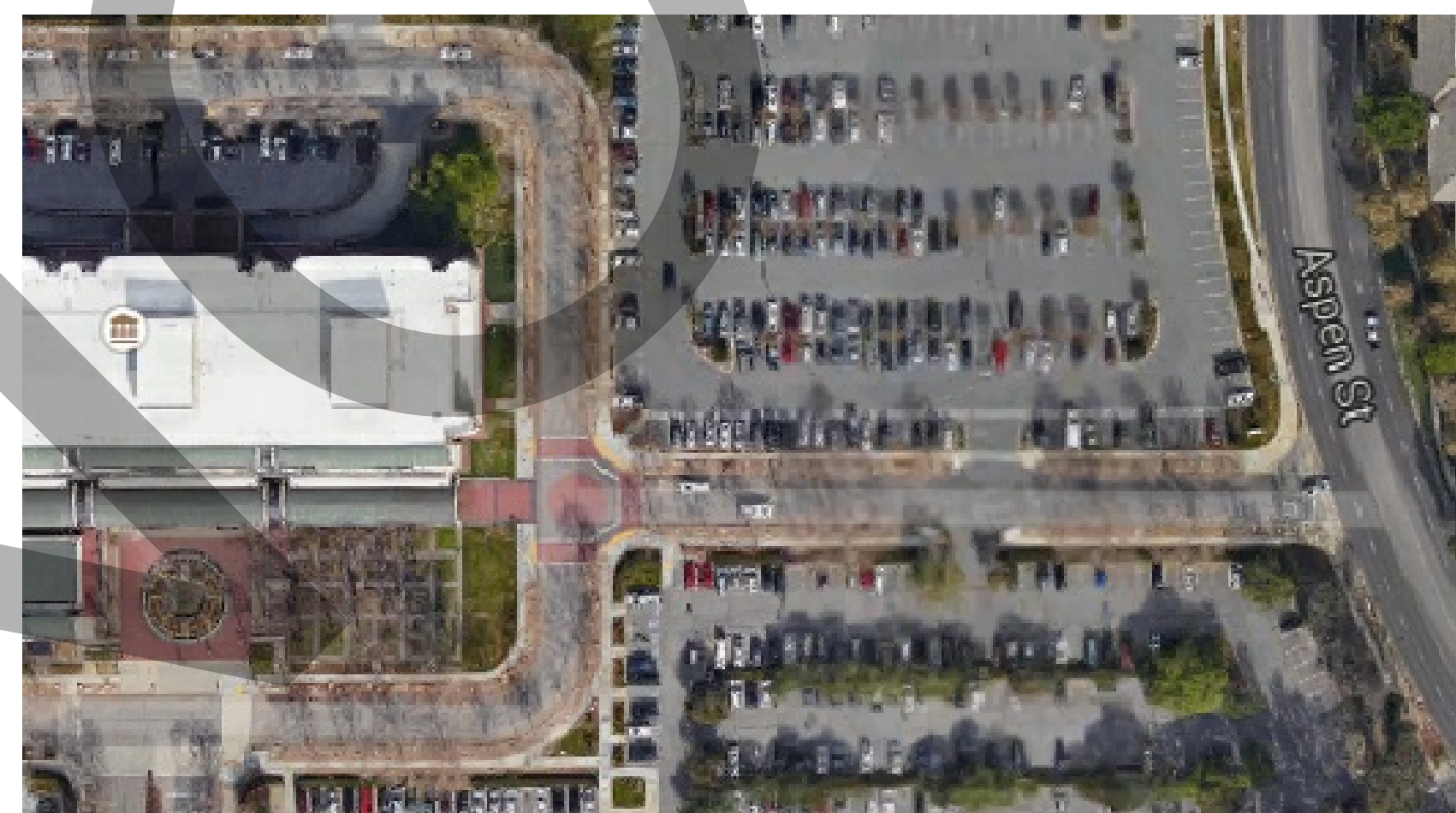
POWER INTERRUPTION NOTE: THE MAXIMUM DURATION OF ANY SINGLE POWER INTERRUPTION TO THE SITE SHALL BE LIMITED TO 20 MINUTES.

GENERAL PROJECT DESCRIPTION: EXTEND POWER FROM EXISTING MAIN SERVICE AND CONNECT TO NEW ELECTRICAL EQUIPMENT, AUTOMATIC TRANSFER SWITCHES, GENERATORS, PANELS, ETC., TO FEED PRE MANUFACTURED BUILDING. PROVIDE & INSTALL COMMUNICATION MONOPOLE.

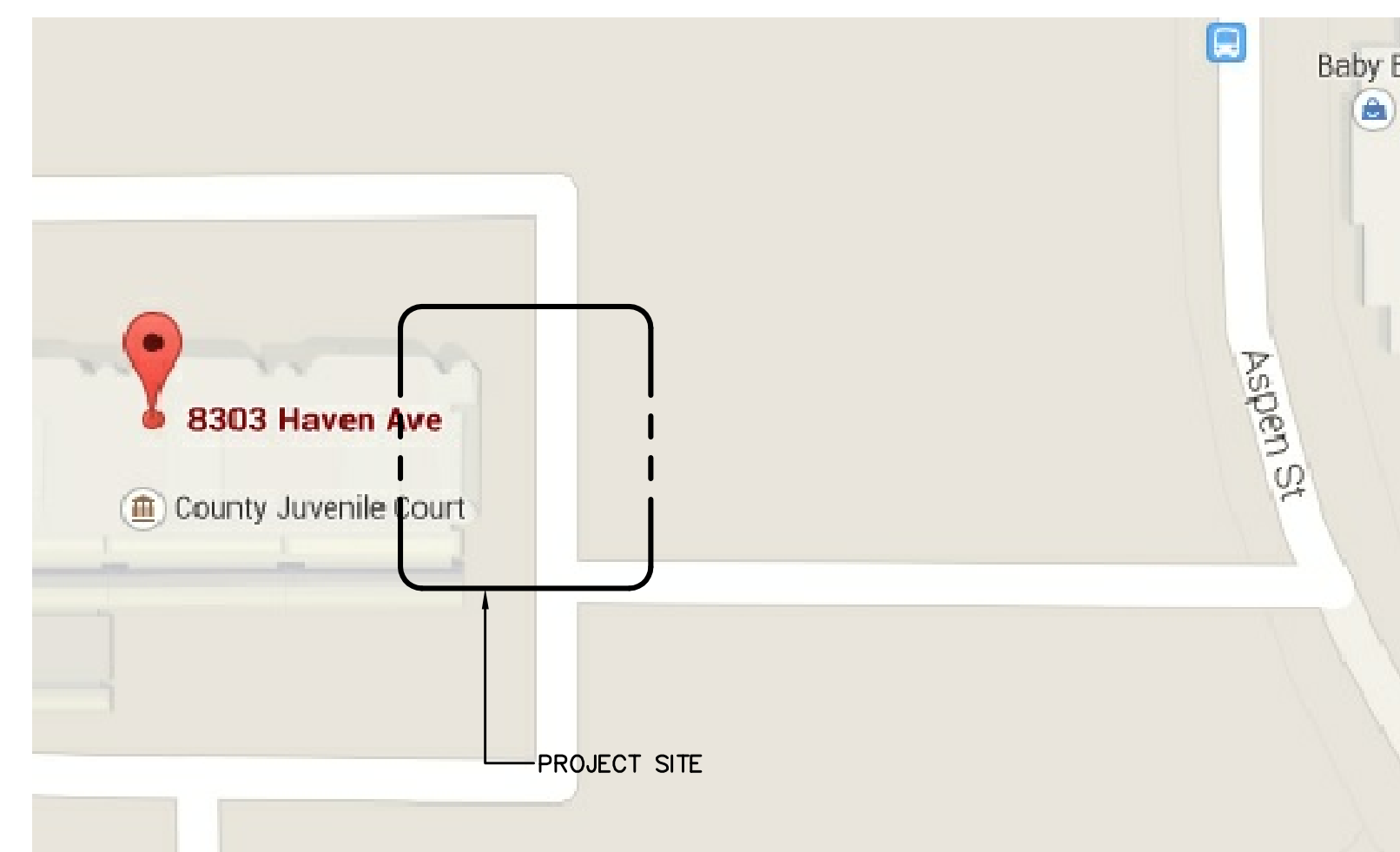
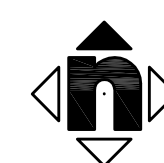
CODE REQUIREMENTS table listing applicable codes and regulations such as California Administrative Code, Building Code, Electrical Code, etc.

CONSTRUCTION GENERAL NOTES: 1. WHENEVER CUTTING, PATCHING, ETC. IS REQUIRED; ALL ADJACENT SURFACES SHALL BE FINISHED TO ACHIEVE A MATCHING SURFACE CONDITION. 2. IT IS HEREBY UNDERSTOOD THAT THE ENTIRE FACILITY MUST MAINTAIN ITS REGULAR SERVICE DURING THE TIME WORK IS IN PROGRESS...

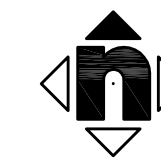
SHEET INDEX table with columns SHEET NO. and DESCRIPTION. Lists sheets TO.1 through S1.0.



AERIAL SITE VIEW N.T.S.



PROJECT LOCATION MAP N.T.S.



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CLIENT:

PROJECT: RANCHO CUCAMONGA COURTHOUSE 800MHz TOWER PROJECT ADDRESS: 8303 Haven Ave, Rancho Cucamonga, CA

SHEET TITLE: TITLE SHEET

Table with columns No., REVISION, DATE. Contains a grid for tracking revisions.

DRAWN BY: SO CHECKED BY: KW DATE: 5/9/16 SCALE: N.T.S. PROJECT No.: SHEET T0.1

GENERAL NOTES

- 1. ALL ELECTRICAL PREFABRICATED EQUIPMENT SHALL BE DESIGNED AND CONSTRUCTED IN SUCH A MANNER THAT ALL PORTIONS, ELEMENTS, SUB-ASSEMBLIES AND/OR PARTS OF SAID EQUIPMENT, AND THE EQUIPMENT AS A WHOLE INCLUDING ITS ATTACHMENTS, WILL RESIST A LOAD WHICH EXCEEDS THE FORCE LEVEL USED TO RESTRAIN AND ANCHOR THE EQUIPMENT TO THE SUPPORTING STRUCTURE.
2. ALL ELECTRICAL MATERIALS AND EQUIPMENT SHALL BE NEW AND SHALL BE LISTED BY UNDERWRITER'S LABORATORIES (UL) AND BEAR THEIR LABEL, OR LISTED AND CERTIFIED BY A NATIONALLY RECOGNIZED TESTING AUTHORITY, WHERE UL DOES NOT HAVE A LISTING, CUSTOM MADE EQUIPMENT SHALL HAVE COMPLETE TEST DATA SUBMITTED BY THE MANUFACTURER ATTESTING TO ITS SAFETY. IN ADDITION, THE MATERIALS, EQUIPMENT, AND INSTALLATION SHALL COMPLY WITH THE REQUIREMENTS OF THE FOLLOWING:
AMERICAN SOCIETY OF TESTING MATERIALS (ASTM)
INSULATED POWER CABLE ENGINEERS ASSOCIATION (IPCEA)
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
AMERICAN STANDARD ASSOCIATION (ASA)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)
CALIFORNIA ELECTRICAL CODE (CEC) - LATEST EDITION
CALIFORNIA CODE OF REGULATIONS TITLE 24 (CCR)
INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
ALL LOCAL CODES HAVING JURISDICTION.
WHERE THE CODES HAVE DIFFERENT LEVELS OF REQUIREMENTS, THE MOST STRINGENT RULE SHALL APPLY.
3. THE CONTRACTOR SHALL VISIT THE SITE INCLUDING ALL AREAS INDICATED ON THE DRAWINGS. HE SHALL THOROUGHLY FAMILIARIZE HIMSELF WITH THE EXISTING CONDITIONS AND BY SUBMITTING A BID, ACCEPTS THE CONDITIONS UNDER WHICH HE SHALL BE REQUIRED TO PERFORM HIS WORK.
4. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN A COMPLETE SET OF CONTRACT DOCUMENTS AND ADDENDA (DRAWINGS AND SPECIFICATIONS.) HE SHALL CHECK THE CONTRACT DOCUMENTS OF THE OTHER TRADES AND DETERMINE HIS RESPONSIBILITIES. FAILURE TO DO SO SHALL NOT RELEASE THE CONTRACTOR FROM DOING THE WORK IN COMPLETE ACCORDANCE WITH THE CONTRACT DOCUMENTS.
5. CONTRACTOR SHALL SECURE AND PAY FOR ALL PERMITS, FEES, CHARGES, AND INCIDENTAL COSTS NECESSARY FOR EXECUTION AND COMPLETION OF ELECTRICAL WORK, INCLUDING ALL CHARGES BY STATE, COUNTY AND LOCAL GOVERNMENTAL AGENCIES.
6. CONTRACTOR SHALL COORDINATE THIS WORK WITH OTHER TRADES AT THE SITE. ANY COSTS TO INSTALL WORK TO ACCOMPLISH SAID COORDINATION WHICH DIFFERS FROM THE WORK AS SHOWN ON THE CONTRACT DOCUMENTS SHALL BE INCURRED BY THE CONTRACTOR. ANY DISCREPANCIES, AMBIGUITIES OR CONFLICTS SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT DURING BID TIME FOR CLARIFICATION. ANY SUCH CONFLICTS NOT CLARIFIED PRIOR TO BID SHALL BE SUBJECT TO THE INTERPRETATION OF THE ARCHITECT AT NO ADDITIONAL COST TO THE OWNER.
7. THE CONTRACTOR SHALL PROVIDE AND KEEP UP-TO-DATE A COMPLETE RECORD SET OF DRAWINGS, THESE PRINTS SHALL BE CORRECTED DAILY AND SHOW EVERY CHANGE FROM THE ORIGINAL DRAWINGS. THIS SET OF DRAWINGS SHALL BE KEPT ON THE JOB SITE AND SHALL BE USED ONLY AS A RECORD SET. THIS SHALL NOT BE CONSTRUED AS AUTHORIZATION FOR THE CONTRACTOR TO MAKE CHANGES IN THE LAYOUT WITHOUT DEFINITE INSTRUCTION IN EACH CASE. UPON COMPLETION OF THE WORK, A SET OF REPRODUCIBLE CONTRACT DRAWINGS SHALL BE OBTAINED FROM THE ENGINEER, AND ALL CHANGES AS NOTED ON THE RECORD SET OF DRAWINGS SHALL BE INCORPORATED THEREON WITH BLACK INK IN A NEAT, LEGIBLE, UNDERSTANDABLE AND PROFESSIONAL MANNER. FAILURE TO KEEP RECORD DRAWINGS UP-TO-DATE SHALL CONSTITUTE CAUSE FOR WITHHOLDING OF PROGRESS PAYMENTS.
8. CONTRACTOR SHALL PROVIDE TEMPORARY POWER FACILITIES AND CONNECTIONS FOR ALL FEEDERS, BRANCH CIRCUITS AND COMMUNICATIONS SYSTEMS BEING DISCONNECTED IN ORDER TO MAINTAIN SYSTEMS IN OPERATION.
9. NOT USED.
10. NOT USED.
11. NOT USED.
12. ALL FINAL CONNECTIONS TO OWNER FURNISHED EQUIPMENT SHALL BE MADE BY THE CONTRACTOR.
13. CONTRACTOR SHALL SUPPLY POWER AND MAKE CONNECTION TO MOTORS AND EQUIPMENT REQUIRING ELECTRICAL CONNECTIONS AS INDICATED ON THE SINGLE LINE DIAGRAM, ELECTRICAL DRAWINGS, AND DRAWINGS OF OTHER TRADES: DISCONNECT SWITCHES, STARTERS, WIRING, CONTROLS, AND CONDUIT FOR MECHANICAL AND PLUMBING OPERATIONS SHALL BE PROVIDED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING MANUFACTURER'S SHOP DRAWINGS PRIOR TO ROUGHING IN ALL CONDUIT TO THIS EQUIPMENT.
14. CONNECTIONS TO VIBRATING EQUIPMENT SHALL BE LIQUID-TIGHT FLEXIBLE STEEL CONDUIT. ALL CONDUIT MOUNTED ON EXTERIOR OR INDOOR LOCATIONS SUBJECT TO PHYSICAL DAMAGE SHALL BE GALVANIZED RIGID STEEL CONDUIT.

- 15. CONTRACTOR SHALL PROVIDE ALL SAWCUTTING, TRENCHING, BACKFILLING, COMPACTING AND PATCHING OF CONCRETE, ASPHALT AND LANDSCAPING AS REQUIRED TO PERFORM HIS WORK. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN TRENCHING FOR HIS WORK. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER AND APPROVED REPAIR OF ANY AND ALL DAMAGES CAUSED BY HIM OR HIS WORK.
16. WHENEVER A DISCREPANCY IN QUANTITY OR SIZE OF CONDUIT, WIRE, EQUIPMENT DEVICES, CIRCUIT BREAKERS, GROUND FAULT PROTECTION SYSTEMS, ETC. (ALL MATERIALS LISTED ON THE CONTRACT DOCUMENTS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND INSTALLING ALL MATERIAL AND SERVICES REQUIRED BY THE STRICTEST CONDITIONS NOTED ON THE DRAWINGS OR IN THE SPECIFICATIONS TO ENSURE COMPLETE AND OPERABLE SYSTEMS AS REQUIRED BY THE OWNER AND ARCHITECT/ENGINEER.
17. REFER TO SINGLE LINE DIAGRAM AND FEEDER SCHEDULES FOR CONDUIT AND CONDUCTOR SIZE TO PANELS, TRANSFORMERS, MECHANICAL AND PLUMBING EQUIPMENT, ETC. CONDUIT RUNS MAY NOT BE SHOWN ON DRAWINGS, BUT ARE PART OF THIS CONTRACT.
18. STRAIGHT FEEDER, BRANCH CIRCUIT, AND CONDUIT RUNS SHALL BE PROVIDED WITH SUFFICIENT PULL BOXES OR JUNCTION BOXES TO LIMIT THE MAXIMUM LENGTH OF ANY SINGLE CABLE PULL TO 100 FEET. PULL BOXES SHALL BE SIZED PER CODE OR AS INDICATED ON DRAWINGS. LOCATION SHALL BE DETERMINED IN THE FIELD OR AS INDICATED ON THE DRAWINGS.
19. MAXIMUM NUMBER OF CONDUCTORS IN OUTLET OR JUNCTION BOXES SHALL CONFORM TO THE CALIFORNIA ELECTRICAL CODE, ARTICLE 314.16, BUT IN NO CASE SHALL CONTAIN MORE THAN THE FOLLOWING NUMBER OF #12 AWG CONDUCTORS FOR THE SIZE OF BOX INDICATED. THE MINIMUM SIZE OUTLET OR JUNCTION BOX PERMITTED IN A WALL IS FOUR INCHES SQUARE BY 1-1/2 INCHES DEEP.
4" SQ. BY 1-1/2" D = 9 CONDUCTORS
4" SQ. BY 2-1/8" D = 13 CONDUCTORS
4-11/16" SQ. BY 1-1/2" D = 11 CONDUCTORS
4-11/16" SQ. BY 2-1/8" D = 18 CONDUCTORS
ALL OUTLET BOXES CONTAINING MORE THAN ONE DEVICE SHALL BE GANGED. TWO DEVICES DOUBLE GANGED, MINIMUM.
20. WHERE MULTI-HOMERUNS ARE INDICATED ON DRAWINGS INDICATING THE SAME PANELBOARD CIRCUIT NUMBER, PROVIDE JUNCTION BOX ABOVE ACCESSIBLE CEILING AND ROUTE ONE SET OF WIRES TO CIRCUIT BREAKERS.
21. MOUNTING HEIGHTS OF ALL DEVICES AND EQUIPMENT ARE FROM FINISHED FLOOR TO CENTER OF DEVICES AND EQUIPMENT UNLESS OTHERWISE NOTED. BOXES INSTALLED IN LOCATIONS NOT APPROVED BY THE ENGINEER SHALL BE RELOCATED AS DIRECTED BY THE OWNER AT NO ADDITIONAL COST TO THE OWNER.
22. DRAWINGS ARE DIAGRAMMATIC ONLY AND DO NOT INDICATE DETAILED CONDUIT ROUTING OR LENGTHS REQUIRED FOR COMPLETE INSTALLATION. ROUTING OF RISEWAYS SHALL BE AT THE OPTION OF THE CONTRACTOR BUT SHALL BE IN STRICT COMPLIANCE WITH STRUCTURAL REQUIREMENTS AND CONTRACT DOCUMENTS UNLESS OTHERWISE NOTED.
23. THE EQUIPMENT GROUNDING CONDUCTOR ALTHOUGH NOT SHOWN ON CONDUIT RUNS SHALL BE INSTALLED AND RUN CONTINUOUS FROM PANEL TO LAST OUTLET. THIS WIRE SHALL BE PITGAILED IN EACH OUTLET FOR CONNECTION TO BOX AND DEVICE SO THAT IF DEVICE IS REMOVED, GROUND WILL NOT BE INTERRUPTED. ALL EQUIPMENT GROUNDING CONDUCTORS SHALL BE INSULATED GREEN CONDUCTORS - ALTERNATE METHODS OF IDENTIFICATION SHALL NOT BE USED. CONTRACTOR SHALL NOTIFY ELECTRICAL ENGINEER TO EXAMINE CONDUCTOR INSTALLATION PRIOR TO INSTALLATION OF DEVICES.
24. COORDINATE WITH EQUIPMENT SUPPLIERS FOR EXACT HOUSEKEEPING PADS AND EQUIPMENT FOUNDATIONS SIZES; PROVIDE SIZES AS REQUIRED BY MANUFACTURER FOR ALL EQUIPMENT TO BE INSTALLED.
24. NOT USED
25. ALL LOW-VOLTAGE CONDUCTORS (600 VOLTS, OR LESS, NOMINAL) SHALL BE U.L. LISTED COPPER #10 AWG MINIMUM SIZE, TYPE THHN/THWN THERMOPLASTIC, 75 DEGREES CELSIUS (WET INSTALLATION) AND 90 DEGREES CELSIUS (DRY INSTALLATION), UNLESS NOTED OTHERWISE. CONDUCTORS #10 AWG AND SMALLER SHALL BE SOLID. CONDUCTORS #8 AWG AND LARGER SHALL BE STRANDED. REFER TO ELECTRICAL SPECIFICATIONS FOR COMPLETE REQUIREMENTS.
26. NOT USED
27. JUNCTION AND PULL BOXES: FOR INTERIOR DRY LOCATIONS, BOXES SHALL BE GALVANIZED ONE-PIECE, DRAWN STEEL, KNOCKOUT TYPE WITH REMOVABLE MACHINE SCREW SECURED COVERS, FOR OUTSIDE, DAMP, OR SURFACE LOCATIONS, BOXES SHALL BE HEAVY CAST ALUMINUM OR CAST IRON WITH REMOVABLE, GASKETED, NON-FERROUS MACHINE SCREW SECURED COVERS. BOXES SHALL BE SIZED FOR THE NUMBER AND SIZES OF CONDUCTORS AND CONDUIT ENTERING THE BOX AND EQUIPPED WITH PLASTER EXTENSION RINGS WHERE REQUIRED. BOXES SHALL BE LABELED TO INDICATE PANEL AND CIRCUIT NUMBER, OR TYPE OF SIGNAL OR COMMUNICATIONS SYSTEM.
28. PANEL SCHEDULES SHALL BE REVISED TO REFLECT FINAL ROOM NAMES AND NUMBERS USING OWNERS ROOM NAMES AND NUMBERS DESIGNATIONS. REFER TO 26 24 16 FOR ADDITIONAL INFORMATION.
29. WHEN A DISCREPANCY ARISES ON THE CONTRACT DOCUMENT, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ALL MATERIAL AND SERVICES TO THE STRICTER CONDITION OR HIGHER QUALITY OR QUANTITY.
30. ALL WORK IS NEW UNLESS SPECIFICALLY NOTED AS EXISTING.
31. ALL EMT FITTINGS SHALL BE COMPRESSION TYPE WITH INSULATED THROATS. ALL CONDUIT BELOW GRADE SHALL BE PVC SCHEDULE 40, MINIMUM SIZE SHALL BE 1". REFER TO DETAIL #3/E4.2 FOR RISER DETAIL.
32. CONTRACTOR SHALL PROVIDE PORTABLE EMERGENCY POWER GENERATOR AS REQUIRED TO MAINTAIN POWER TO EXISTING SITE SERVICE PANELS WHILE NEW CONSTRUCTION WORK IS BEING ACCOMPLISHED. ALL POWER INTERRUPTIONS SHALL BE CLOSELY COORDINATED WITH THE PROJECT OWNER'S REPRESENTATIVE. PROVIDE NOTIFICATION A MINIMUM OF 14 WORKING-DAYS PRIOR TO POWER INTERRUPTION. SEE DEMOLITION NOTE #18 FOR ADDITIONAL REQUIREMENTS.
33. IDENTIFICATION OF PANELBOARDS, TERMINAL/SWITCHGEAR ENCLOSURES, CIRCUIT BREAKERS, DISCONNECT SWITCHES, ATS, ETC. SHALL REQUIRE BLACK ON WHITE LETTERED LAMINATED NAMEPLATES ENGRAVED IN MINIMUM 1/4" HIGH LETTERS TO CORRESPOND WITH THE DESIGNATIONS INDICATED ON THE DRAWINGS. 277/480V. EQUIPMENT SHALL BE ENGRAVED WITH 1/2" HIGH LETTERING. UPS AND EMERGENCY SYSTEM RELATED EQUIPMENT AND PANELS SHALL HAVE RED NAMEPLATES WITH WHITE LETTERING NOTING AS "EMERGENCY CIRCUIT". ALL NAMEPLATES SHALL INCLUDE VOLTAGE, PHASE, AMP RATING AND SOURCE OF WHERE IT IS FED FROM. SEE SPECIFICATION 260532 FOR ADDITIONAL INFORMATION.

CODE ANALYSIS

- THE CONSTRUCTION OF THIS PROJECT SHALL CONFORM TO THE REQUIREMENTS OF:
1. CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PART 2 - CALIFORNIA BUILDING CODE (CBC) - 2013 EDITION.
2. CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PART 3 - CALIFORNIA ELECTRICAL CODE (CEC) - 2013 EDITION.
3. CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PART 9 - CALIFORNIA FIRE CODE (CFC) - 2013 EDITION.
4. NFPA 110

DEMOLITION NOTES

- 1. IN GENERAL, THE DEMOLITION PLAN INDICATES ALL EXISTING EQUIPMENT TO BE REMOVED. HOWEVER, ELECTRICAL EQUIPMENT, AND CONNECTION SHALL BE FIELD VERIFIED & REMOVED AS REQUIRED TO COMPLETE SCOPE OF WORK.
2. THE CONTRACTOR SHALL VISIT THE SITE SPECIFICALLY INCLUDING ALL AREAS INDICATED ON THE DRAWINGS. HE SHALL THOROUGHLY FAMILIARIZE HIMSELF WITH THESE EXISTING CONDITIONS, AND BY SUBMITTING A BID ACCEPTS CONDITIONS UNDER WHICH HE WILL BE REQUIRED TO PERFORM HIS WORK.
3. IT SHALL BE THE ELECTRICAL CONTRACTOR'S RESPONSIBILITY TO DISCONNECT AND REMOVE ALL EXISTING ELECTRICAL EQUIPMENT, ETC., AFFECTED BY THE REMOVED AREA. THIS WILL INCLUDE REROUTING OR THE EXTENSION OF EXISTING CONDUIT AND FEEDERS WHERE NECESSARY TO MAINTAIN THE CONTINUITY OF EXISTING EQUIPMENT REMAINING.
4. ALL CIRCUIT NUMBERS AND EXISTING CONDUIT HOMERUNS SHOWN ON THESE DRAWINGS WERE TAKEN FROM EXISTING RECORD DRAWINGS. IT IS THIS CONTRACTOR'S RESPONSIBILITY TO VERIFY LOCATIONS OF HOMERUNS, AND ADJUST CIRCUIT NUMBERS ACCORDING TO EXISTING CONDITIONS IF REQUIRED.
5. EXISTING CONDUIT FEEDS (RISING UP THROUGH FLOOR) SHALL BE CUT OFF AND PLUGGED FLUSH WITH FLOOR WHERE EXISTING WALLS, EQUIPMENT, ETC., ARE REMOVED. REMOVE CONDUCTORS FROM THIS POINT BACK TO LAST OUTLET-BOX, JUNCTION-BOX, OR PULL-BOX REMAINING IN SERVICE IN ORDER TO MAINTAIN CIRCUIT CONTINUITY.
7. IT SHALL BE THE RESPONSIBILITY OF THIS CONTRACTOR TO MAINTAIN CONTINUITY OF ALL ELECTRICAL SYSTEMS, EQUIPMENT, ETC., REMAINING IN OPERATION WHICH ARE BEING FED BY AN ABANDONED OUTLET, MAINTAINING CONTINUITY SHALL CONSIST OF REROUTING CONDUIT, WIRING, ETC., AS REQUIRED.
8. ALL ELECTRICAL EQUIPMENT, OUTLETS, DEVICES, ETC., THAT ARE REMOVED SHALL BE REMOVED COMPLETELY, INCLUDING CONDUIT AND WIRING BACK TO THE LAST OUTLET, DEVICE, JUNCTION-BOX, PULL-BOX, ETC., REMAINING IN SERVICE IN ORDER TO MAINTAIN CIRCUIT CONTINUITY.
9. EXISTING CIRCUITS WHICH ARE REMOVED AND NOT REUSED SHALL BE IDENTIFIED ON THE PANEL SCHEDULE AS "SPARE".
10. THE ELECTRICAL CONTRACTOR SHALL COORDINATE WITH THE OWNER PRIOR TO REMOVAL OF EXISTING ELECTRICAL EQUIPMENT AND TURN OVER REMOVED EQUIPMENT THAT IS TO BE TURNED OVER SHALL BE BOXED AND TAGGED TO IDENTIFY THE SPECIFIC EQUIPMENT.
11. EXISTING CONDUIT MAY BE REUSED IF ADEQUATELY SIZED, BUT IN NO CASE SHALL ANY EXISTING CONDUCTORS BE REUSED.
12. IN SOME INSTANCES, IT MAY BE NECESSARY FOR THE ELECTRICAL CONTRACTOR TO TEMPORARILY RELOCATE, REROUTE, ETC., EXISTING ELECTRICAL EQUIPMENT. THIS SHALL BE DONE SO THAT THE SYSTEMS IN ALL PHASES (THOSE COMPLETED AND THOSE YET TO BEGIN), ARE IN COMPLETE, OPERABLE, CONDITION AS CONSTRUCTION PROCEEDS THROUGH EACH PHASE
13. WHERE NEW CIRCUITS ARE SHOWN CROSSING PHASING BOUNDARIES (I.E. CORRIDOR LIGHTING, ETC.) THIS CONTRACTOR SHALL CONNECT ALL EQUIPMENT, FIXTURES, ETC., IN THE PHASE WHICH IS THEN UNDER CONSTRUCTION CONTRACTOR SHALL STUB-OUT ALL REQUIRED CONDUIT AND WIRING ACROSS PHASE BOUNDARIES, THEN, PICK UP AND EXTEND THESE CONDUIT RUNS WHEN CONSTRUCTION BEGINS IN THE ADJACENT PHASE.
14. DURING EACH PHASE OF DEMOLITION, ALL CIRCUITS FROM EXISTING PANELS WHICH FEED AREAS OUTSIDE THE BOUNDARIES OF THAT PHASE, SHALL BE MAINTAINED.
15. THE CONTRACTOR SHALL PROVIDE AND INSTALL ALL EQUIPMENT REQUIRED TO TEMPORARILY SUPPORT PANELS. PANELS MAY BE TEMPORARILY PREFRSTANDING, MOUNTED IN TEMPORARY PORTION OF EQUIPMENT TO BE DEMOLISHED LATER, ETC.; THE CONTRACTOR SHALL CHECK WITH ENGINEER FOR APPROVAL OF SUPPORTS. IT SHALL ALSO BE THE CONTRACTOR'S RESPONSIBILITY TO RELOCATE AND RECONNECT ALL CIRCUITS ON A TEMPORARY BASIS IF THE PANELS, ETC., CONFLICT WITH THE NEW CONSTRUCTION PHASES, AND THEN REMOVED AFTER COMPLETION OF PHASES.
16. ALL ABANDONED OUTLETS INCLUDING RECEPTACLES, CONDUITS THROUGH SLAB, ETC., SHALL BE COVERED AND PATCHED TO MATCH THE FINISH OF SURROUNDING AREA, TO THE SATISFACTION OF THE OWNER.
17. ALL DEVICES REMOVED TO ACCOMPLISH DEMOLITION WORK SHALL BE REINSTALLED SIMILAR TO NEW WORK.
18. CONTRACTOR IS REQUIRED TO PROVIDE A DETAILED SCHEDULE OF THE PROPOSED CONSTRUCTION SEQUENCE FOR DEMOLITION OF ALL EQUIPMENT IN SEQUENCE WITH ALL NEW WORK TO THE OWNER FOR APPROVAL PRIOR TO CONSTRUCTION. ALL POWER "DOWNTIME" SHALL BE KEPT TO A MINIMUM AND CONTRACTOR SHALL PROVIDE TEMPORARY EMERGENCY POWER GENERATOR TO MAINTAIN THE EXISTING FACILITY UNDER NORMAL OPERATIONS AS NEEDED.

STRUCTURAL NOTE

UNLESS SPECIFICALLY SHOWN ON THESE PLANS, STRUCTURAL MEMBERS SHALL NOT BE CUT, DRILLED, OR NOTCHED WITHOUT PRIOR WRITTEN AUTHORIZATION FROM THE STRUCTURAL ENGINEER

EQUIPMENT ANCHORAGE NOTES

- MEP COMPONENT ANCHORAGE NOTE
ALL MECHANICAL, PLUMBING, AND ELECTRICAL COMPONENTS SHALL BE ANCHORED AND INSTALLED PER THE DETAILS ON THE APPROVED CONSTRUCTION DOCUMENTS. WHERE NO DETAIL IS INDICATED, THE FOLLOWING COMPONENTS SHALL BE ANCHORED OR BRACED TO MEET THE FORCE AND DISPLACEMENT REQUIREMENTS PRESCRIBED IN THE 2013 CBC, SECTIONS 1615A.1.12 THROUGH 1615A.1.22 AND ASCE 7-05 CHAPTER 6 AND 13.
1. ALL PERMANENT EQUIPMENT AND COMPARTMENTS.
2. TEMPORARY OR MOVABLE EQUIPMENT THAT IS PERMANENTLY ATTACHED (E.G. HARD WIRED) TO THE BUILDING UTILITY SERVICES SUCH AS ELECTRICITY, GAS OR WATER.
3. MOVABLE EQUIPMENT WHICH IS STATIONED IN ONE PLACE FOR MORE THAN 8 HOURS AND HEAVIER THAN 400 POUNDS ARE REQUIRED TO BE ANCHORED WITH TEMPORARY ATTACHMENTS.
THE ATTACHMENT OF THE FOLLOWING MECHANICAL AND ELECTRICAL COMPONENTS SHALL BE POSITIVELY ATTACHED TO THE STRUCTURE, BUT NEED NOT BE DETAILED ON THE PLANS. THESE COMPONENTS SHALL HAVE FLEXIBLE CONNECTIONS PROVIDED BETWEEN THE COMPONENT AND ASSOCIATED PIPING AND CONDUIT.
A. COMPONENTS WEIGHING LESS THAN 400 POUNDS AND HAVE A CENTER OF MASS LOCATED 4 FEET OR LESS ABOVE THE ADJACENT FLOOR OR ROOF LEVEL THAT DIRECTLY SUPPORT THE COMPONENT.
B. COMPONENTS WEIGHING LESS THAN 20 POUNDS, OR IN THE CASE DISTRIBUTED SYSTEMS, LESS THAN 5 POUNDS PER FOOT, WHICH ARE SUSPENDED FROM A ROOF OR FLOOR OR HUNG FROM A WALL.
FOR THOSE ELEMENTS THAT DO NOT REQUIRE DETAILS ON THE APPROVED DRAWINGS, THE INSTALLATION SHALL BE SUBJECT TO THE APPROVAL OF THE STRUCTURAL ENGINEER OF RECORD AND THE STRUCTURAL ENGINEER, THE PROJECT INSPECTOR WILL VERIFY THAT ALL COMPONENTS AND EQUIPMENT HAVE BEEN ANCHORED IN ACCORDANCE WITH ABOVE REQUIREMENTS.

ELECTRICAL DISTRIBUTION SYSTEM BRACING NOTE

ELECTRICAL DISTRIBUTION SYSTEMS SHALL BE BRACED TO COMPLY WITH THE FORCES AND DISPLACEMENTS PRESCRIBED IN ASCE 7-05 SECTION 13.3 AS DEFINED IN ASCE 7-05 SECTION 13.6.8, 13.6.7, 13.6.5.6, AND 2013 CBC, SECTIONS 1615A.1.20, 1615A.1.21 AND 1615A.1.22.
THE BRACING AND ATTACHMENTS TO THE STRUCTURE SHALL BE DETAILED ON THE APPROVED DRAWINGS OR THEY SHALL COMPLY WITH ONE OF THE OSHPD PRE-APPROVALS (OPA#) AS AS MODIFIED TO SATISFY ANCHORAGE REQUIREMENTS OF ACI 318, APPENDIX D.
COPIES OF THE MANUAL SHALL BE AVAILABLE ON THE JOBSITE PRIOR TO THE START OF HANGING AND BRACING OF THE PIPE, AND ELECTRICAL DISTRIBUTION SYSTEMS.
THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE BRACE LOADS.

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CLIENT:
PROJECT: RANCHO CUCAMONGA COURTHOUSE 800MHZ TOWER PROJECT
ADDRESS 8303 Haven Ave, Rancho Cucamonga, CA

SHEET TITLE: ELECTRICAL GENERAL NOTES

Table with 3 columns: No., REVISION, DATE. Contains a grid for tracking revisions.

DRAWN BY: SO
CHECKED BY: KW
DATE: 5/9/16
SCALE: N.T.S.
PROJECT No.:
SHEET
E0.1

SWITCHBOARD: (E)DSB LOAD SUMMARY & FEEDER SCHEDULE										VOLTAGE: 480/277V,3P,4W	
BRANCH: NORMAL										MIN. BUS: 1,600 AMPS	
ENCLOSURE: NEMA-1										** MCB TRIP: 1,600 AMPS	
AIC RATING: 65,000 AIC SYM, MINIMUM											
FEEDER NUMBER	FEEDER FROM	FEEDER TO	NO. OF SETS	CONDUIT (INCHES)	CONDUCTORS (AWG)	GROUND (AWG)	CONNECTED LOAD AMPS	KVA	FEEDER LENGTH*	VOLTAGE DROP	REMARKS
DSB-1	DSB	SW-1	1	2"	3 # 1/0	6	57.74	48.00	500	1.26%	
DSB-2	DSB	TR-1	1	2"	3 # 1/0	6	57.74	48.00	1	0.00%	
							115.47	96.00	SUBTOTAL		
									25% OF LARGEST MOTOR		
							115.47	96.00	TOTAL LOAD		

* FEEDER LENGTH IN FEET IS INDICATED FOR VOLTAGE DROP CALCULATION ONLY AND SHALL NOT BE USED FOR QUANTITY TAKEOFFS.
** MCB = MAIN CIRCUIT BREAKER ** MLO = MAIN LUGS ONLY

LOAD SUMMARY "MS"	
EXISTING HIGH DEMAND PER SCE	= 962 KVA
362 KVA @ 125%	= 1202.5 KVA
BLDG EQUIPMENT LOAD	= 19 KVA
BLDG A/C LOAD	= 19.71 KVA
BLDG LTO LOAD	= 2.0 KVA
MISC LOAD	= 2 KVA
TOTAL	= 1245.21 KVA
1245.21 KVA @ 480V, 3ø	= 1498.45A
(E)1600A. PANEL IS ADEQUATE	

MODULAR BUILDING LOAD SUMMARY	
BLDG EQUIPMENT LOAD	= 19 KVA
25% EXPANSION	= 4.75 KVA
BLDG A/C LOAD	= 19.71 KVA
BLDG LIGHTING LOAD	= 2.0 KVA
MISC. BUILDING LOAD	= 2.0 KVA
TOTAL BUILDING LOAD	= 47.46 KVA
47.46 KVA @ 208V, 3ø	= 131.8 AMPS
131.8 @ 125%	= 164.8 AMPS
200A PANEL IS ADEQUATE	

TR1 LOAD SUMMARY & FEEDER SCHEDULE										VOLTAGE: 208/120V,3P,4W	
BRANCH: NORMAL										MIN. BUS: 200 AMPS	
ENCLOSURE: NEMA-3R										** MCB TRIP: 200 AMPS	
AIC RATING: 65,000 AIC SYM, MINIMUM											
FEEDER NUMBER	FEEDER FROM	FEEDER TO	NO. OF SETS	CONDUIT (INCHES)	CONDUCTORS (AWG)	GROUND (AWG)	CONNECTED LOAD AMPS	KVA	FEEDER LENGTH*	VOLTAGE DROP	REMARKS
TR1-1	TR1	SW-2	1	2"	4 # 3/0	6	133.33	48.00	2	0.02%	
TR1-2	SW-2	ATS-1	1	2"	4 # 3/0	6	133.33	48.00	20	0.18%	
TR1-3	ATS-1	ATS-2	1	2"	4 # 3/0	6	133.33	48.00	10	0.09%	
TR1-4	ATS-1	MTS	1	2"	4 # 3/0	6	133.33	48.00	2	0.02%	
TR1-5	MTS	EP1	1	2"	4 # 3/0	6	133.33	48.00	2	0.02%	
TR1-6	EP1	MDP	1	2"	4 # 3/0	6	133.33	48.00	10	0.09%	
TR1-7	ATS-2	G2	1	2"	4 # 3/0	6	133.33	48.00	10	0.09%	
TR1-8	ATS-2	G1	1	2"	4 # 3/0	6	133.33	48.00	10	0.09%	
							1065.88	384.00	SUBTOTAL		
									25% OF LARGEST MOTOR		
							1065.88	384.00	TOTAL LOAD		

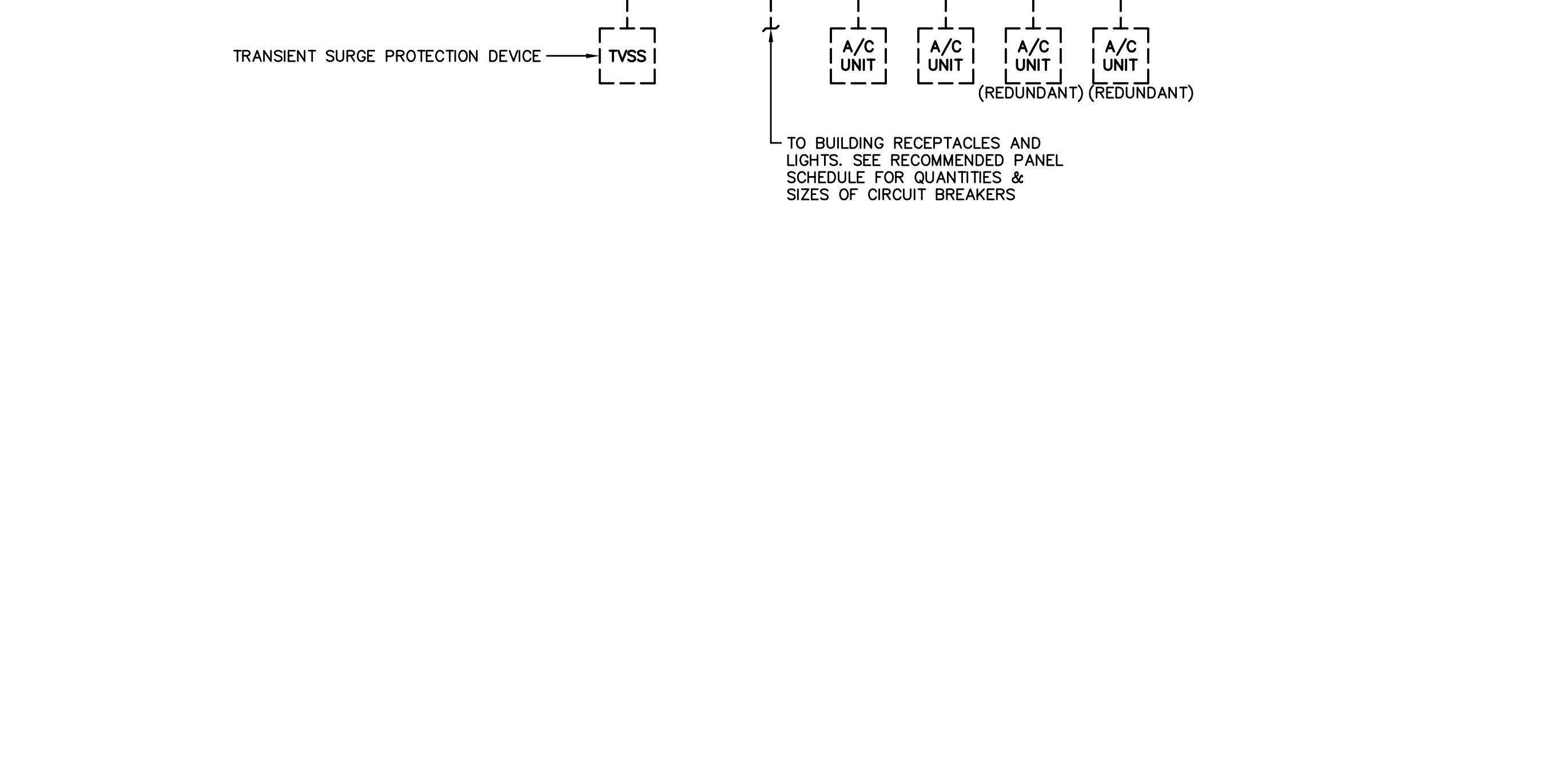
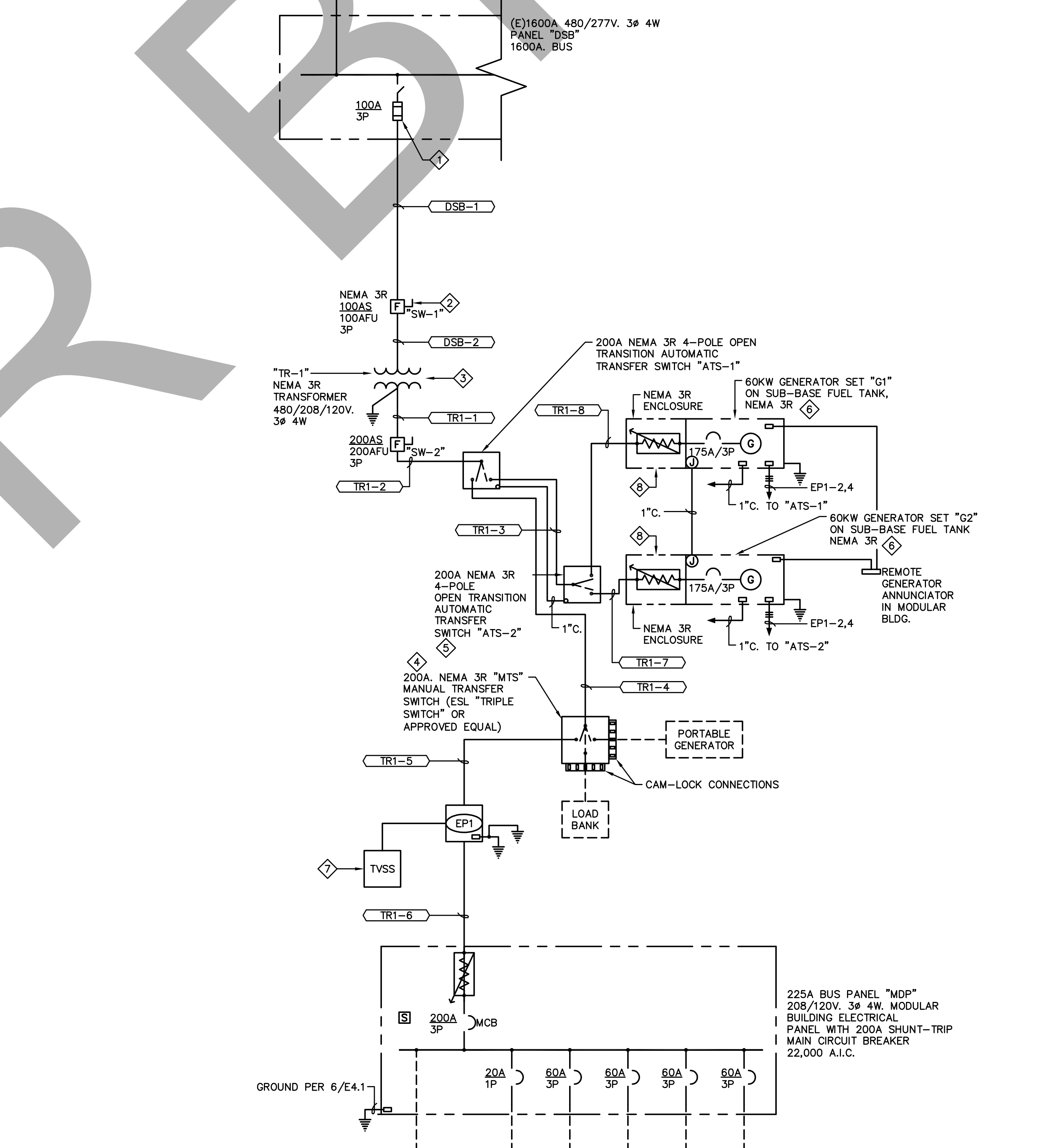
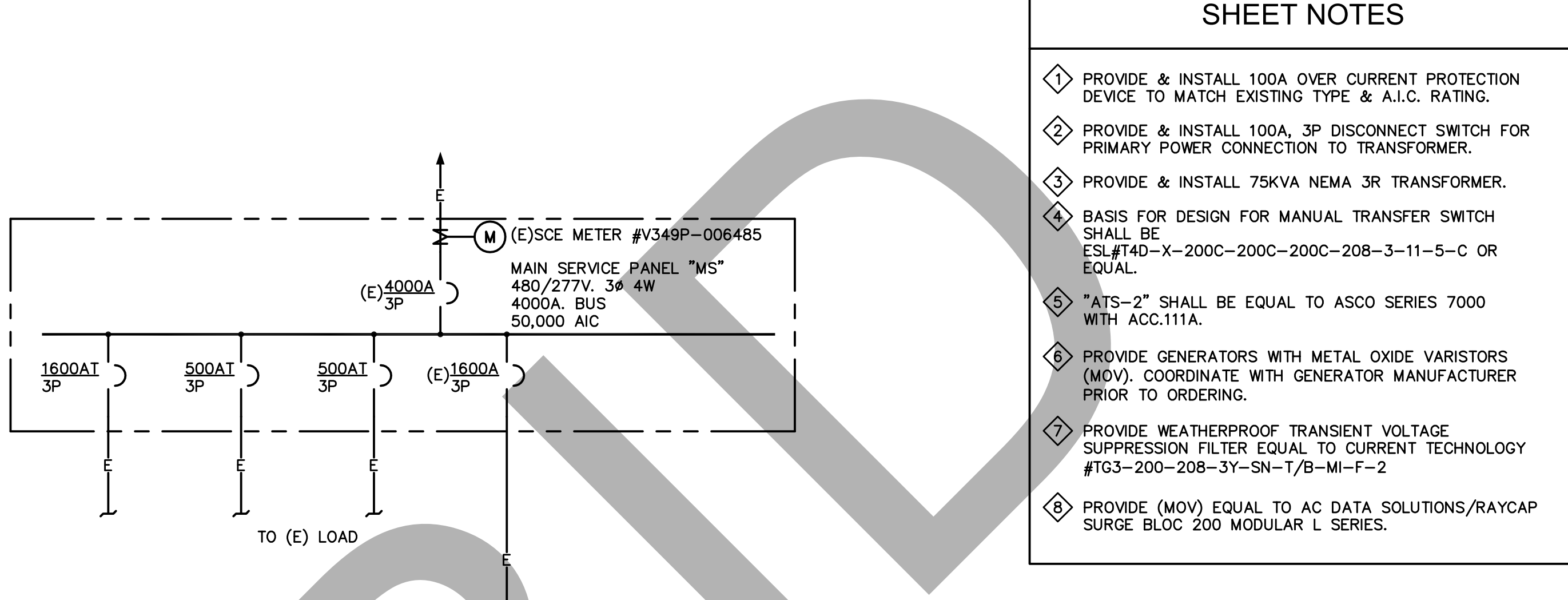
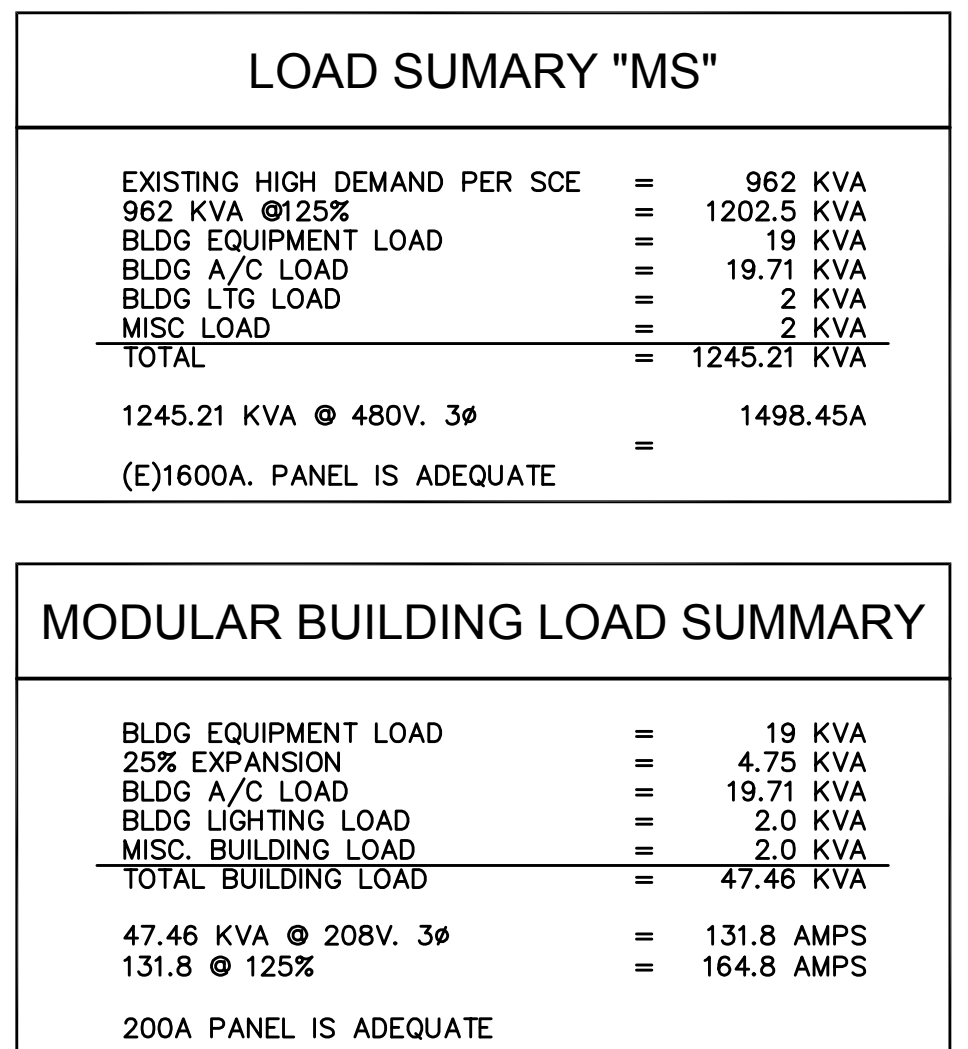
* FEEDER LENGTH IN FEET IS INDICATED FOR VOLTAGE DROP CALCULATION ONLY AND SHALL NOT BE USED FOR QUANTITY TAKEOFFS.
** MCB = MAIN CIRCUIT BREAKER ** MLO = MAIN LUGS ONLY

PANEL: "EPI" EXTERIOR										BRANCH: NORMAL		VOLTAGE: 208/120V		OCT CODE: 1=(CONTINUOUS LOAD)								
FED FROM: SURFACE NEMA-3R										PHASE & WIRE: 3PH,4W		MIN. BUS: 400 AMPS		2=(NON-CONTINUOUS)								
MOUNTING: SURFACE NEMA-3R										MIN. BUS: 200 AMPS		3=(RECEPTACLES)		4=(KITCHEN)								
AIC RATING: 22000										NO. OF EQUIP=												
CIRCUIT	NO	CODE	TRIP	POLE	DESCRIPTION	MISC	REC	LTG	VA	A	B	C	VA	LTG	REC	MISC	DESCRIPTION	POLE	TRIP	CODE	NO	
1	2	175	3	MDP					13740	14240			500				1 BATTERY CHARGER "G2"	1	20	2	2	
3	2	175	3	MDP					13740	14240			500				1 JACKET HEATER "G2"	1	20	2	4	
5	2	175	3	MDP					13740	14240			180	1			1 TVSS REC	1	20	3	6	
7	1	20	1	CONV. REC					500				500				1 BATTERY CHARGER "G2"	1	20	2	8	
9	20	1	SPARE						500				500				1 JACKET HEATER "G2"	1	20	2	10	
11	20	1	SPARE						0				0				SPACE	1	20	2	12	
13	20	1	SPARE						0				0				SPACE	1	20	2	14	
15	20	1	SPARE						0				0				SPACE	1	20	2	16	
17	2	100	3	TVSS					0				0				SPACE	1	20	2	18	
19	2	100	3	TVSS					0				0				SPACE	1	20	2	20	
21	2	100	3	TVSS					0				0				SPACE	1	20	2	22	
23	2	100	3	TVSS					0				0				SPACE	1	20	2	24	
25									0				0				SPACE	1	20	2	26	
27									0				0				SPACE	1	20	2	28	
29									0				0				SPACE	1	20	2	30	
31									0				0				SPACE	1	20	2	32	
33									0				0				SPACE	1	20	2	34	
35									0				0				SPACE	1	20	2	36	
37									0				0				SPACE	1	20	2	38	
39									0				0				SPACE	1	20	2	40	
41									0				0				SPACE	1	20	2	42	
NOTES:										TOTAL	14740	14740	13920									

CONN.KVA (CODE 1) 0.0
CONN.KVA (CODE 2) 43.2
CONN.KVA (CODE 3) 0.2
CONN.KVA (CODE 4) 0.0
CONNECTED KVA 43.4
CONNECTED AMPS 120.5
FEEDER DEMAND KVA 43.4
FEEDER DEMAND AMPS 120.5
MCB = MAIN CIRCUIT BREAKER MLO = MAIN LUGS ONLY

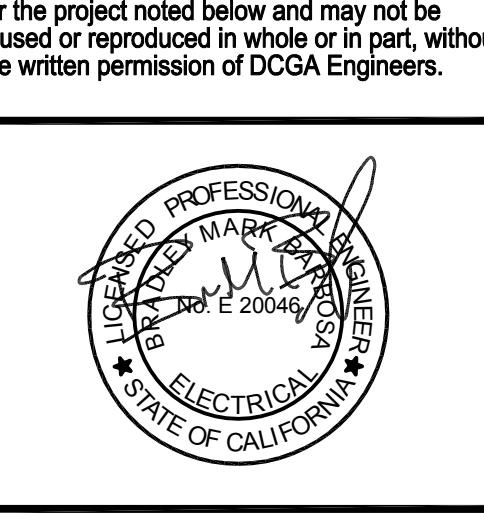
PANEL: "MDP" MODULAR BUILDING										BRANCH: NORMAL		VOLTAGE: 208/120V		OCT CODE: 1=(CONTINUOUS LOAD)								
FED FROM: EPI										PHASE & WIRE: 3PH,4W		MIN. BUS: 225 AMPS		2=(NON-CONTINUOUS)								
MOUNTING: SURFACE NEMA-1										MIN. BUS: 200 AMPS		3=(RECEPTACLES)		4=(KITCHEN)								
AIC RATING: 22000										NO. OF EQUIP=												
CIRCUIT	NO	CODE	TRIP	POLE	DESCRIPTION	MISC	REC	LTG	VA	A	B	C	VA	LTG	REC	MISC	DESCRIPTION	POLE	TRIP	CODE	NO	
1	60	3	A/C EQUIP						2690	5380			2690				A/C EQUIP	3	60	1	2	
3	1		A/C EQUIP						2690	5380			2690				A/C EQUIP	1	20	1	4	
5	1		A/C EQUIP						2690	5380			2690				A/C EQUIP	1	20	1	6	
7	1	60	3	A/C EQUIP (REDUNDANT)					585				585				TELE COM	2	30	2	8	
9	1								585				585				TELE COM	1	20	2	10	
11	1								585				585				TELE COM	2	30	2	12	
13	1	60	3	A/C EQUIP (REDUNDANT)					585				585				TELE COM	2	30	2	14	
15	1								585				585				TELE COM	2	30	2	16	
17	1								585				585				TELE COM	1	20	1	18	
19	20	1	SPARE						212				212				LIGHTING	1	20	1	20	
21	20	1	SPARE						900				900		5		CONV. REC	1	20	3	22	
23	20	1	SPARE						585				585				TELE COM	2	30	2	24	
25	20	1	SPARE						585				585				TELE COM	1	20	2	26	
27	20	1	SPARE						0				0				SPACE	1	20	2	28	
29	20	1	SPARE						0				0				SPACE	1	20	2	30	
31	20	1	SPARE						0				0				SPACE	1	20	2	32	
33	20	1	SPARE						0				0				SPACE	1	20	2	34	
35	20	1	SPARE						0				0				SPACE	1	20	2	36	
37	20	1	SPARE						0				0				SPACE	1	20	2	38	
39	20	1	SPARE						0				0				SPACE	1	20	2	40	
41									0				0				SPACE	1	20	2	42	
NOTES:										TOTAL	7347	7450	7135									

CONN.KVA (CODE 1) 16.4
CONN.KVA (CODE 2) 4.7
CONN.KVA (CODE 3) 0.9
CONN.KVA (CODE 4) 0.0
CONNECTED KVA 21.9
CONNECTED AMPS 60.9
FEEDER DEMAND KVA 26.0
FEEDER DEMAND AMPS 72.2
MCB = MAIN CIRCUIT BREAKER MLO = MAIN LUGS ONLY



- ### SHEET NOTES
- PROVIDE & INSTALL 100A OVER CURRENT PROTECTION DEVICE TO MATCH EXISTING TYPE & A.I.C. RATING.
 - PROVIDE & INSTALL 100A, 3P DISCONNECT SWITCH FOR PRIMARY POWER CONNECTION TO TRANSFORMER.
 - PROVIDE & INSTALL 75KVA NEMA 3R TRANSFORMER.
 - BASIS FOR DESIGN FOR MANUAL TRANSFER SWITCH SHALL BE ESL440-X-200C-200C-200C-208-3-11-5-C OR EQUAL.
 - "ATS-2" SHALL BE EQUAL TO ASCO SERIES 7000 WITH ACC.111A.
 - PROVIDE GENERATORS WITH METAL OXIDE VARISTORS (MOV). COORDINATE WITH GENERATOR MANUFACTURER PRIOR TO ORDERING.
 - PROVIDE WEATHERPROOF TRANSIENT VOLTAGE SUPPRESSION FILTER EQUAL TO CURRENT TECHNOLOGY #TG3-200-208-3Y-SN-17/B-M-F-2
 - PROVIDE (MOV) EQUAL TO AC DATA SOLUTIONS/RAYCAP SURGE BLOC 200 MODULAR I. SERIES.

CLIENT:



PROJECT: RANCHO CUCAMONGA COURTHOUSE 800MHZ TOWER PROJECT
ADDRESS: 8303 Haven Ave, Rancho Cucamonga, CA

SHEET TITLE: SINGLE LINE DIAGRAM, PANEL SCHEDULE AND FEEDER SCHEDULE

No.	REVISION	DATE

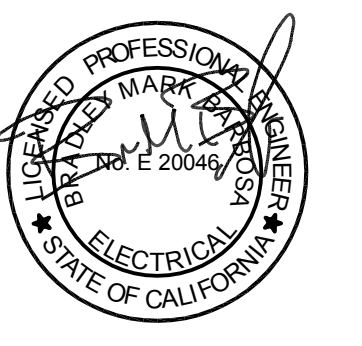
DRAWN BY: SOIMH
CHECKED BY: KW
DATE: 5/9/16
SCALE: N.T.S.
PROJECT No.: -
SHEET
E0.3

SHEET NOTES

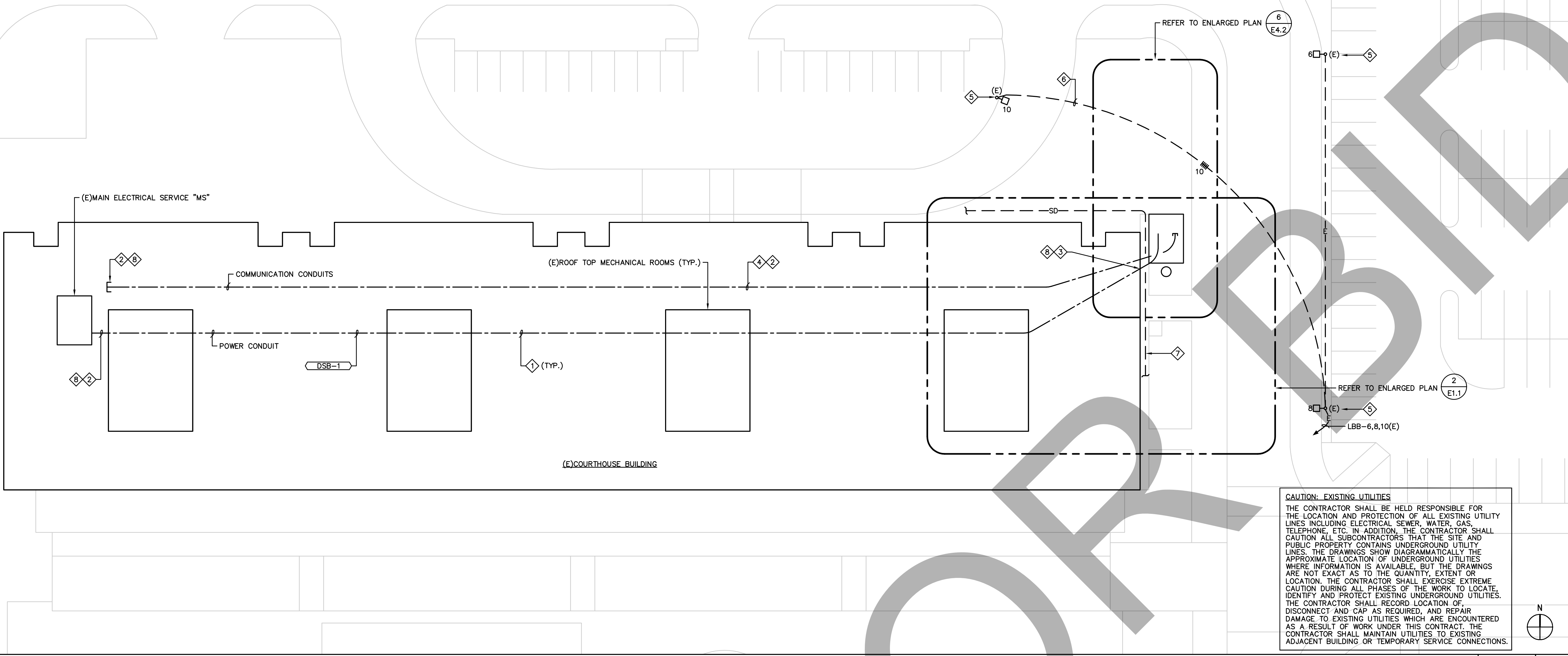
- 1 REFER TO SINGLE LINE DIAGRAM FOR FEEDER SIZES.
- 2 COREDRILL THROUGH FLOOR & EXTEND CONDUIT BELOW BUILDING THROUGH CRAWL SPACE.
- 3 COREDRILL THROUGH EXISTING CONCRETE EXTERIOR WALL EXTERIOR WALL AS REQUIRED & SEAL PENETRATION WATER TIGHT.
- 4 ROUTE (2) 2" C.O. FROM MODULAR BUILDING TO TELECOMMUNICATION ROOM.
- 5 EXISTING LIGHTING FIXTURE TO REMAIN.
- 6 EXISTING SITE LIGHTING CIRCUIT TO BE REMOVED AND REINSTALLED TO MAINTAIN CIRCUIT.
- 7 APPROXIMATE LOCATION OF EXISTING STORM DRAIN. POT-HOLE TO CONFIRM EXACT LOCATION & PROVIDE ALL MEANS TO PROTECT IN PLACE.
- 8 CONTRACTOR SHALL NOTE THAT BUILDING IS CONSTRUCTED ON SEISMIC ISOLATION BASES AND WHERE CONDUIT FEEDERS TRANSITION FROM GRADE TO BUILDING, SEISMIC SEPARATION SEAL/TITE FLEXIBLE CONNECTIONS & JUNCTION BOXES WILL BE REQUIRED.

DCGA ENGINEERS
 Consulting Mechanical and Electrical Engineers
 4760 E. Chabon Mill Pkwy
 Ontario, CA 91764
 Fax: 951.989.7233

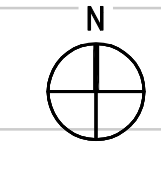
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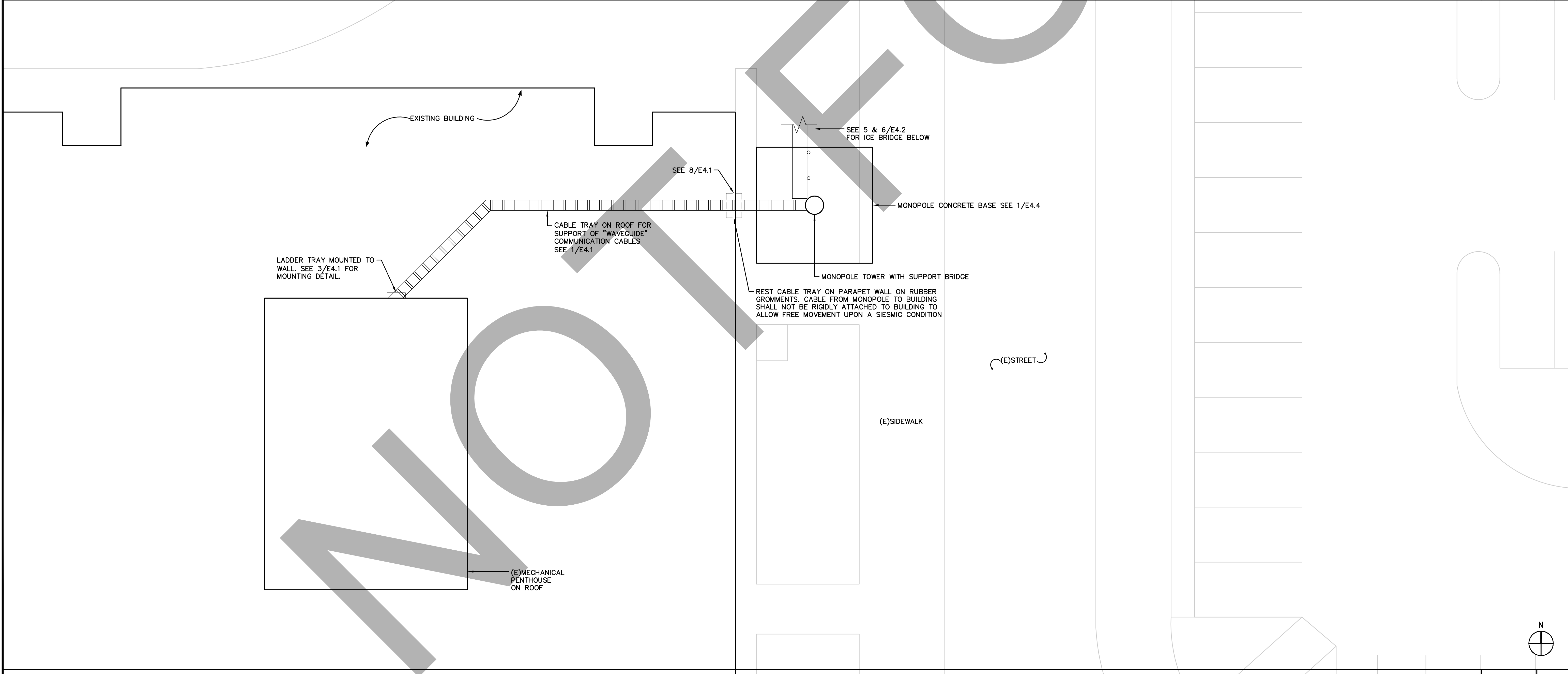


CAUTION: EXISTING UTILITIES
 THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITY LINES INCLUDING ELECTRICAL, SEWER, WATER, GAS, TELEPHONE, ETC. IN ADDITION, THE CONTRACTOR SHALL CAUTION ALL SUBCONTRACTORS THAT THE SITE AND PUBLIC PROPERTY CONTAINS UNDERGROUND UTILITY LINES. THE DRAWINGS SHOW DIAGRAMMATICALLY THE APPROXIMATE LOCATION OF UNDERGROUND UTILITIES WHERE INFORMATION IS AVAILABLE, BUT THE DRAWINGS ARE NOT EXACT AS TO THE QUANTITY, EXTENT OR LOCATION. THE CONTRACTOR SHALL EXERCISE EXTREME CAUTION DURING ALL PHASES OF THE WORK TO LOCATE, IDENTIFY AND PROTECT EXISTING UNDERGROUND UTILITIES. THE CONTRACTOR SHALL RECORD LOCATION OF, DISCONNECT AND CAP AS REQUIRED, AND REPAIR DAMAGE TO EXISTING UTILITIES WHICH ARE ENCOUNTERED AS A RESULT OF WORK UNDER THIS CONTRACT. THE CONTRACTOR SHALL MAINTAIN UTILITIES TO EXISTING ADJACENT BUILDING OR TEMPORARY SERVICE CONNECTIONS.



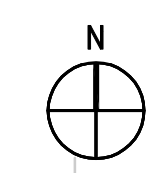
ELECTRICAL SITE PLAN

SCALE	1
1"=20'-0"	



PARTIAL ROOF PLAN AT MONOPOLE CONNECTION TO BUILDING

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



PROJECT:
RANCHO CUCAMONGA COURTHOUSE 800MHZ TOWER PROJECT

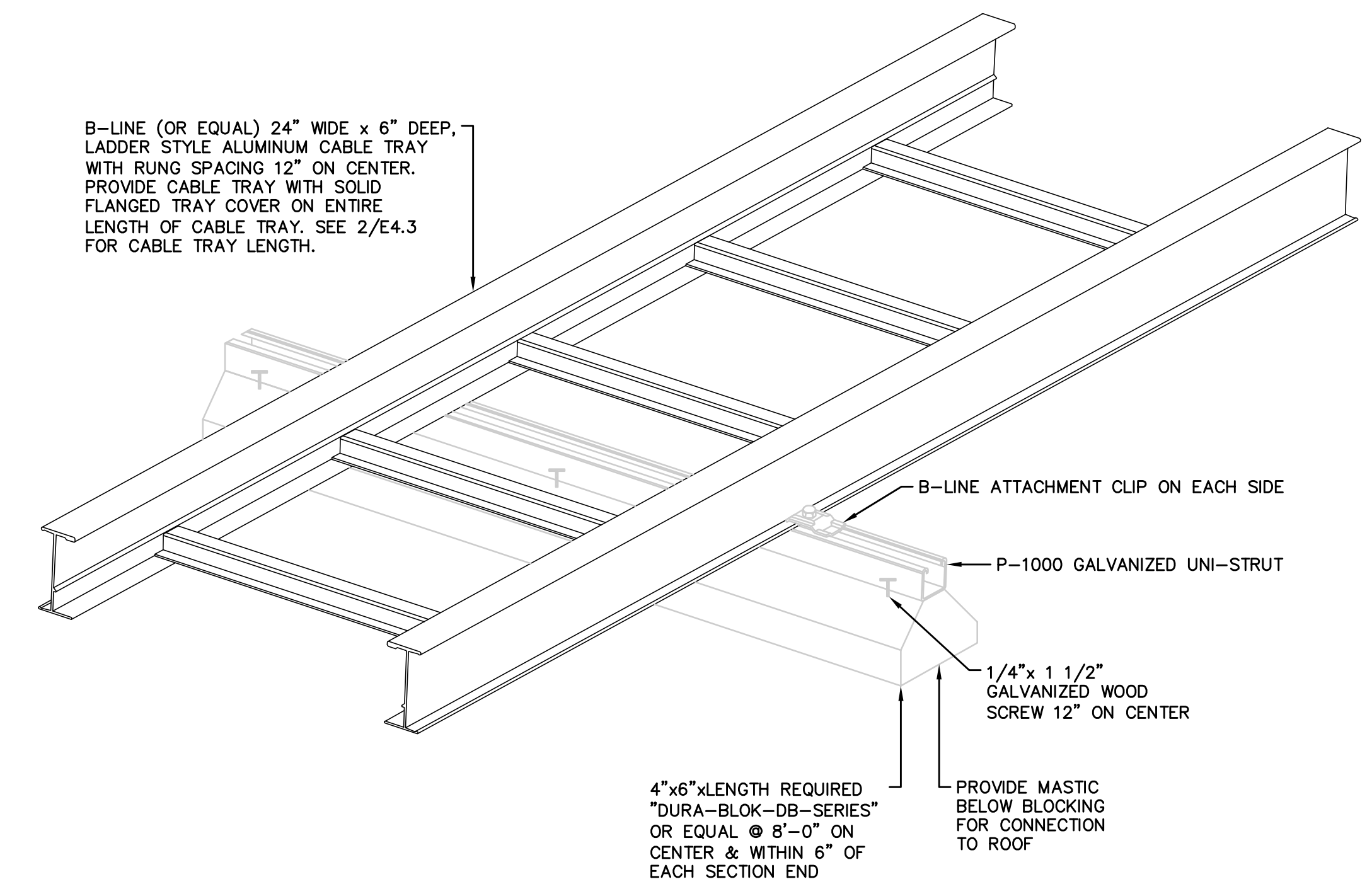
ADDRESS
 8303 Haven Ave.
 Rancho Cucamonga, CA

SHEET TITLE
ELECTRICAL SITE PLAN

No.	REVISION	DATE

DRAWN BY :	SO
CHECKED BY :	KW
DATE :	5/9/16
SCALE :	AS NOTED
PROJECT No. :	-
SHEET	
E1.1	

(BASIS OF DESIGN = B-LINE #26
SERIES-26-A-12-24-144 WITH
B1-7-A.24-144 COVER WITH ALL MOUNTING
ACCESSORIES & HARDWARE)

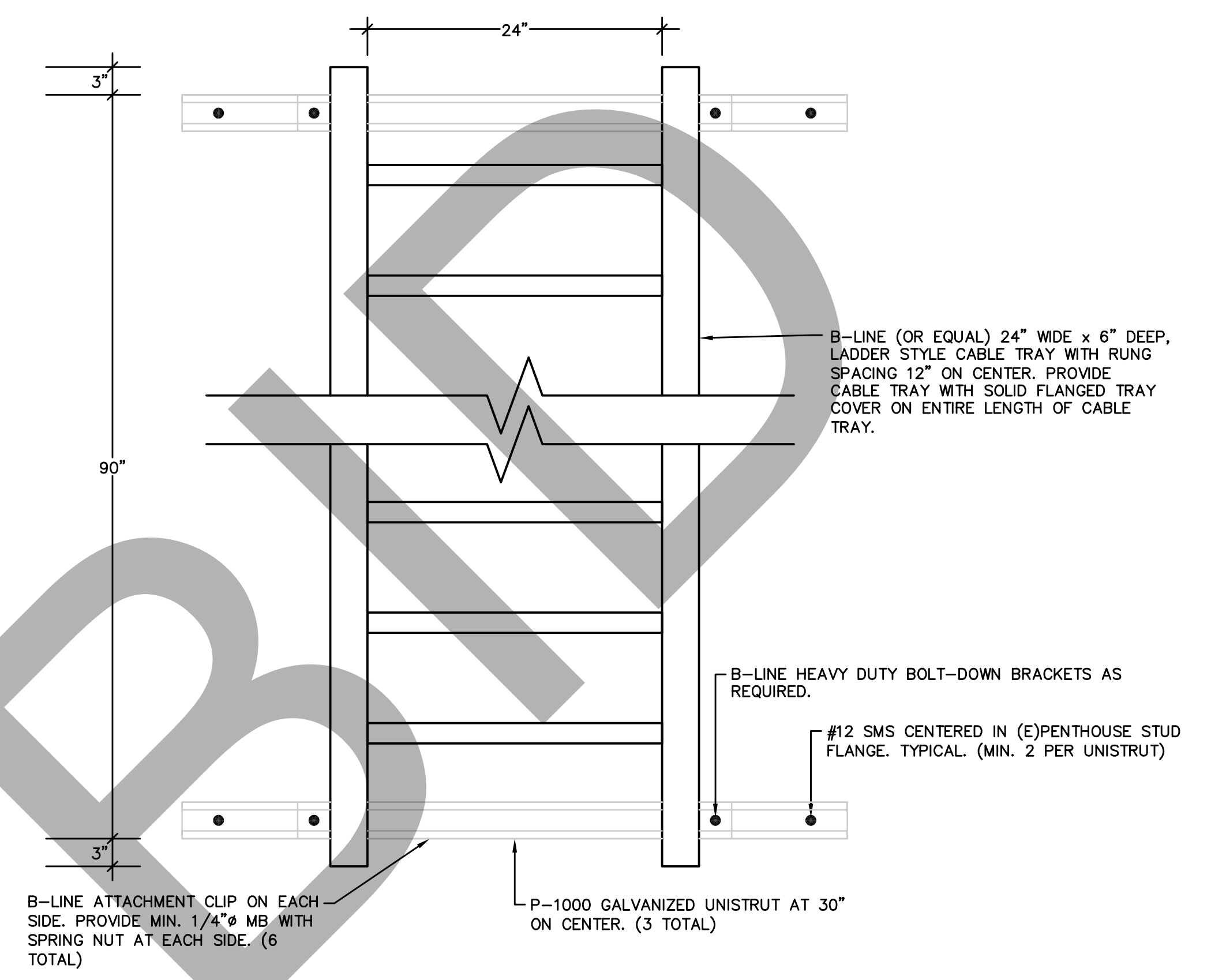
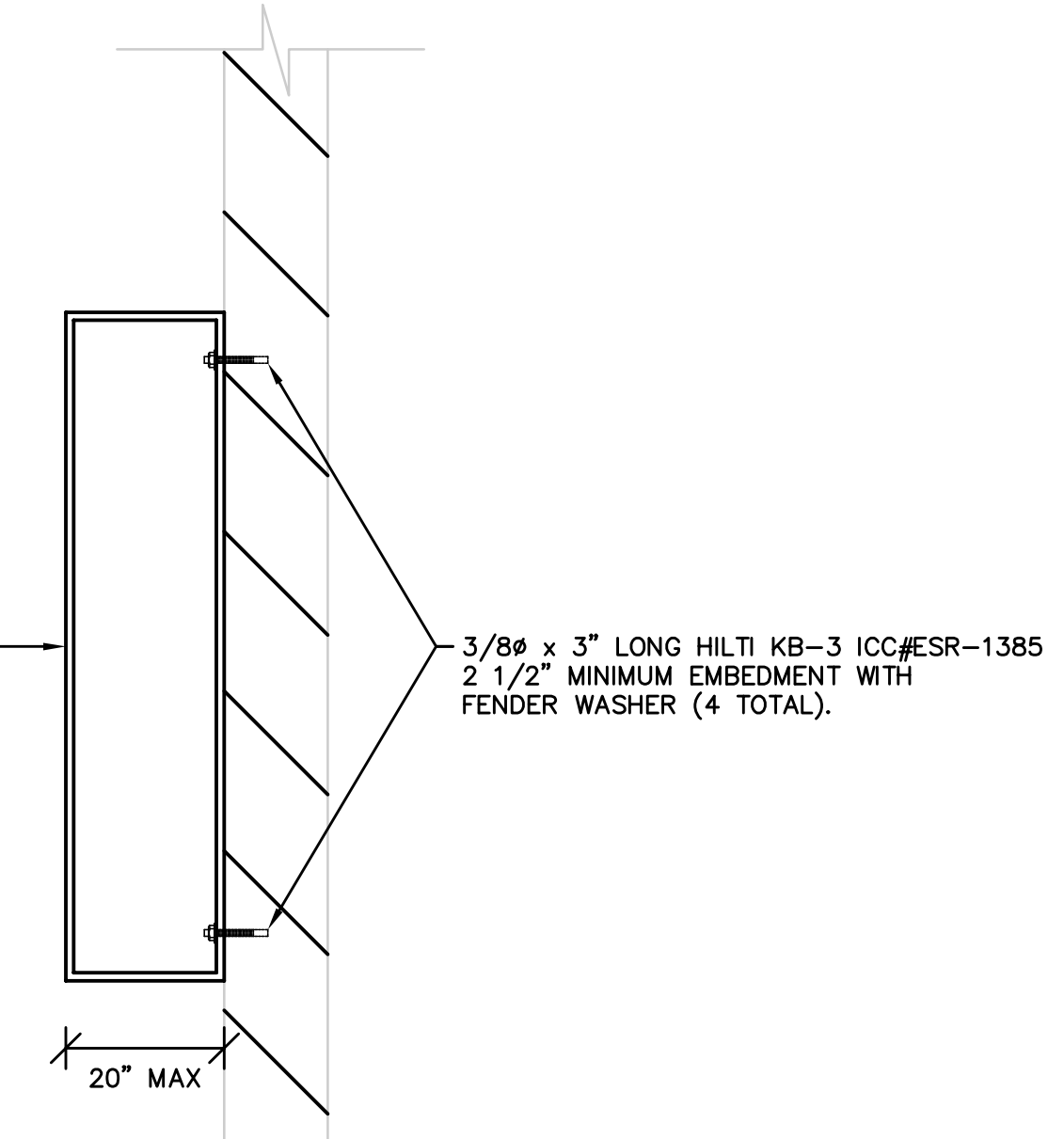


CABLE TRAY ON SLEEPER DETAIL

SCALE
N.T.S. 1

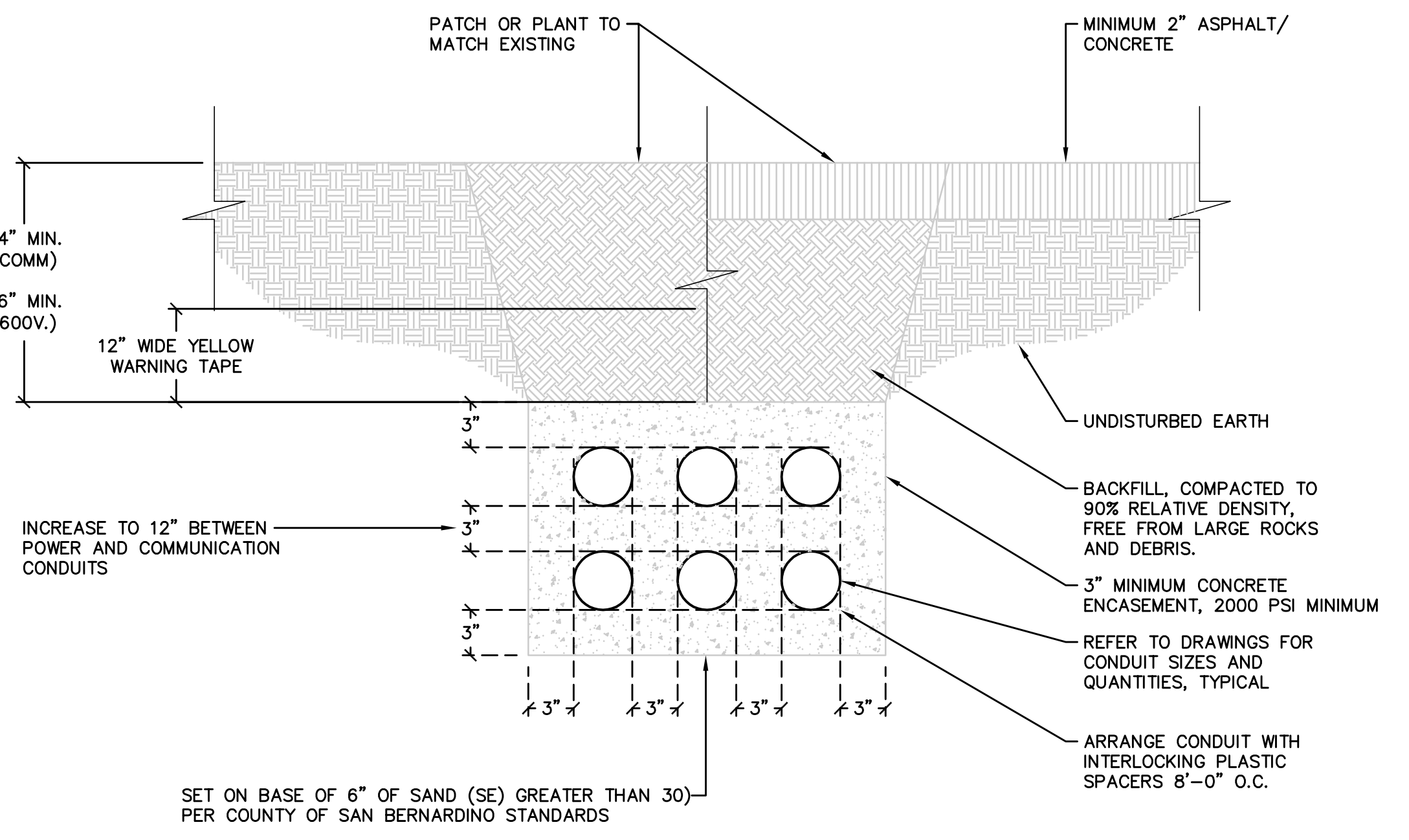
SURFACE MOUNTED PANEL @ MASONRY WALL

SCALE
N.T.S. 2



LADDER TRAY ELEVATION DETAIL AT PENTHOUSE

SCALE
N.T.S. 3

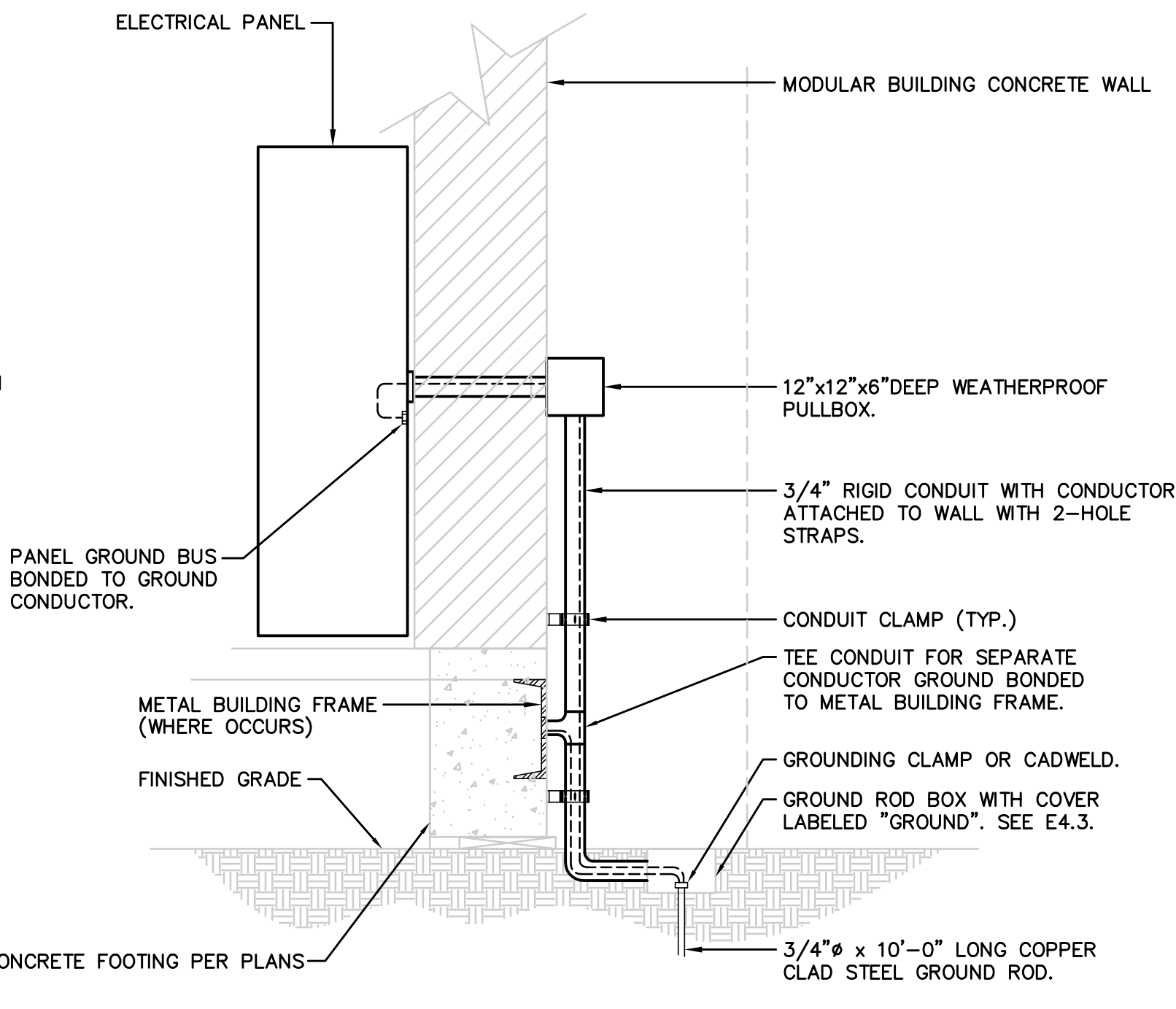


TYPICAL MULTI-CONDUIT PLACEMENT DETAIL

SCALE
N.T.S. 4

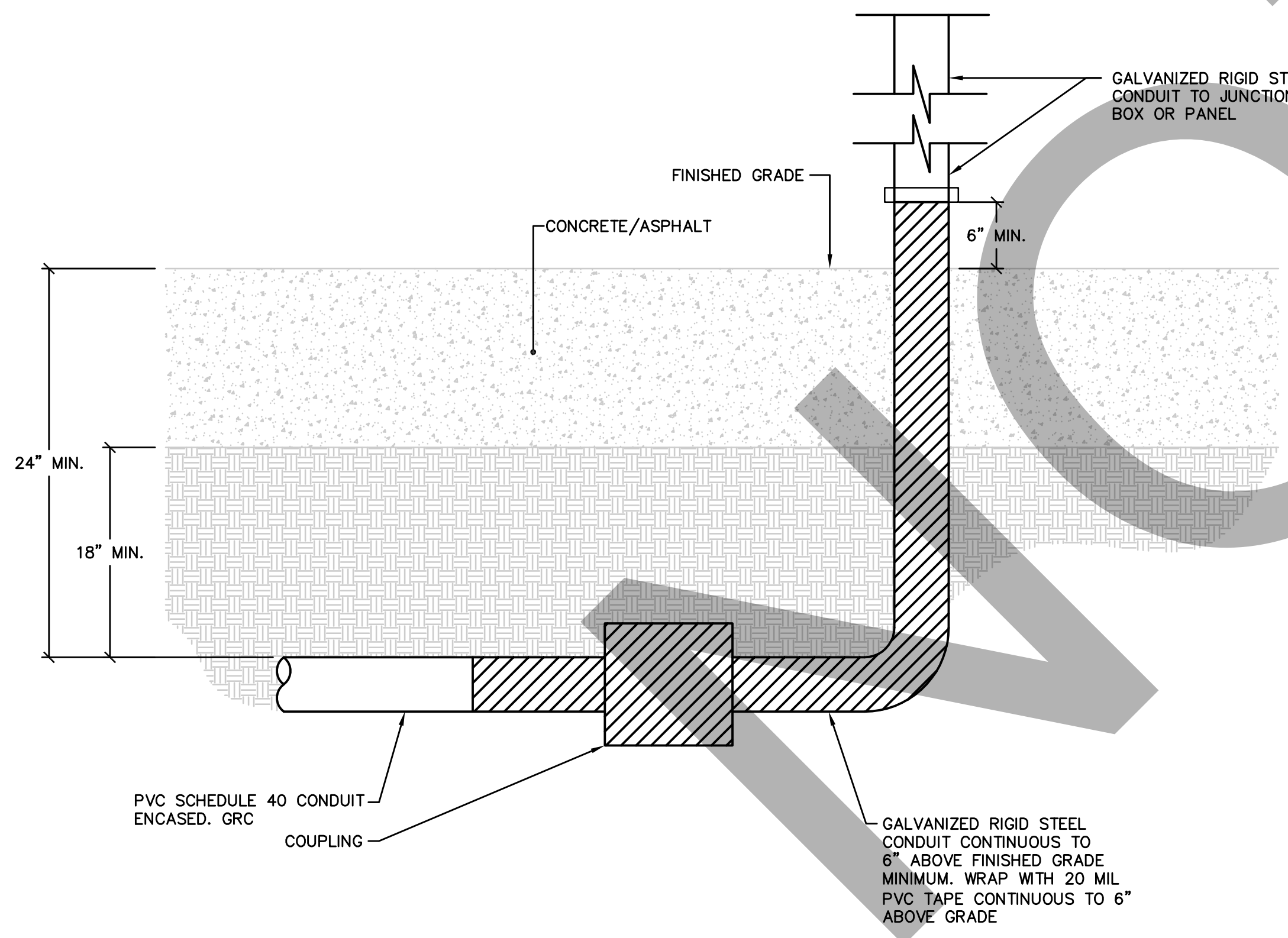
DETAIL NOTES:

1. SIZE OF CONDUCTOR SHALL BE #1/0 AWG CU.
2. BOND SEPARATE CONDUCTORS FROM GROUND ROD TO ELECTRICAL PANEL AND TO METAL BUILDING FRAME (CEC. 250-81). IN ADDITION TO THE DETAIL SHOWN ABOVE, BOND THE ELECTRICAL GROUND TO METAL WATER PIPE EMBEDDED AT LEAST 10 FT. INTO THE SOIL IF AVAILABLE (CEC. 250-81 & 250-83).
3. ALL MODULES OF METAL FRAME BUILDINGS SHALL BE ELECTRICALLY BONDED TOGETHER (BOLTING ONLY IS NOT ACCEPTABLE BONDING).
4. CHECK RESISTANCE TO GROUND, IF RESISTANCE EXCEEDS 5 OHMS, INSTALL ADDITIONAL GROUND RODS WITH CONDUCTORS AS SHOWN, SEPARATED AT LEAST 6'-0" UNTIL RESISTANCE IS REDUCED TO 5 OHMS OR UNLESS NOTED OTHERWISE IN SPECIFICATIONS. (CEC. 250-84).
5. GROUND TEST SHALL BE WITNESSED BY PROJECT INSPECTOR, AND RECORDED FOR OWNER MANUAL.



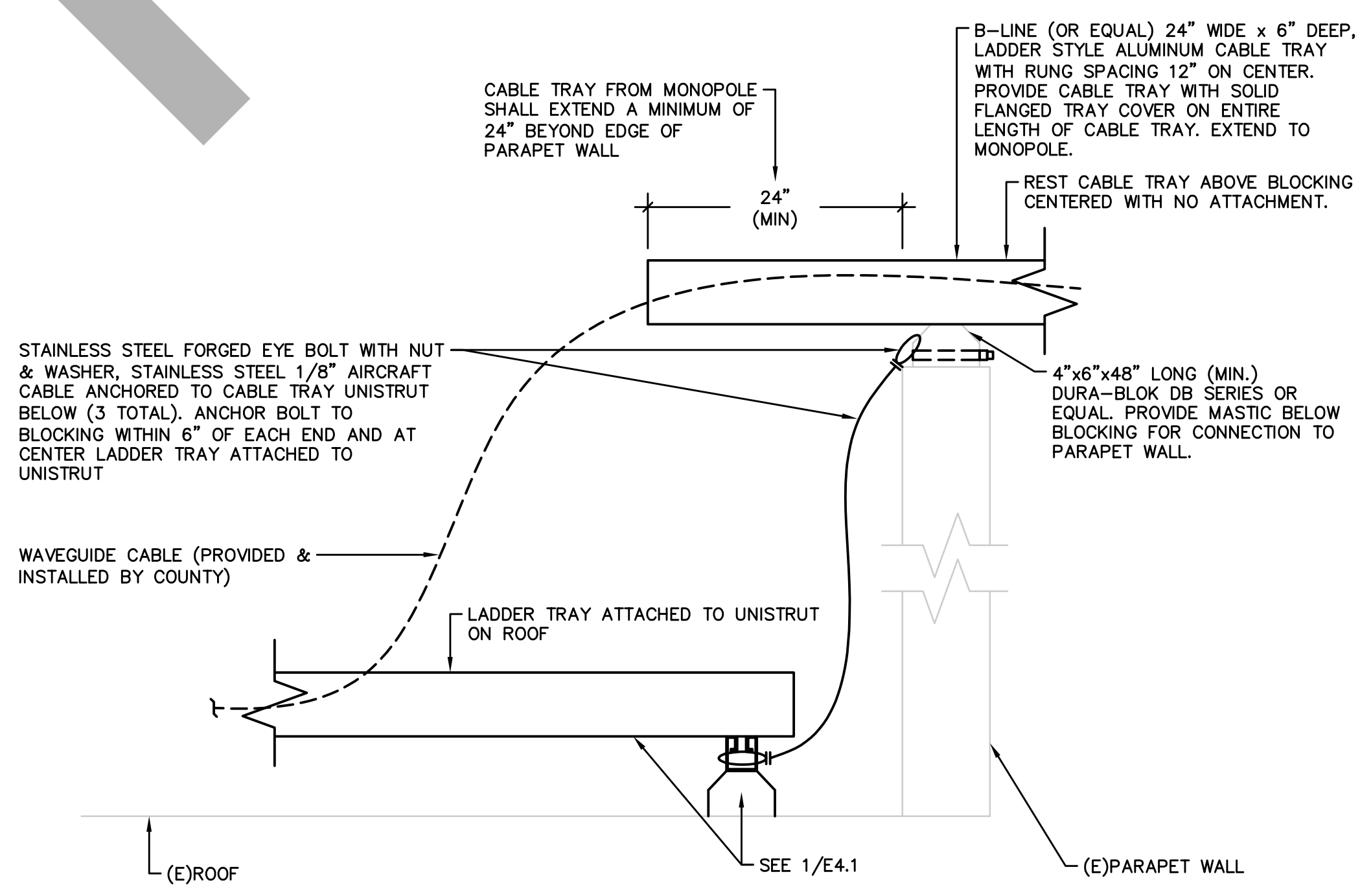
MODULAR BLDG GROUNDING DETAIL

SCALE
N.T.S. 6



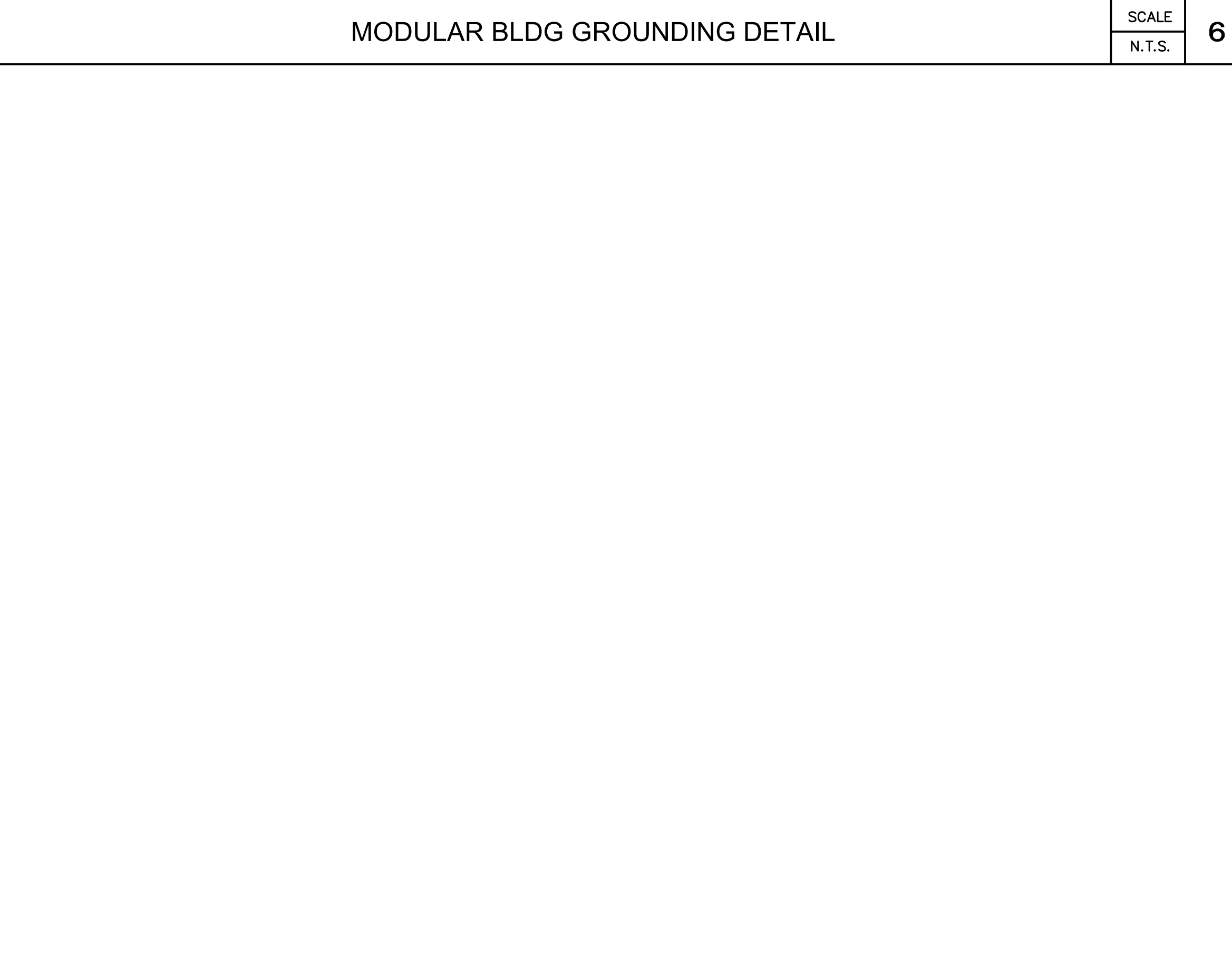
CONDUIT RISER INSTALLATION DETAIL

SCALE
N.T.S. 7



CABLE TRAY AT PARAPET WALL DETAIL

SCALE
N.T.S. 8



SCALE
N.T.S. 9

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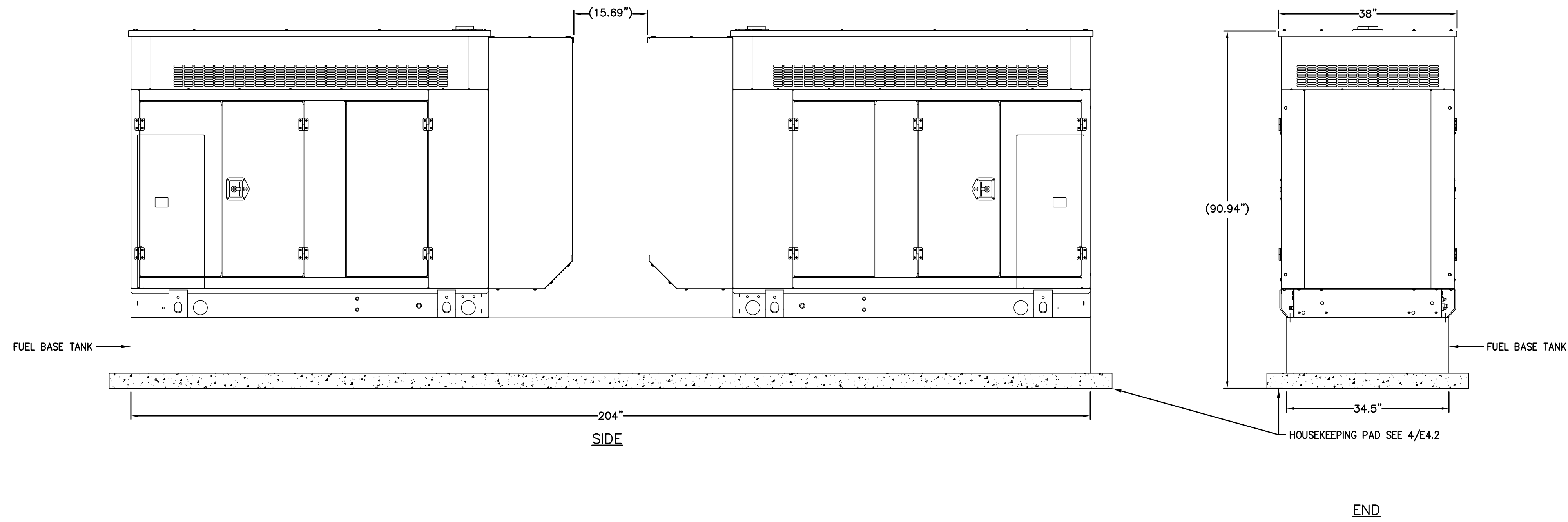
PROJECT:
**RANCHO CUCAMONGA
COURTHOUSE 800MHZ TOWER PROJECT**
ADDRESS
8303 Haven Ave.
Rancho Cucamonga, CA

SHEET TITLE
ELECTRICAL DETAILS

No.	REVISION	DATE

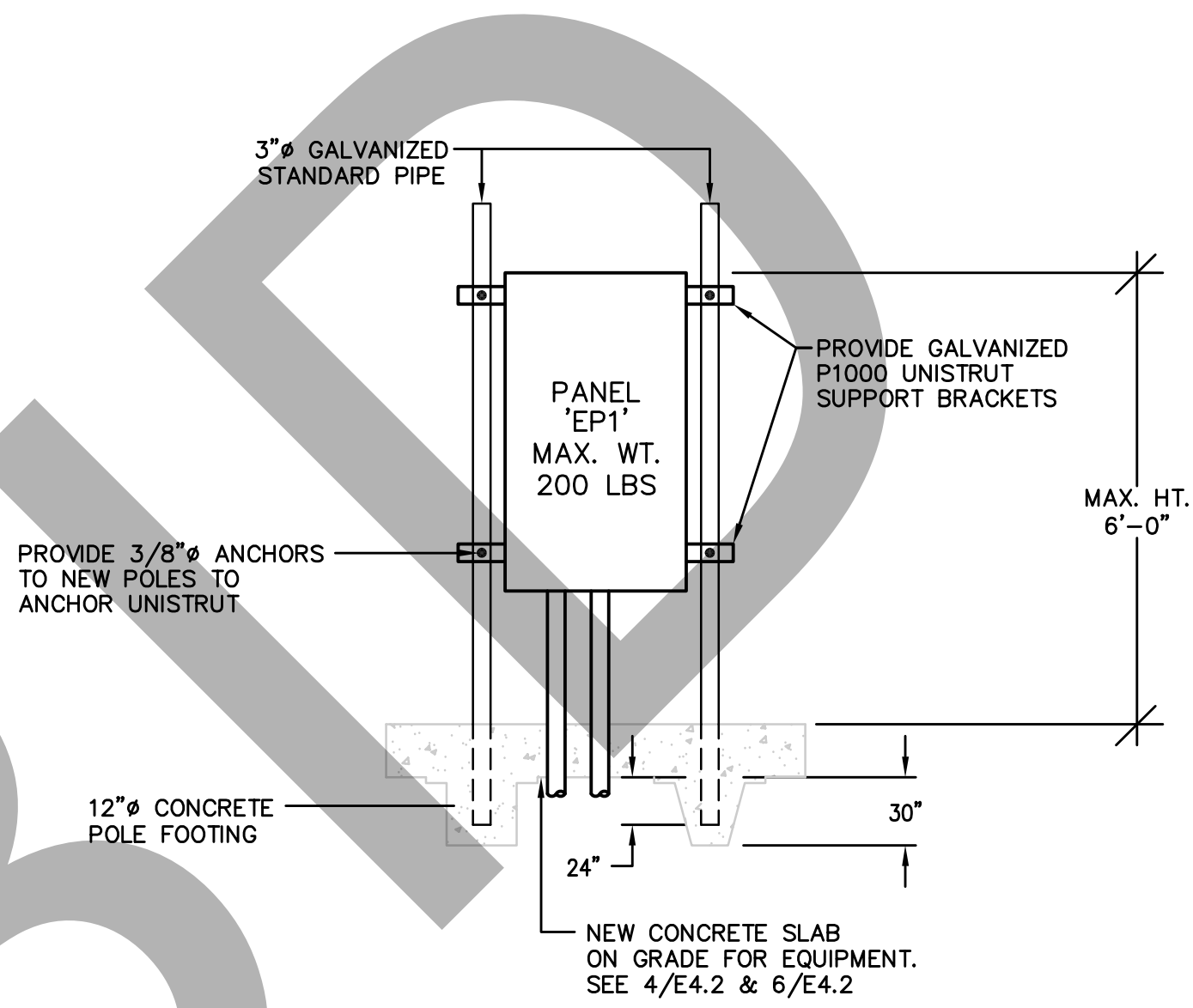
DRAWN BY: SO
CHECKED BY: KW
DATE: 5/9/16
SCALE: AS NOTED

PROJECT No.: -
SHEET
E4.1



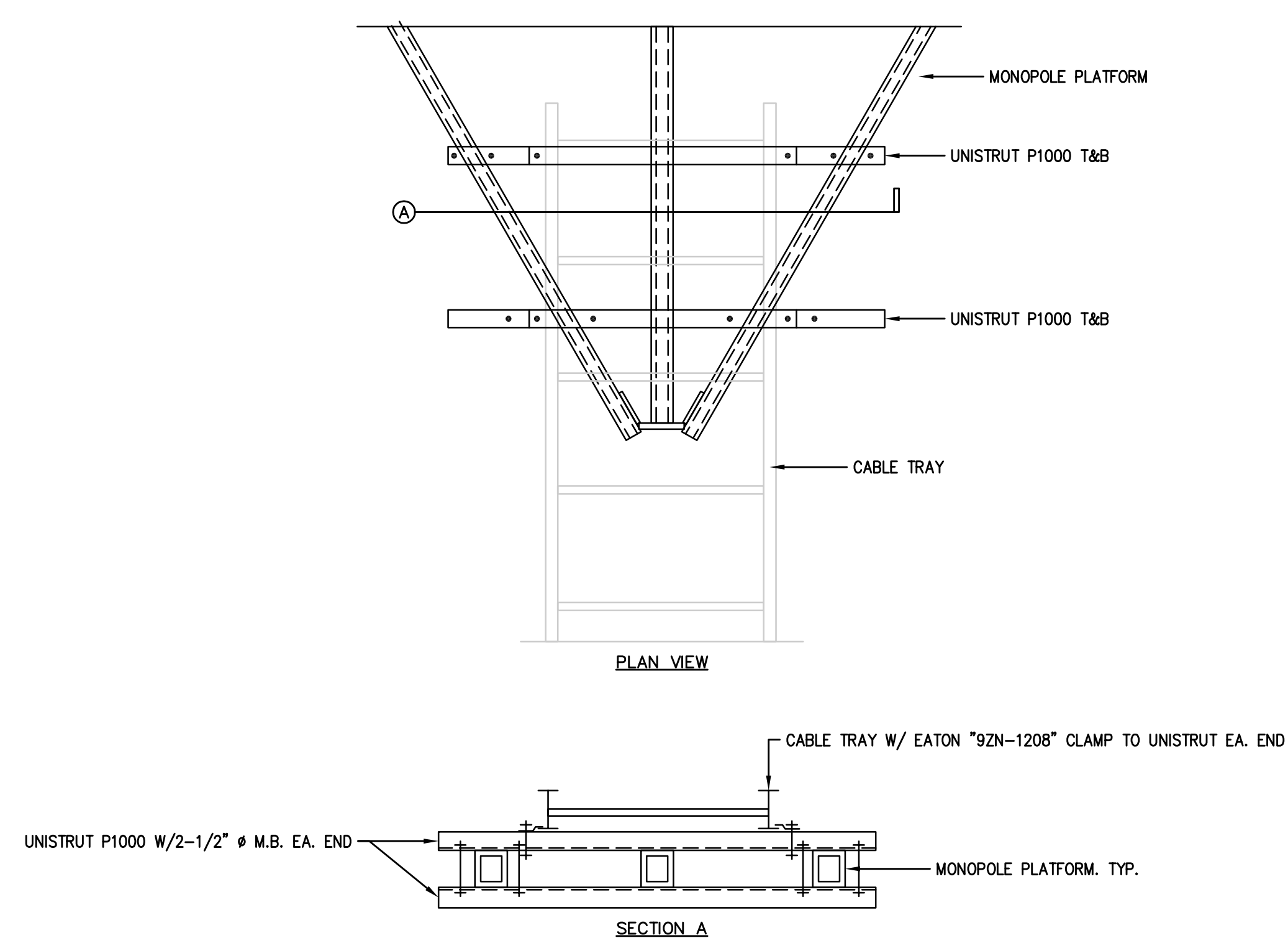
GENERATOR SET DETAIL

SCALE
N.T.S. 1



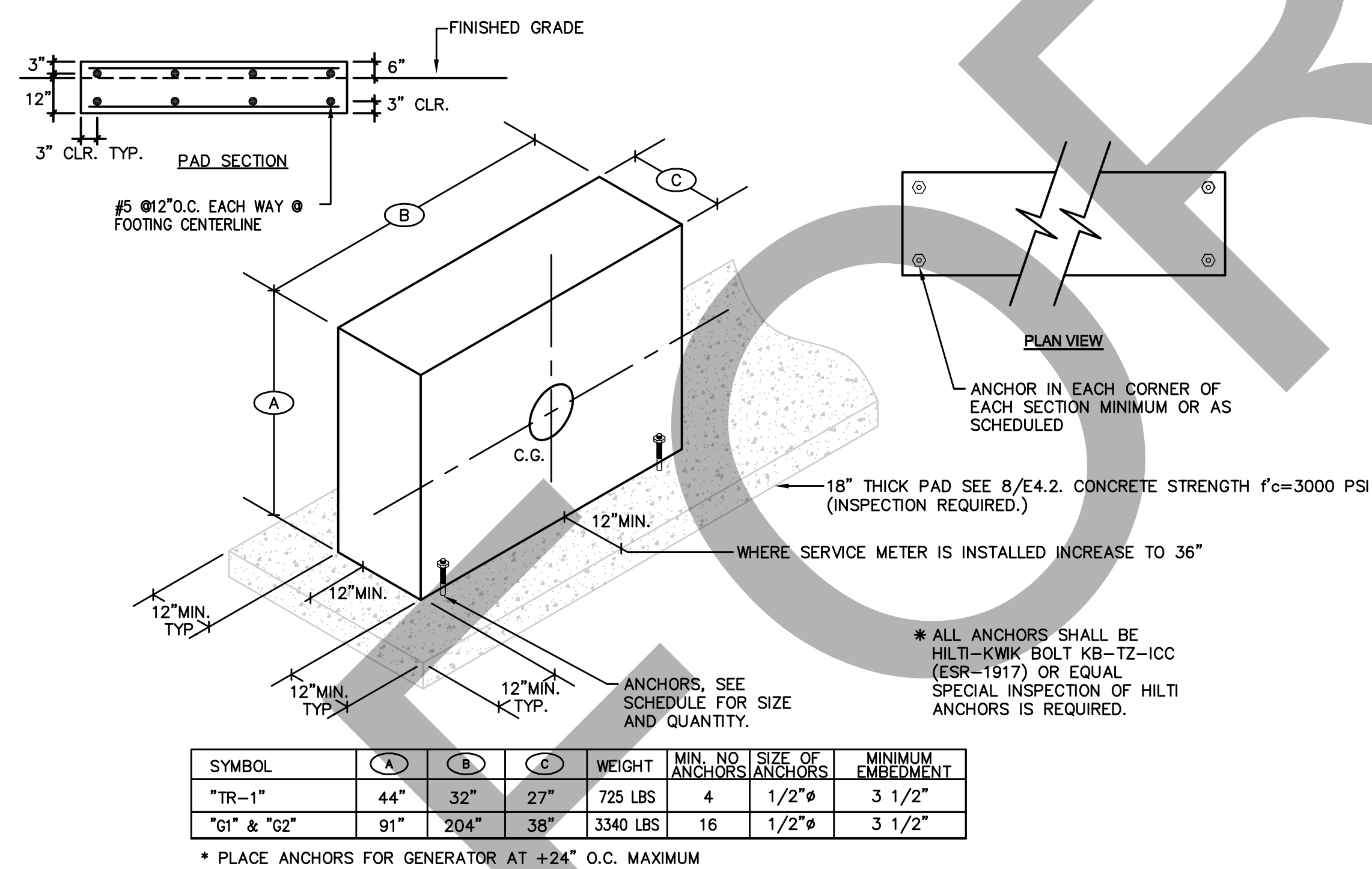
PANEL "EP1" MOUNTING DETAIL

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



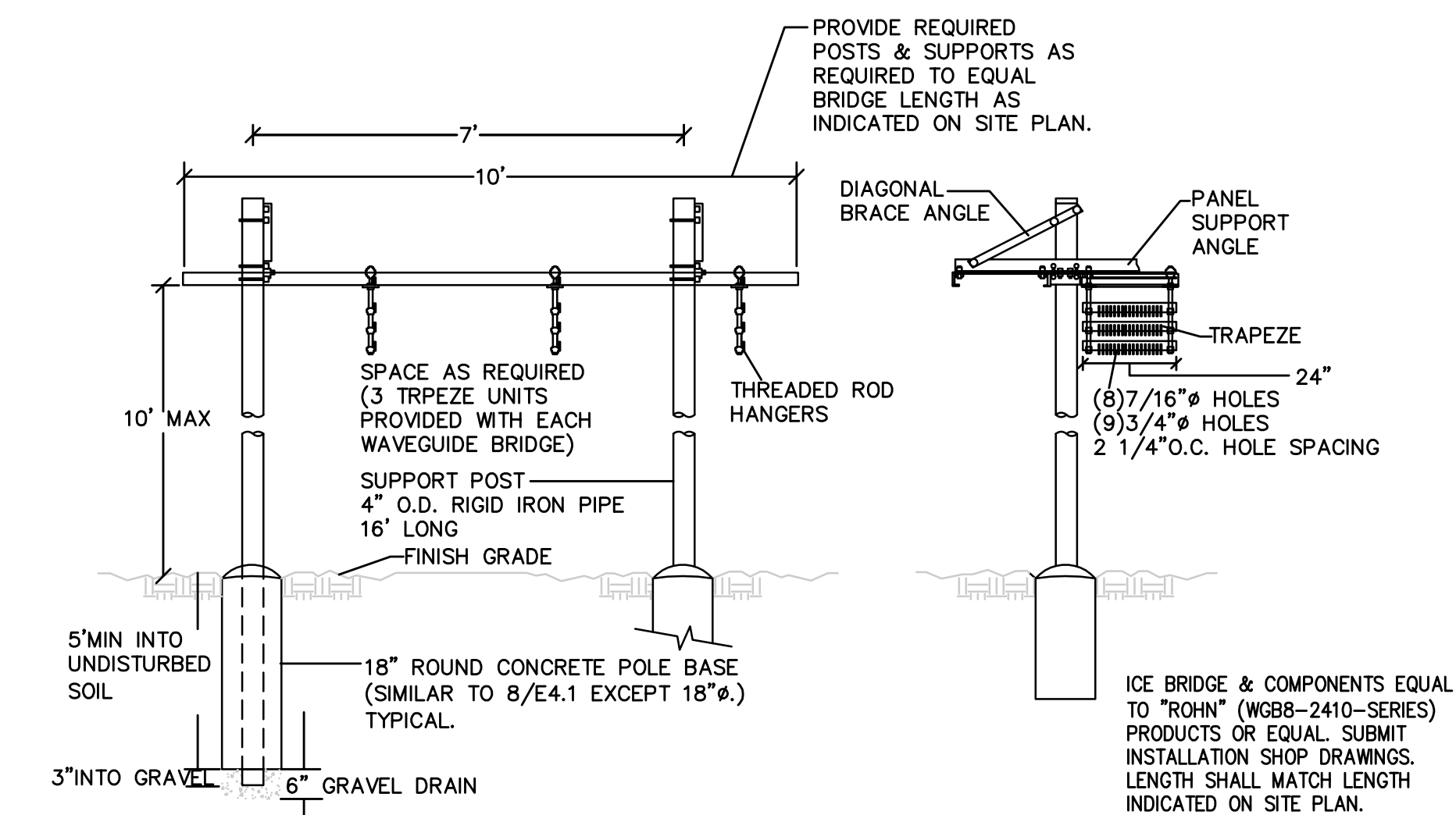
CABLE TRAY TO MONOPOLE PLATFORM ATTACHMENT

SCALE
N.T.S. 3



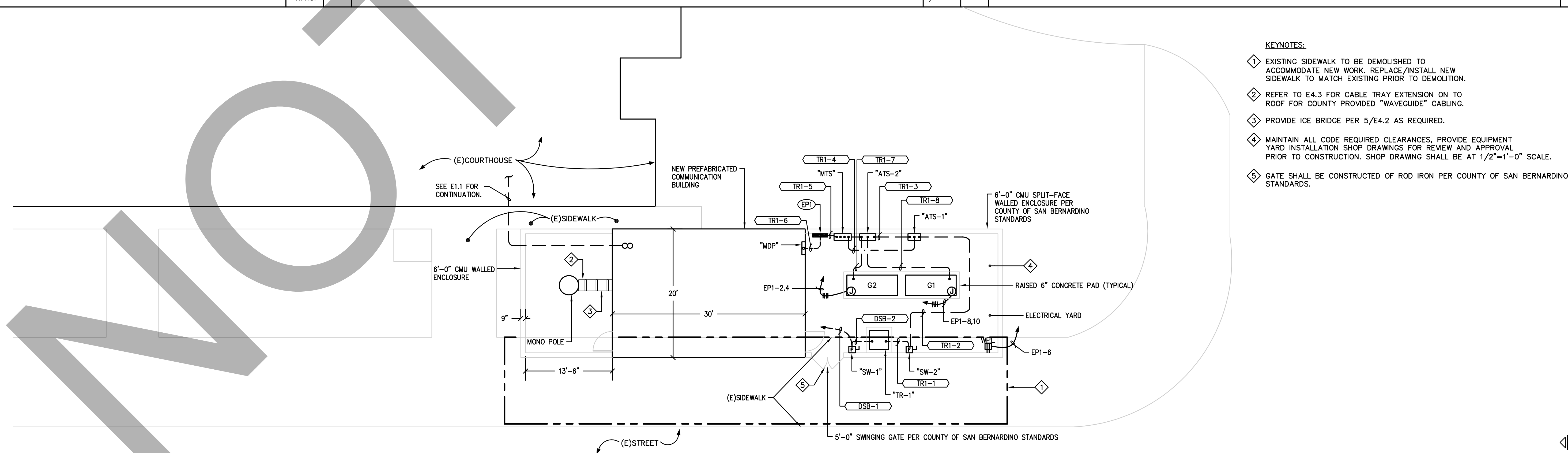
TRANSFORMER/GENERATOR/CONCRETE PAD MOUNTING DETAIL

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



ICE BRIDGE DETAIL

SCALE
N.T.S. 5



ENLARGED ELECTRICAL PLAN

SCALE
1/8" = 1'-0" 6

- KEYNOTES:**
- EXISTING SIDEWALK TO BE DEMOLISHED TO ACCOMMODATE NEW WORK. REPLACE/INSTALL NEW SIDEWALK TO MATCH EXISTING PRIOR TO DEMOLITION.
 - REFER TO E4.3 FOR CABLE TRAY EXTENSION ON TO ROOF FOR COUNTY PROVIDED "WAVEGUIDE" CABLING.
 - PROVIDE ICE BRIDGE PER 5/E4.2 AS REQUIRED.
 - MAINTAIN ALL CODE REQUIRED CLEARANCES, PROVIDE EQUIPMENT YARD INSTALLATION SHOP DRAWINGS FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION. SHOP DRAWING SHALL BE AT 1/2"=1'-0" SCALE.
 - GATE SHALL BE CONSTRUCTED OF ROD IRON PER COUNTY OF SAN BERNARDINO STANDARDS.

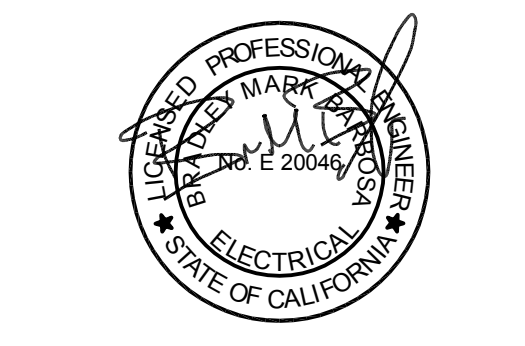
SHEET TITLE
ELECTRICAL DETAILS

No.	REVISION	DATE

DRAWN BY :	SO
CHECKED BY :	KW
DATE :	5/9/16
SCALE :	AS NOTED
PROJECT No. :	-
SHEET	E4.2

DCGA ENGINEERS
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CLIENT:

PROJECT:
RANCHO CUCAMONGA COURTHOUSE 800MHZ TOWER PROJECT
ADDRESS
8303 Haven Ave.
Rancho Cucamonga, CA

GENERAL SITE GROUNDING SCOPE:

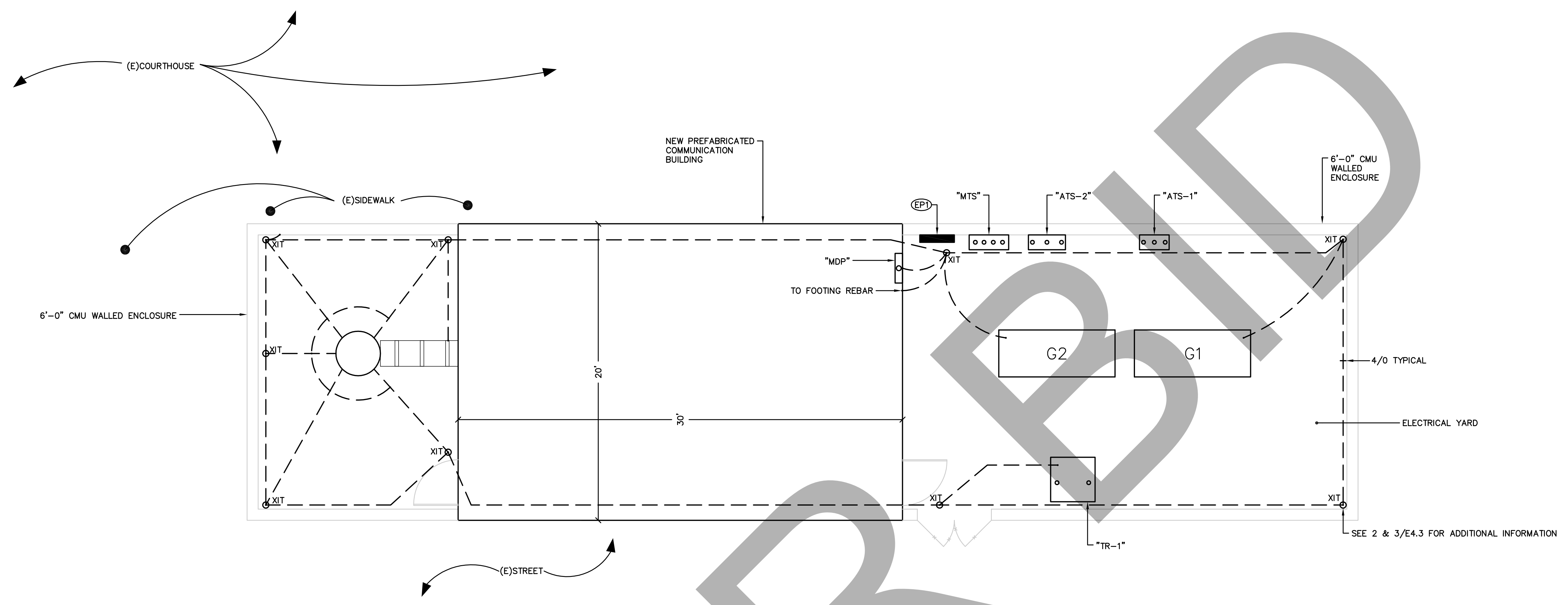
CONTRACTOR TO PROVIDE MATERIALS, EQUIPMENT, TOOLS AND LABOR AS REQUIRED TO INSTALL AND TEST THE NEW GROUNDING SYSTEM SITE PER MOTOROLA-R56 MANUAL, CHAPTER 4.

1. TASK LIST:

- EXCAVATE A 12" X 36" DITCH AS SPECIFIC AROUND THE EQUIPMENT AND BUILDING FOR THE GROUNDING LOOP AND XIT GROUNDING RODS. NOTICE TO EXCAVATION CONTRACTOR: SOIL IN REGION IS HARD AND ROCKY. EXCAVATION OF TRENCH MAY REQUIRE SPECIALIZED EQUIPMENT.
- INSTALL HORIZONTAL XIT GROUNDING RODS PER MANUFACTURER'S SPECIFICATIONS OF SPECIFIED LENGTH AND DIAMETER WITH CONCRETE TRAFFIC RATED BOX AND LID AT THE CONNECTION END.
- INSTALL 4/0 STRANDED COPPER GROUNDING CABLE IN EXCAVATED TRENCH.
- BACKFILL GROUNDING ROD EXCAVATION AREA WITH BETONITE MIXTURE PER MANUFACTURER'S SPECIFICATION.
- BACKFILL EXCAVATED PATH WITH NO. 2 CARBON FILL PER MOTOROLA SPECIFICATION R-56.
- LAND MECHANICAL GROUNDING CABLE TO EQUIPMENT NOTED ON GROUNDING SCHEME ON 2/E4.3 WITH EXOTHERMIC WELDS.
- ALL COPPER CABLE CONNECTIONS ARE TO BE EXOTHERMIC UNLESS NOTED.
- EXOTHERMICALLY WELD GROUNDING SYSTEM LEGS TO EXISTING FENCE POSTS ICE BRIDGE ABOVE GROUND CONNECTIONS TO FENCING SHALL USE NO. 2 STRANDED COPPER WIRE WITHIN NON-METALLIC SEAL TIGHT. FENCES AND MOVING OBJECT THAT ARE TO BE GROUNDED SHALL BE INSTALLED SIMILARLY WITH THE ADDITION OF A 12" STRAIN RELIEF LOOP AT EACH PIVOT POINT.
- IDENTIFY LOCATION OF EXISTING SHELTER AND TOWER HALOS MAKE CONNECTIONS.
- TRENCH SHALL BE BACKFILLED WITH SPOILS
- SPOILS FROM EXCAVATION SHALL BE DISPERSED ON OR NEAR THE SITE AT THE DIRECTION OF THE PROJECT MANAGER. SPOILS IN NO WAY SHALL INTERFERE WITH WATER RUNOFF OR ROADS.

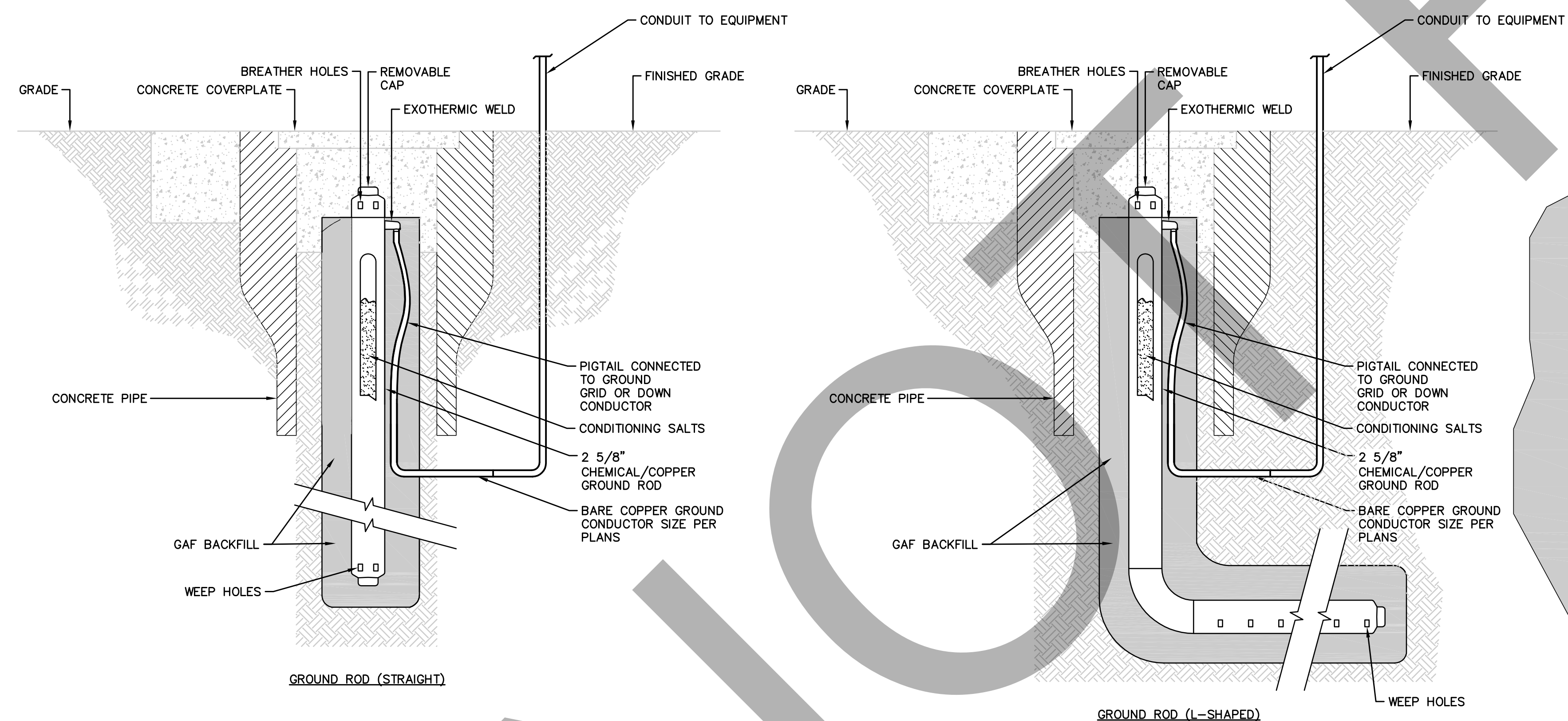
2. BACKFILL:

LYNCONITE II IS USED AS A BACKFILL TO SURROUND THE XIT SYSTEMS DURING INSTALLATION. IT IS BASED ON NATURAL CLAY FORMED BY VOLCANIC ACTION. SPECIALLY PROCESSED TO BE VERY ELECTRICALLY CONDUCTIVE. LYNCONITE II ENHANCES THE PERFORMANCE OF THE GROUNDING SYSTEM. IT IS MIXED WITH WATER (14 GALS/BAG) UNTIL A SLURRY IS FORMED (SIMILAR TO PANCAKE BATTER) AND PUMPED OR Poured AROUND THE ELECTRODE IN THE HOLE.



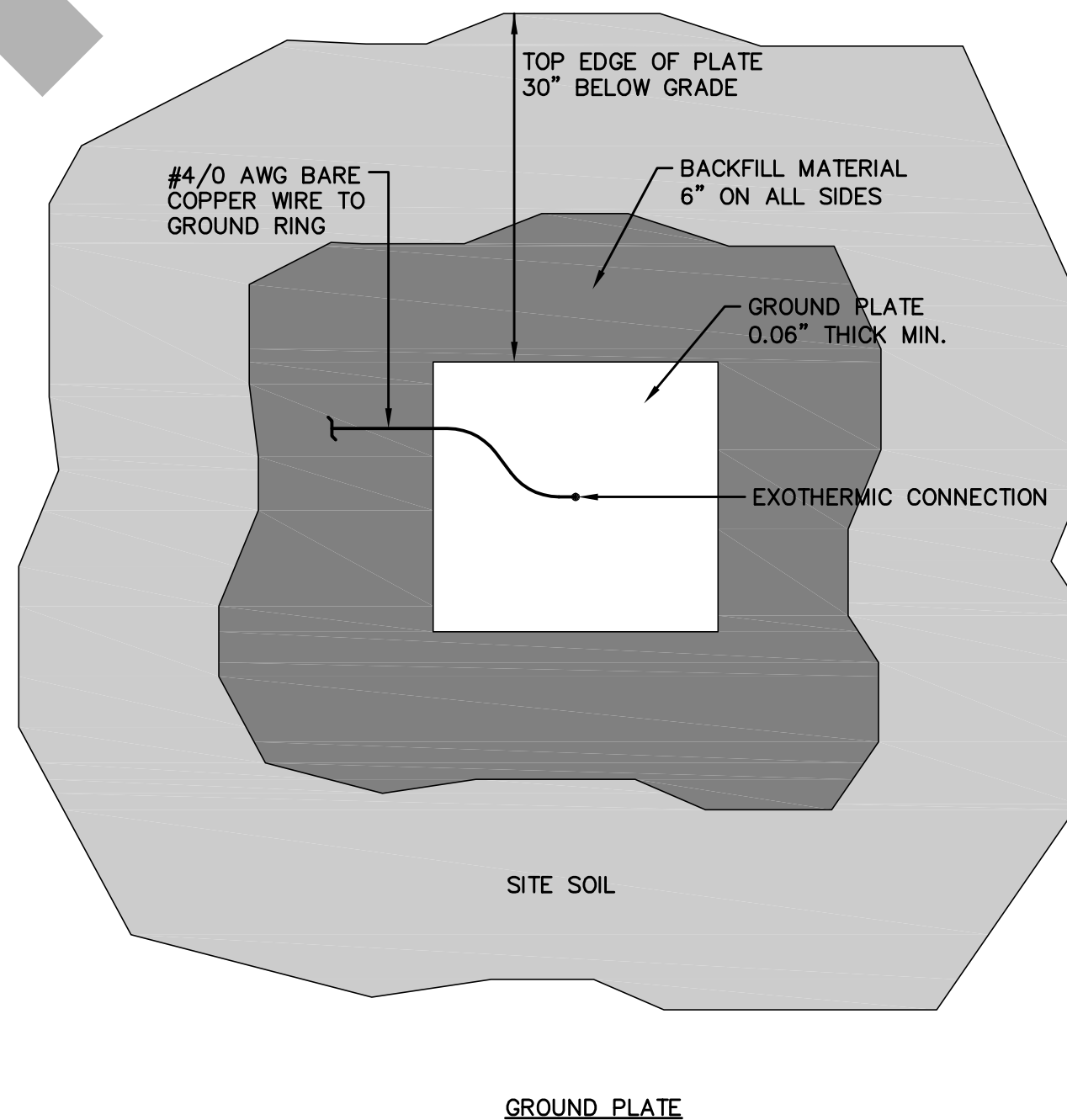
ELECTICAL GROUND HALO SCHEME

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



"XIT" CHEMICAL GROUND ROD/PLATE

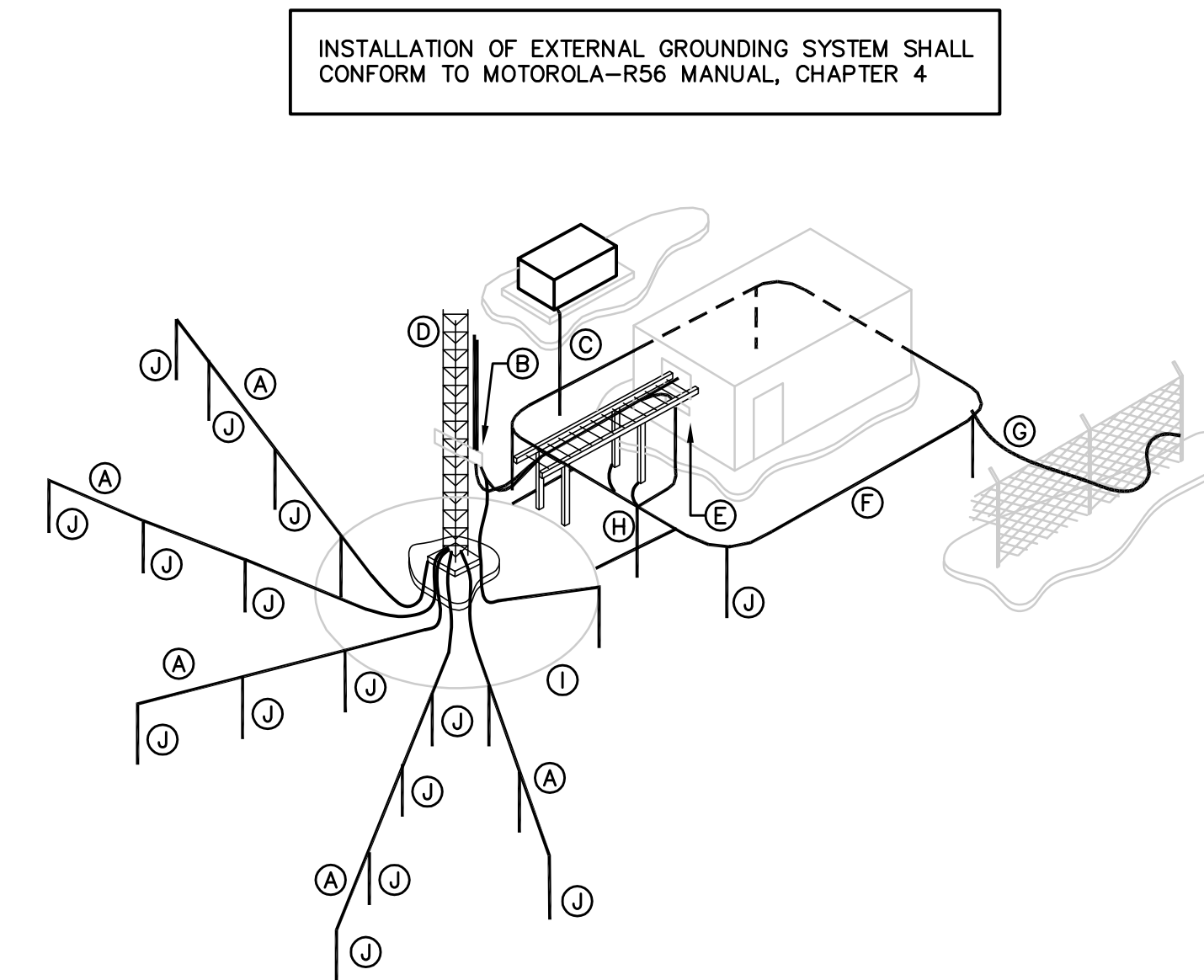
SCALE
N.T.S. 2



- KEY NOTES**
- GROUNDING RADIALS
 - MONOPOLE GROUND BUS BAR AND DOWN CONDUCTOR
 - GENERATOR GROUNDING CONDUCTOR(S)
 - MONOPOLE
 - EXTERNAL GROUND BUS BAR
 - SHELTER GROUND RING INSTALLED AT LEAST 36" FROM BUILDING FOUNDATION.
 - FENCE GROUNDING CONDUCTOR
 - GROUND RING BONDING CONDUCTORS
 - TOWER GROUND RING (INSTALLED AT LEAST 24" FROM MONOPOLE FOUNDATION.
 - EATHING ELECTRODES (GROUND RODS OR PLATES TO ACHIEVE REQUIRED RESISTANCE)

TYPICAL EXTERNAL GROUNDING ELECTRODE SYSTEM

SCALE
N.T.S. 3



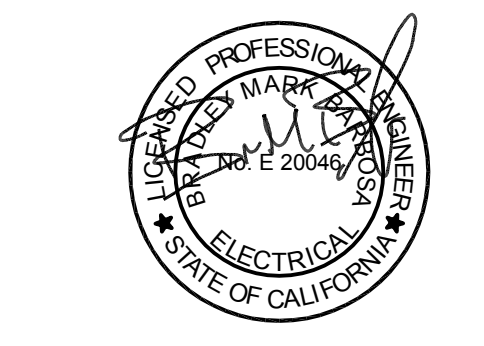
ELECTRICAL DETAILS

No.	REVISION	DATE

DRAWN BY :	SO
CHECKED BY :	KW
DATE :	5/9/16
SCALE :	AS NOTED
PROJECT No. :	-
SHEET	E4.3

E4.3

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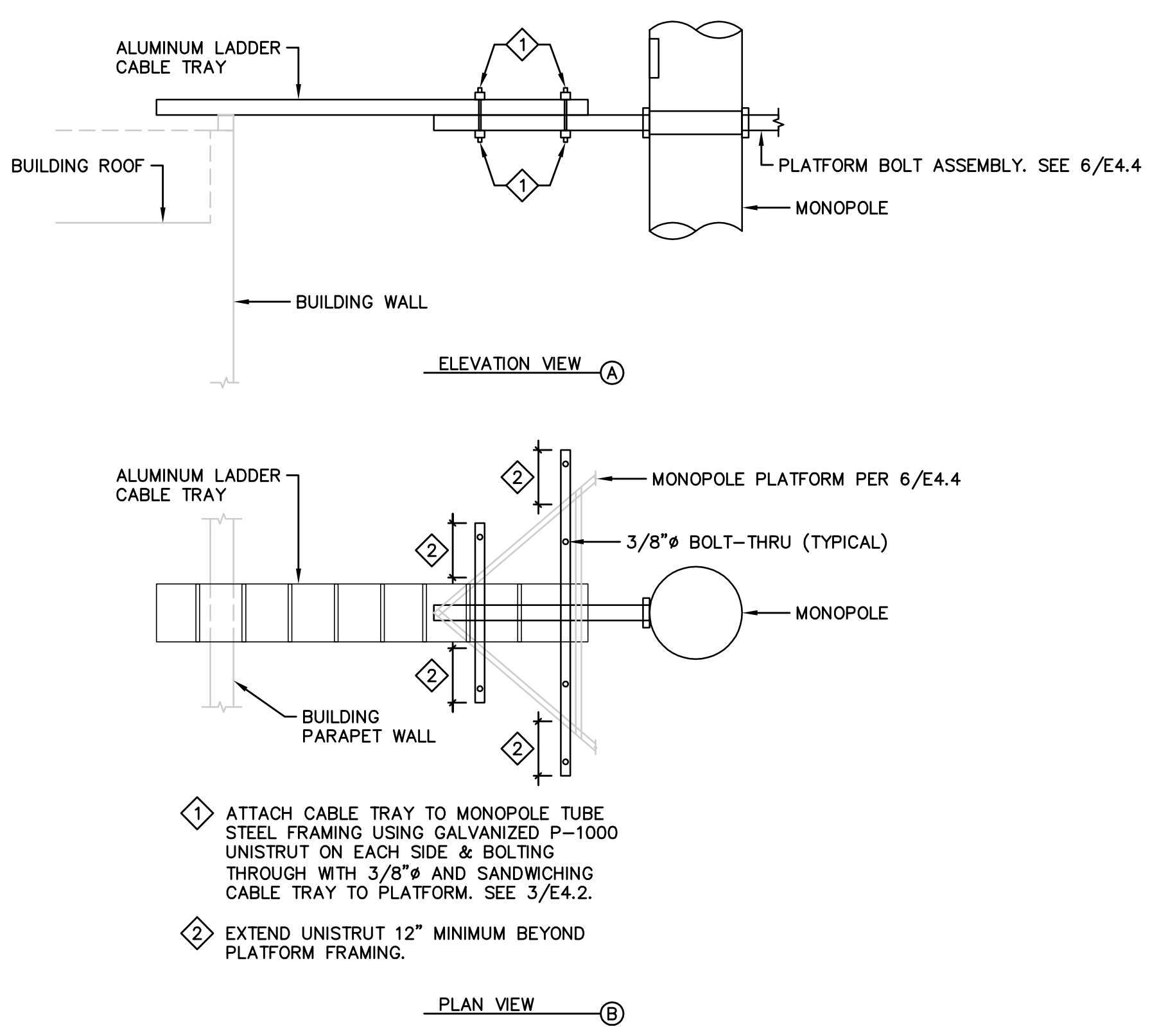


CLIENT:
-

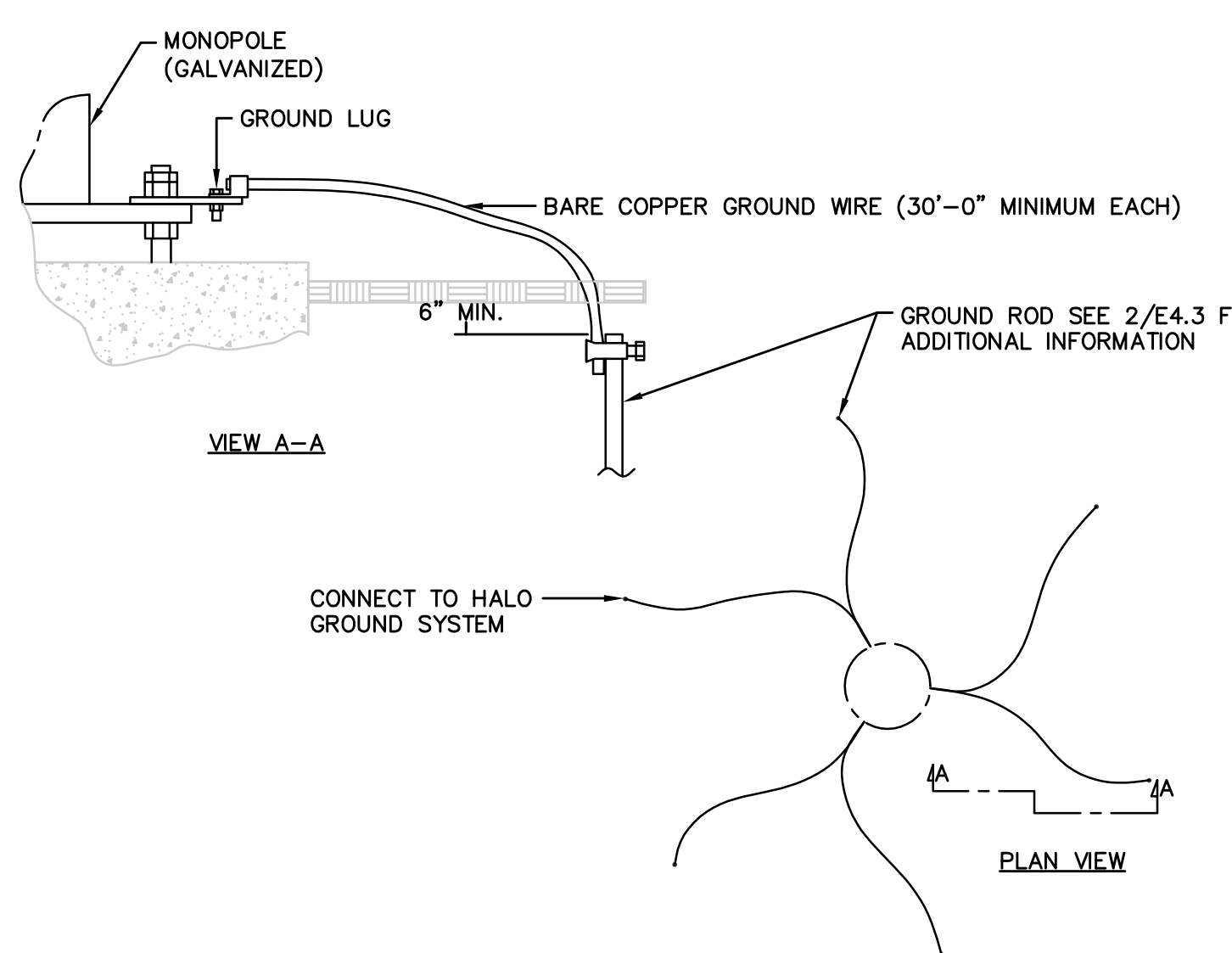
PROJECT:
RANCHO CUCAMONGA COURTHOUSE 800MHZ TOWER PROJECT
ADDRESS
8303 Haven Ave.
Rancho Cucamonga, CA

No.	REVISION	DATE

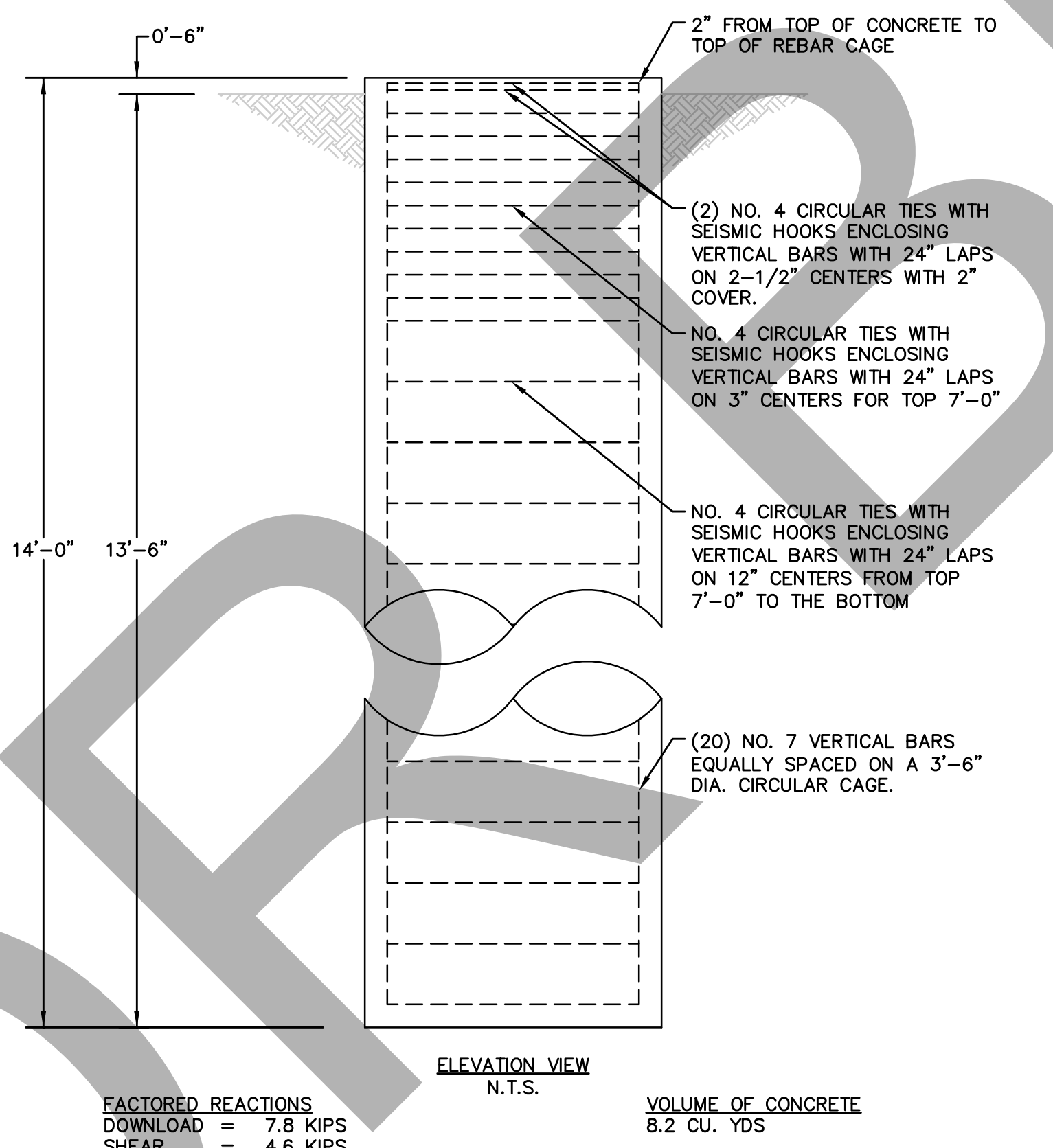
DRAWN BY:	SO
CHECKED BY:	KW
DATE:	5/9/16
SCALE:	AS NOTED
PROJECT No.:	-
SHEET	E4.4



CABLE TRAY ATTACHMENT TO MONOPOLE PLATFORM
SCALE: 1/4"=1'-0"
3



MONOPOLE GROUNDING DETAIL
SCALE: N.T.S.
2



MONOPOLE CONCRETE BASE DETAIL
SCALE: N.T.S.
1

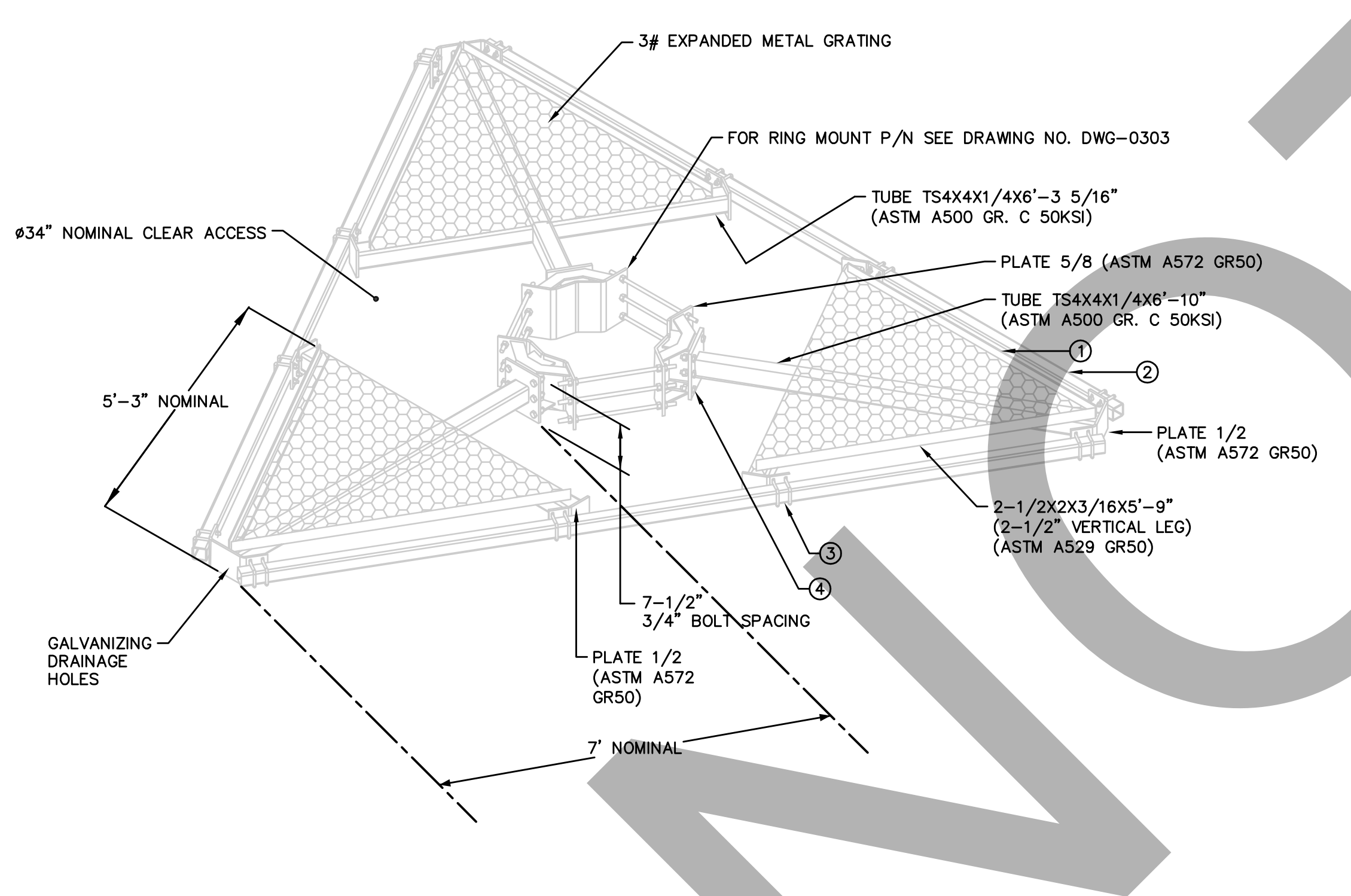
GENERAL NOTES:

- FOUNDATION DESIGN HAS BEEN DEVELOPED IN ACCORDANCE WITH GENERALLY ACCEPTED PROFESSIONAL ENGINEERING PRINCIPLES AND PRACTICES WITHIN THE LIMITS OF THE SUBSURFACE DATA PROVIDED. FOUNDATION DESIGN MODIFICATIONS MAY BE REQUIRED IN THE EVENT THE FOLLOWING DESIGN PARAMETERS ARE NOT APPLICABLE FOR THE SUBSURFACE CONDITIONS ENCOUNTERED.
- WORK SHALL BE IN ACCORDANCE WITH LOCAL CODES, SAFETY REGULATIONS AND UNLESS OTHERWISE NOTED, THE LATEST REVISION OF ACI 318, "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", PROCEDURES FOR THE PROTECTION OF EXCAVATIONS, EXISTING CONSTRUCTION AND UTILITIES SHALL BE ESTABLISHED PRIOR TO FOUNDATION INSTALLATION.
- CONCRETE MATERIALS SHALL CONFORM TO THE APPROPRIATE STATE REQUIREMENTS FOR EXPOSED STRUCTURAL CONCRETE.
- PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI 318 CHAPTER 4 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE. AS A MINIMUM, CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4,500 PSI (31.0 MPA) IN 28 DAYS.
- MAXIMUM SIZE OF AGGREGATE SHALL NOT EXCEED SIZE SUITABLE FOR INSTALLATION METHOD UTILIZED OR 1/3 CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. MAXIMUM SIZE MAY BE INCREASED TO 2.3 CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS OR VOIDS.
- REINFORCING SHALL BE DEFORMED AND CONFORM TO THE REQUIREMENTS OF ASTM A615 GRADE 60 UNLESS OTHERWISE NOTED. SPLICES IN REINFORCEMENT SHALL NOT BE ALLOWED UNLESS OTHERWISE INDICATED.
- REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE WHEN TEMPORARY BRACING IS UTILIZED. BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
- WELDING IS PROHIBIT ON REINFORCING STEEL AND EMBEDMENTS.
- MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3 INCHES (76 MM) UNLESS OTHERWISE NOTED. APPROVED SPACERS SHALL BE USED TO INSURE A 3 INCH (76 MM) MINIMUM COVER ON REINFORCEMENT.
- SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF VERTICAL REINFORCING CAGES TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.
- FOUNDATION DESIGN HAS BEEN BASED ON GEOTECHNICAL REPORT NO. 215-AR15 DATED 6/23/2015 BY HILLTOP GEOTECHNICAL, INC.
- FOUNDATION DEPTH INDICATED IS BASED ON THE GRADE LINE DESCRIBED IN THE REFERENCED GEOTECHNICAL REPORT. FOUNDATION MODIFICATION MAY BE REQUIRED IN THE EVENT CUT OR FILL OPERATIONS HAVE TAKEN PLACE SUBSEQUENT TO THE GEOTECHNICAL INVESTIGATION.
- FOUNDATION DESIGN ASSUMES THE RECOMMENDATIONS IN THE REFERENCED GEOTECHNICAL REPORT CONCERNING VERIFICATION OF SUBSURFACE CONDITIONS ARE IMPLEMENTED PRIOR TO PLACEMENT OF CONCRETE.
- FOUNDATION INSTALLATION SHALL BE SUPERVISED BY PERSONNEL KNOWLEDGEABLE AND EXPERIENCED WITH THE PROPOSED FOUNDATION TYPE. CONSTRUCTION SHALL BE IN ACCORDANCE WITH GENERALLY ACCEPTED INSTALLATION PRACTICES.
- FOUNDATION DESIGN ASSUMES INSTALLATION PROCEDURES WILL INCORPORATE THE PROCEDURES RECOMMENDED IN THE REFERENCED GEOTECHNICAL REPORT.
- FOUNDATION DESIGN ASSUMES FIELD INSPECTIONS WILL BE PERFORMED TO VERIFY THAT CONSTRUCTION MATERIALS, INSTALLATION METHODS AND ASSUMED DESIGN PARAMETERS ARE ACCEPTABLE BASED ON CONDITIONS EXISTING AT THE SITE.
- FOR FOUNDATION INSTALLATION TOLERANCES SEE STRUCTURE ASSEMBLY DRAWING.
- LOOSE MATERIAL SHALL BE REMOVED FROM BOTTOM OF EXCAVATION PRIOR TO CONCRETE PLACEMENT. SIDES OF EXCAVATION SHALL BE ROUGH AND FREE OF LOOSE CUTTINGS.
- CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS. INFILTRATION OF WATER OR SOIL AND OTHER OCCURRENCES WHICH MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.
- FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING SIDES OF EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING OR OTHER OBSTRUCTIONS UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
- CONSTRUCTION JOINTS, IF REQUIRED AT THE BASE OF THE PIERS, MUST BE INTENTIONALLY ROUGHENED TO A FULL AMPLITUDE OF 1/4 INCH (6 MM). FOUNDATION DESIGN ASSUMES NO OTHER CONSTRUCTION JOINTS.
- TOP OF FOUNDATION OUTSIDE LIMITS OF ANCHOR BOLTS SHALL BE SLOPED TO DRAIN WITH A FLOATED FINISH. AREA INSIDE LIMITS OF ANCHOR BOLTS SHALL BE LEVEL WITH A SCRATCHED FINISH.
- EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED 3/4"x3/4" (19MM x 19MM) MINIMUM.
- FOUNDATION DESIGN ASSUMES CASING, IF USED, WILL NOT BE LEFT IN PLACE. EQUIPMENT, PROCEDURES, AND PROPORTIONS OF CONCRETE MATERIALS SHALL INSURE CONCRETE WILL NOT BE ADVERSELY DISTURBED UPON CASING REMOVAL.
- DRILLING FLUID, IF USED, SHALL BE FULLY DISPLACED BY CONCRETE AND SHALL NOT BE DETRIMENTAL TO CONCRETE OR SURROUNDING SOIL. CONTAMINATED CONCRETE SHALL BE REMOVED FROM TOP OF FOUNDATION AND REPLACED WITH FRESH CONCRETE.

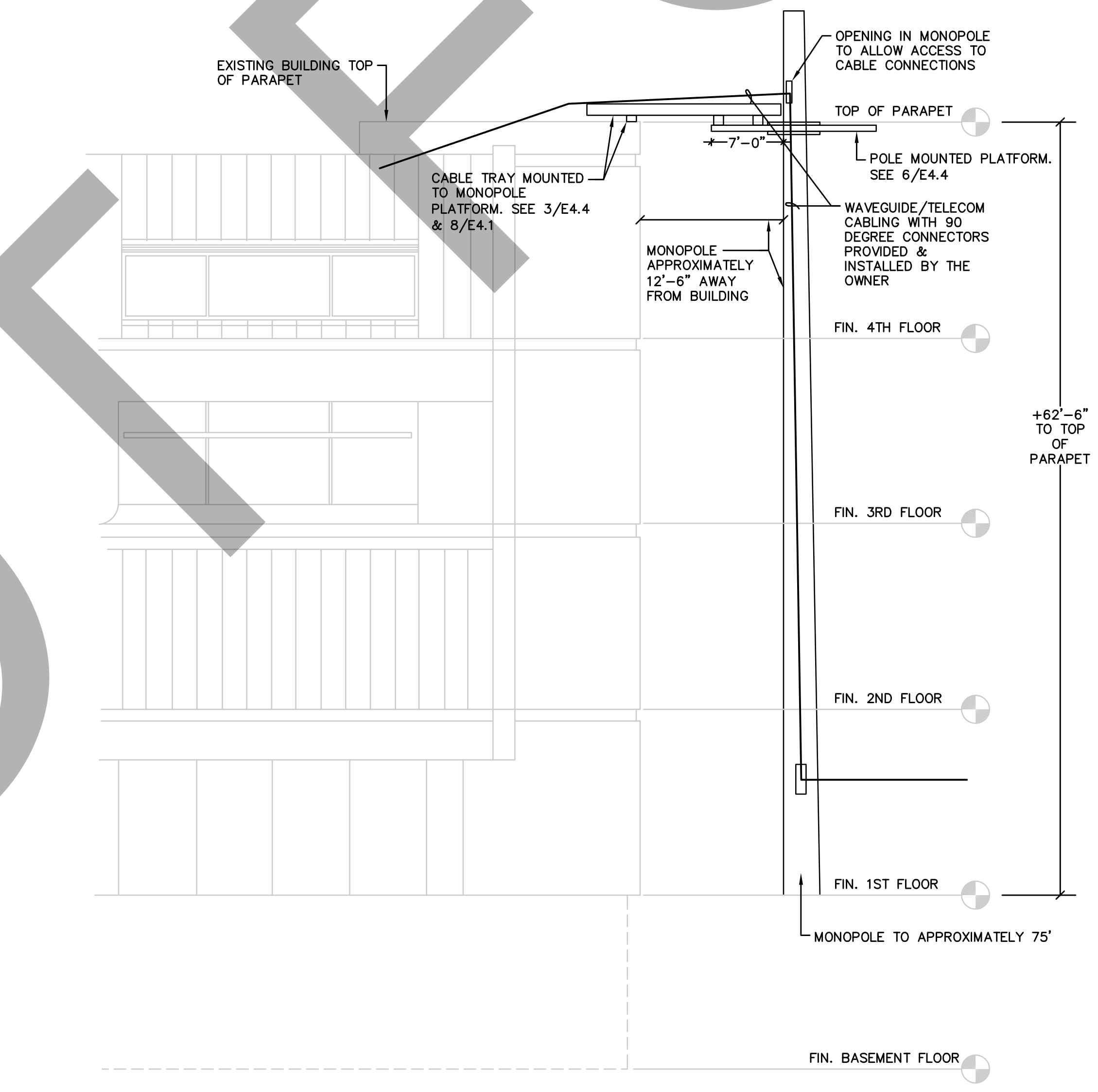
NOTE: SEE STRUCTURE ASSEMBLY DRAWING FOR FOUNDATION LAYOUT AND ANCHORAGE EMBEDMENT DRAWING NUMBER.

BASES OF DESIGN IS ROHN PRODUCTS
ASSEMBLY P/N: RUGGED15PH
(3/1/2" SQ. MOUNTING TUBE)

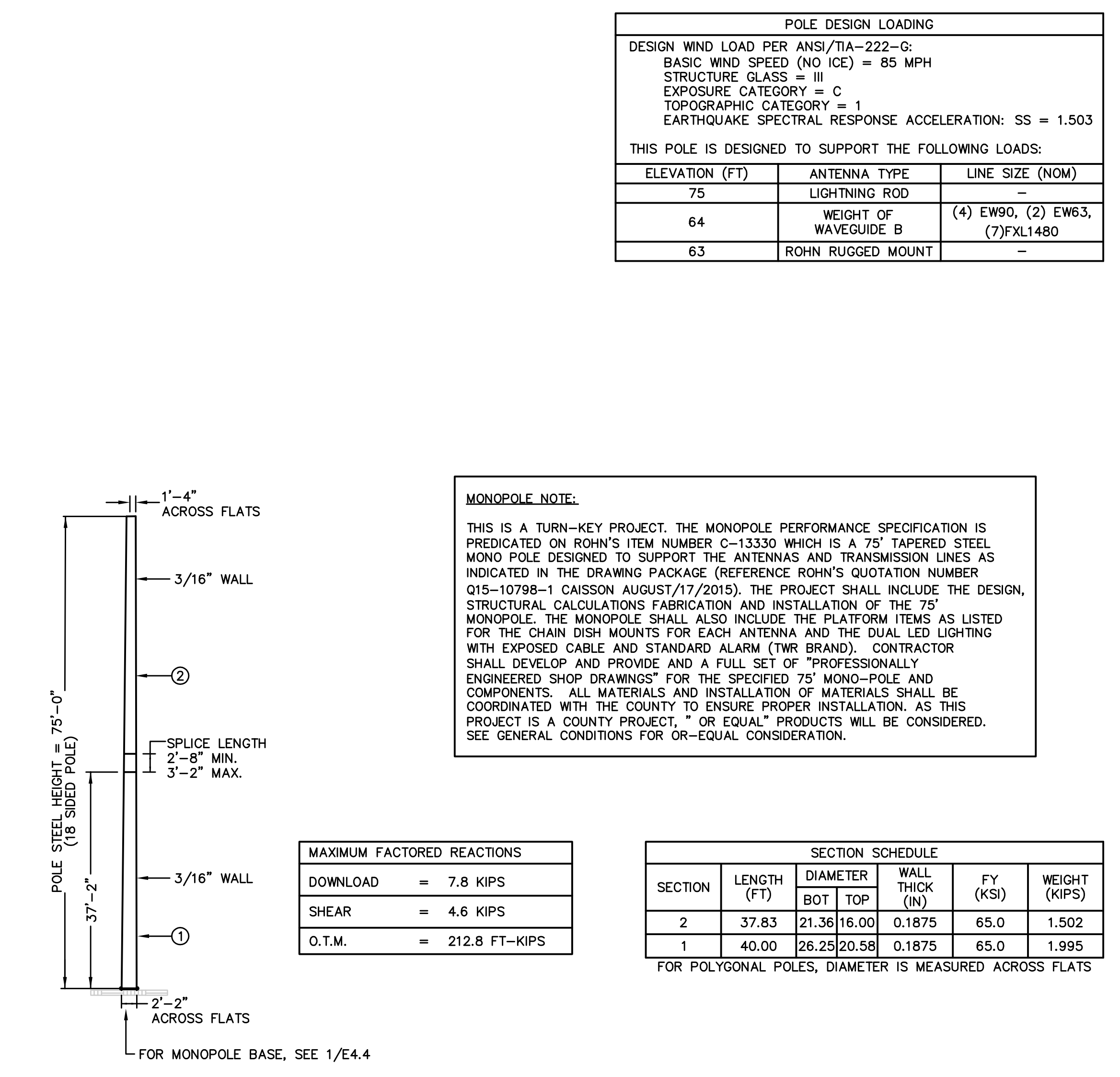
ITEM	QTY	PART NUMBER	DESCRIPTION
1	3	TJ015	WORK PLATFORM PANEL 6.36"x6.92"
2	3	TJ035	TS 3-1/2X3-1/2X1/4X1/8" (ASTM A500 GR.C 50KSI)
3	24	JR818AW	U-BOLT ASSY SQUARE 1/2 X 4-1/8 (ASTM A36)
4	18	210049GA	BOLT ASSY 3/4 X 2-1/2 HSB A325



4" TUBE STEEL POLE MOUNT PLATFORM
SCALE: N.T.S.
6



MONOPOLE AT BUILDING ELEVATION
SCALE: N.T.S.
5



MONOPOLE ELEVATION & REQUIREMENT DETAIL
SCALE: N.T.S.
4

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CONSULTANT:
RM. BYRD AND ASSOCIATES INC.
 Consulting Structural Engineers
 407 WEST 84TH STREET, SUITE A
 ONTARIO, CA 91762
 Phone (909) 983-6599
 Fax (909) 983-4658
 www.rmbyrd.com
 JOB NO. : 24-468

CLIENT:
 -
 -
 -

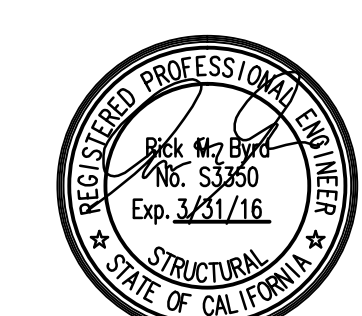
PROJECT:
**RANCHO CUCAMONGA COURT HOUSE
 800 MGHZ TOWER PROJECT**
 ADDRESS
 8303 HAYVEN AVE.
 RANCHO CUCAMONGA, CA

SHEET TITLE
**PRE-CAST BUILDING
 FOUNDATION PLAN,
 GENERAL NOTES
 AND DETAILS**

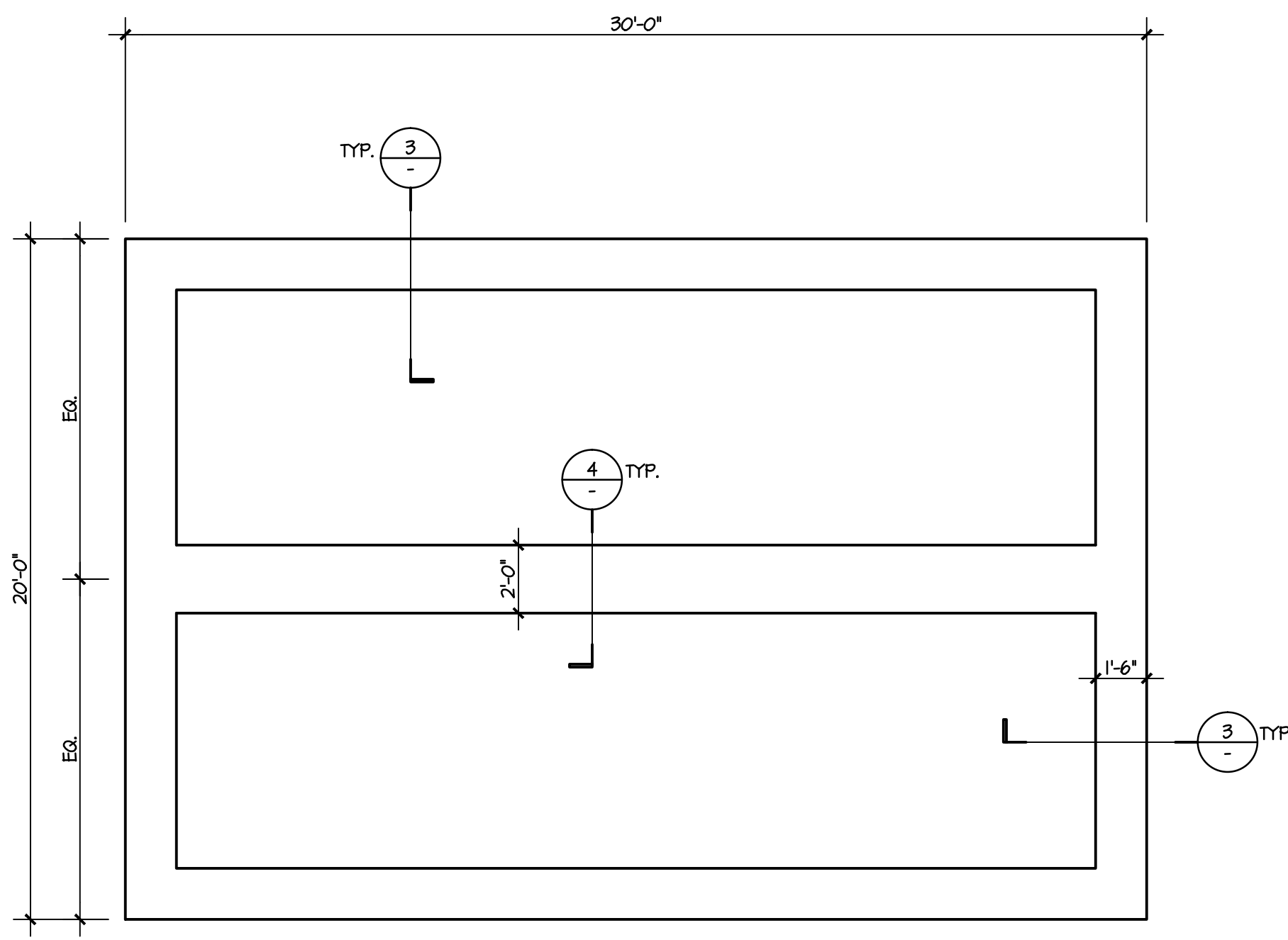
No.	REVISION	DATE

DRAWN BY : NC
 CHECKED BY : RB
 DATE : 5/9/16
 SCALE : AS NOTED
 PROJECT No. : -

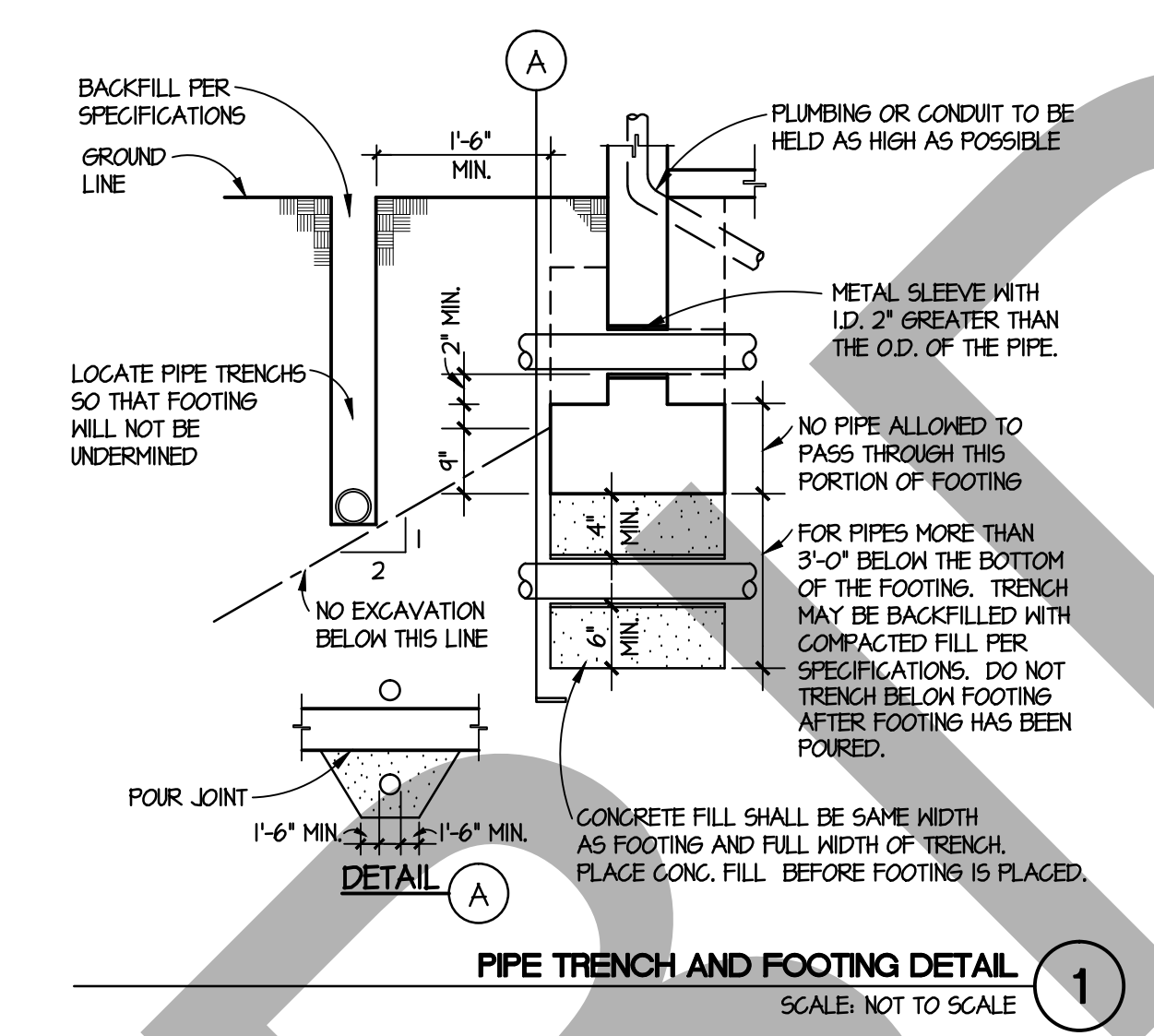
SHEET
S1.0



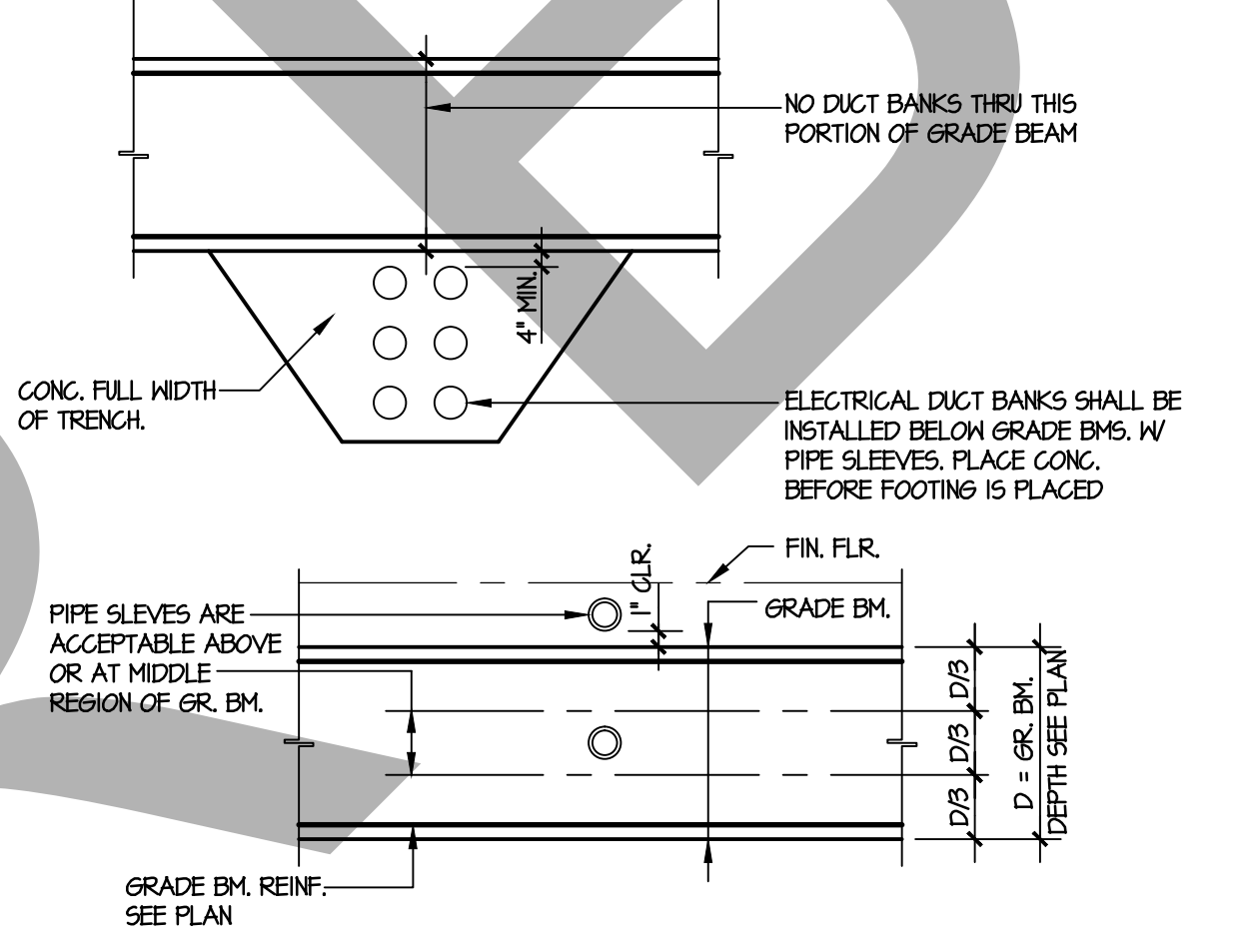
- GENERAL NOTES**
- FOUNDATION INFORMATION IS DERIVED FROM INFORMATION PROVIDED BY OLDCASTLE FOR THE 3030 RGS 30' X 20' INT.
 - PERIMETER FOOTING LOADS: DEAD LOAD: 1/40 PLF
ROOF LIVE LOAD: 650 PLF
FLOOR LIVE LOAD: 1250 PLF
 - INTERIOR FOOTING LOADS: DEAD LOAD: 1/40 PLF
FLOOR LIVE LOAD: 2500 PLF
 - FOUNDATIONS ARE BASED ON 2,000 P.S.F. ALLOWABLE SOIL BEARING PRESSURE AS OUTLINE IN THE GEOTECHNICAL REPORT PREPARED BY HILLTOP GEOTECHNICAL, PROJECT NO. 205-ARIS DATED JUNE 23, 2015.
 - FOUNDATIONS SHALL BE FOUNDED IN UNDISTURBED, DOCUMENTED, PROPERLY COMPACTED FILL, OR UNDISTURBED ALLUVIAL MATERIAL, BUT NOT A COMBINATION OF DIFFERENT EARTH MATERIAL WITHIN THE STRUCTURE.
 - PROVIDE OVER-EXCAVATION AND RE-COMPACT TO 90% FOR SUB-GRADE SOILS AS OUTLINE IN THE GEOTECHNICAL REPORT AND AS STIPULATED BY THE CIVIL ENGINEER.
 - ALL CONSTRUCTION SHALL COMPLY WITH THE 2015 CALIFORNIA BUILDING CODE AND ALL APPLICABLE ORDINANCES.
 - FOUNDATIONS SHALL EXTEND A MINIMUM OF 18 INCHES INTO NATURAL GRADE OR COMPACTED FILL.
- PRECAST BUILDING NOTES:**
- FOUNDATION DIMENSIONS ARE APPROXIMATE AND SHALL BE VERIFIED BY THE ENGINEER OF RECORD BASED ON A SHOP DRAWING SUBMITTAL BY THE PRECAST BUILDING MANUFACTURER.
 - DRAWINGS AND CALCULATIONS FOR THE PRECAST BUILDING SHALL BE SUBMITTED FOR REVIEW IN ADVANCE OF FOUNDATION EXCAVATION.
 - PRECAST BUILDING MANUFACTURER IS RESPONSIBLE FOR ALL ATTACHMENTS TO THE FOUNDATION OF CODE PRESCRIBED VERTICAL AND LATERAL LOADS. SEISMIC DESIGN CRITERIA:
 SITE CLASS: _____ D
 SPECTRAL RESPONSE ACCELERATION SHORT PERIOD (SPS): ... 1.002
 SPECTRAL RESPONSE ACCELERATION SECOND PERIOD (SD2): ... 0.600
 SEISMIC IMPORTANCE FACTOR: ... 1.5
 - CONTRACTOR SHALL CONSULT WITH THE PRECAST BUILDING MANUFACTURER FOR ALL FOUNDATION DIMENSIONS, TOLERANCES AND REQUIREMENTS, COORDINATE ALL NECESSARY EMBED AND ATTACHMENT DETAILS AS REQUIRED BY THE BUILDING MANUFACTURER.
- CONCRETE**
- THE MINIMUM STRENGTH OF CONCRETE AT END OF 28 DAYS SHALL BE:
 FOOTINGS AND EQUIPMENT PADS: 3000 P.S.I. - 150 P.C.F.
 - REINFORCING
 A. BOLTS IN CONCRETE: ASTM F1554 UNCL.
 B. REINFORCING STEEL: ASTM A-615
 TYPICAL REINFORCING: GRADE 60
 C. PROVIDE MINIMUM LAP ON ALL BARS OF 50 DIAMETER.
 D. PROVIDE BENT BAR LAPS OF ALL HORIZONTAL REINFORCEMENT AT FOOTING CORNERS.
 E. THE FOLLOWING MINIMUM CONCRETE COVERAGES SHALL BE MAINTAINED UNLESS NOTED OTHERWISE:
 1. SLABS ON GRADE: _____ CENTER OF SLAB
 2. CAST AGAINST AND EXPOSED TO EARTH: 3"
 3. FORMED, EXPOSED TO EARTH AND WEATHER:
 #6 AND LARGER: 2"
 #5 AND SMALLER: 1 1/2"
 4. NOT EXPOSED TO WEATHER OR EARTH:
 WALLS, SLABS, AND JOISTS: #4 AND #10: 1 1/2"
 #1 AND SMALLER: 3/4"
 COLUMNS, BEAMS, GIRDS: 1 1/2"
 5. THE MINIMUM CLEAR SPACING BETWEEN PARALLEL BARS IN A LAYER SHALL BE 25 BUT NOT LESS THAN 1 INCH.
 - CONCRETE: READY-MIXED CONCRETE ASTM C94.
 - CEMENT: PORTLAND CEMENT TYPE I OR II LOW ALKALI: ASTM C-150
 - NORMAL WT. CONG. - AGGREGATES: NATURAL ROCK AND SAND: ASTM C-330
 LIGHT WT. CONG. - AGGREGATES: NATURAL ROCK AND SAND: ASTM C-330
 DOWELS, ANCHOR BOLTS, INSERTS, ETC. SHALL BE SECURELY TIED IN PLACE PRIOR TO POURING OF CONCRETE OR GROUT.



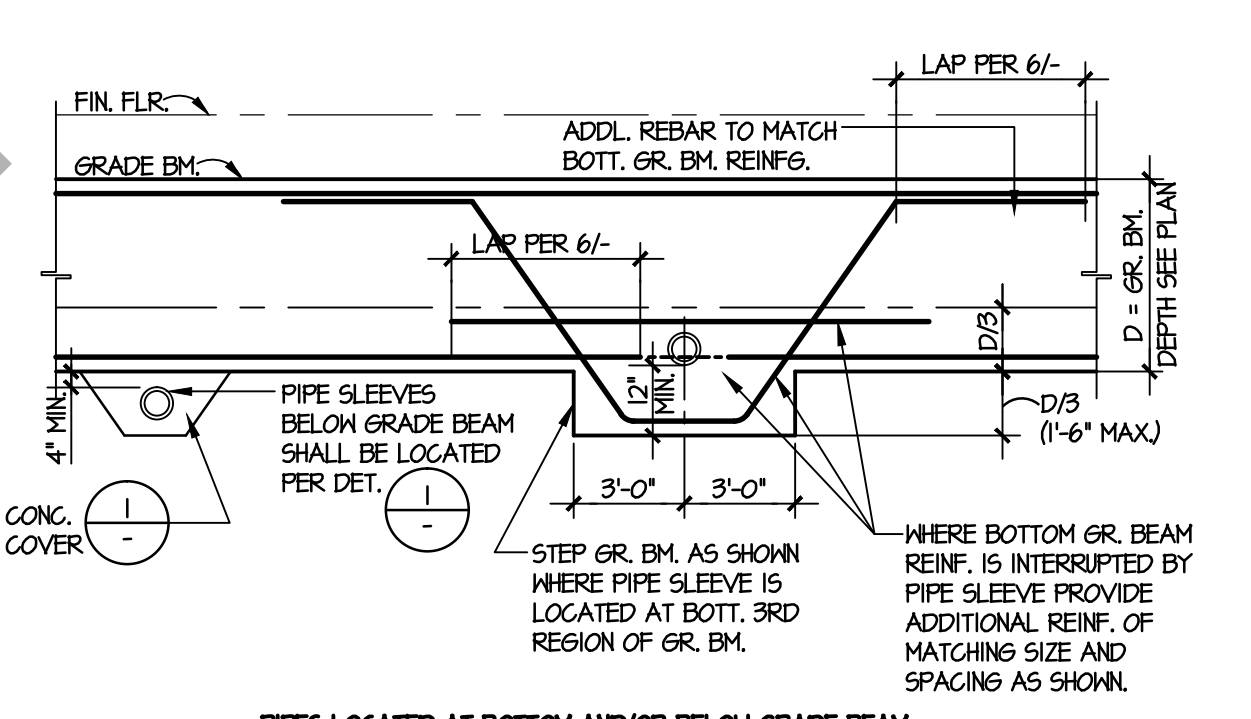
PRE-CAST BUILDING FOUNDATION PLAN
 SCALE: 1/4" = 1'-0"



PIPE TRENCH AND FOOTING DETAIL
 SCALE: NOT TO SCALE

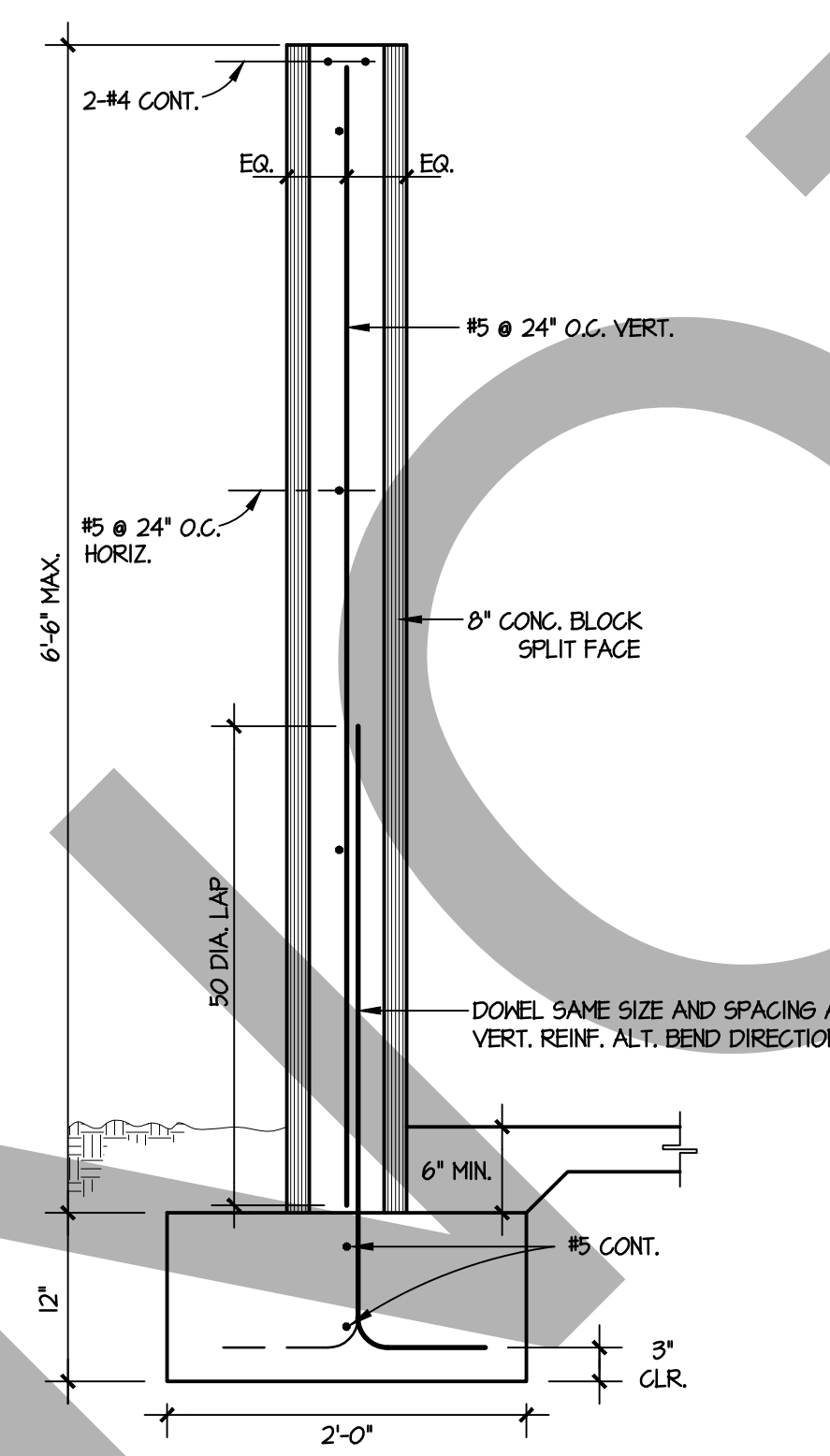


PIPES LOCATED ABOVE AND/OR MIDDLE OF GRADE BEAM

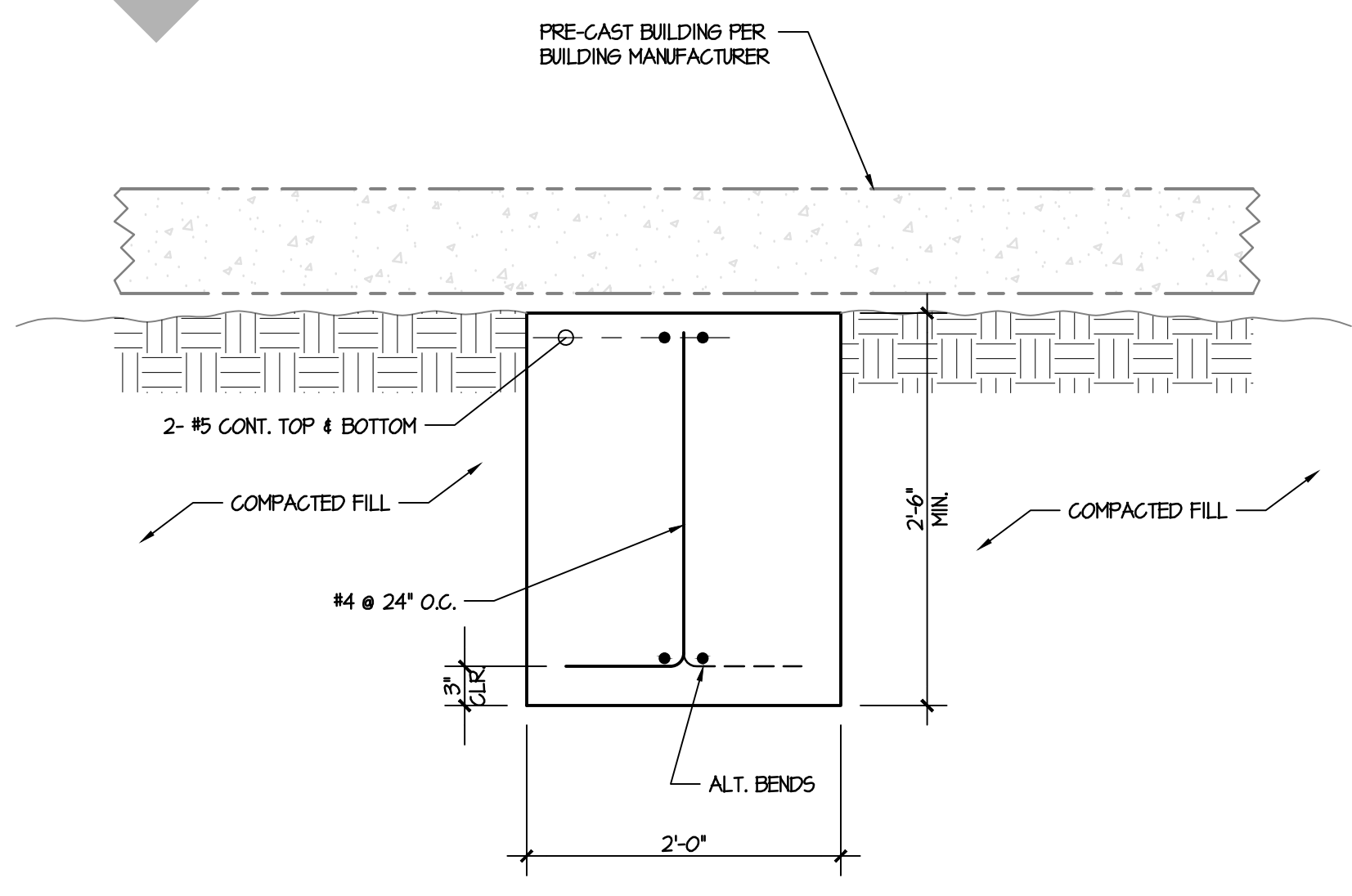


TYPICAL PIPES THRU GRADE BEAM
 SCALE: NOT TO SCALE

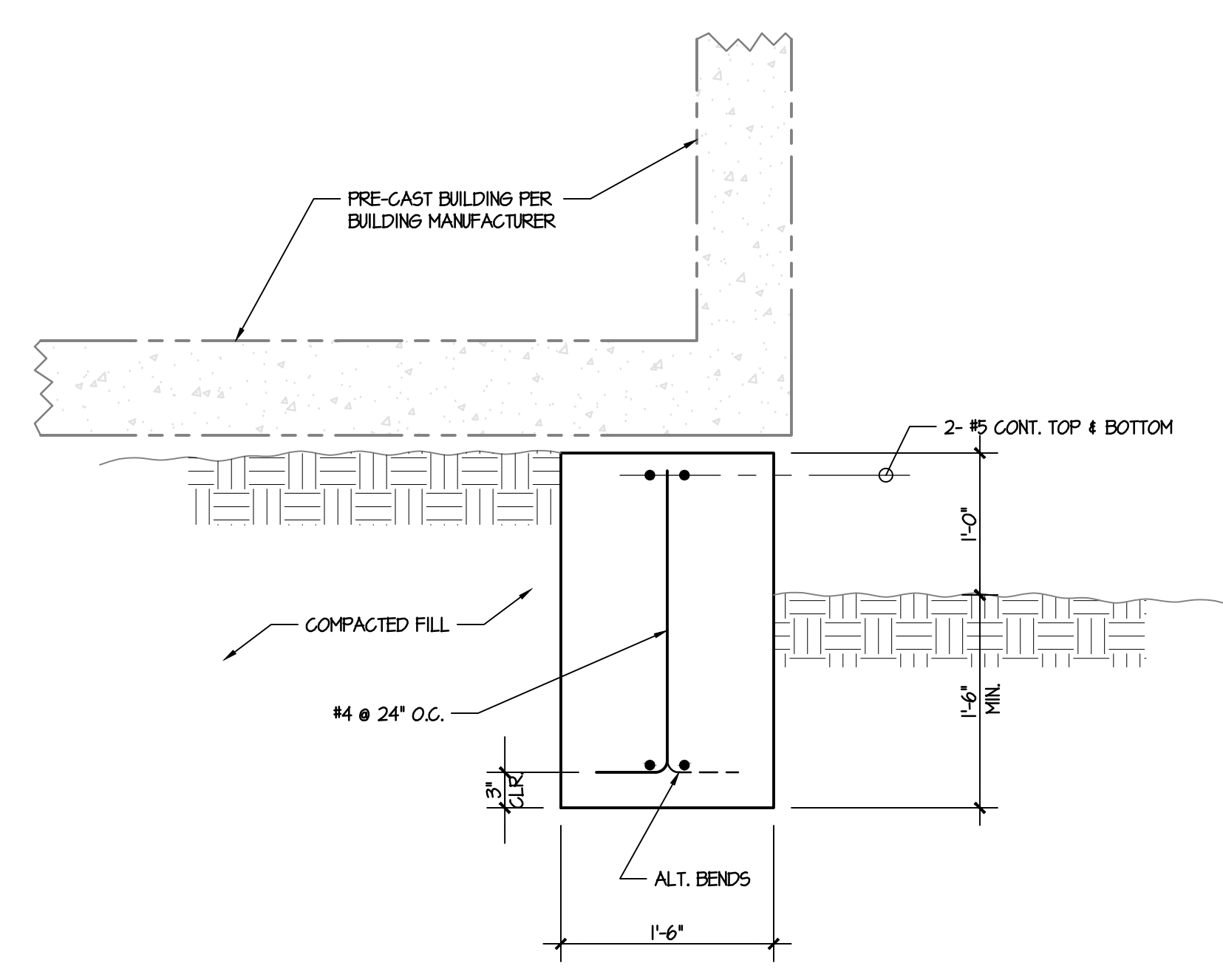
- NOTE:**
- PRIOR TO INSTALLATION OF GR. BMS, CONTRACTOR SHALL COORDINATE LOCATION OF ALL UNDERGROUND LINES IN THE RELATED DISCIPLINES (STRUCTURAL, MECHANICAL, ETC.)
 - IT IS THE CONTRACTOR'S ULTIMATE RESPONSIBILITY TO COORDINATE ALL UTILITY PENETRATIONS THRU FTGS. AND GR. BMS. PRIOR TO UTILITY PLACEMENT. CONTRACTOR SHALL COORDINATE THE RELATIONSHIPS OF THE FOOTINGS TO THE UTILITY LINE AND INCORPORATE STEP FTGS. SLEEVES & ADDL. REINF. AS REQUIRED.
 - NO PIPE SLEEVES ALLOWED IN THE TOP 3RD REGION OF GR. BM.
 - PIPE SLEEVES THRU GR. BM. SHALL BE NO GREATER THAN 8" MAX. OR D/3 (WHICHEVER SMALLER). PIPES GREATER THAN 8" SHALL BE PLACED BELOW GR. BM. PER DETAIL.



TYPICAL ENCLOSURE WALL DETAIL
 SCALE: NOT TO SCALE



TYPICAL INTERIOR FOOTING
 SCALE: NOT TO SCALE



TYPICAL PERIMETER FOOTING
 SCALE: NOT TO SCALE

SPECIFICATION INDEX

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- 01 33 00 SUBMITTAL PROCEDURES
- 01 60 00 PRODUCT REQUIREMENTS
- 01 77 00 CLOSEOUT PROCEDURES
- 01 78 23 OPERATION AND MAINTENANCE DATA
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SECTION 01 07 31

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.

1.2 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 3. Products: List products to be used and firms or entities that will perform the Work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 7. Engineer's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Client's opinion, reduce

the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.4 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Contractor's construction schedule.
 2. Daily construction reports.
 3. Field condition reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. PDF electronic file.

2. Two paper copies.
- B. Start-up Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 3. Total Float Report: List of all activities sorted in ascending order of total float.
 4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Field Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. Substations.
 - b. Transformers.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include not less than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.

- f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
5. Work Stages: Indicate important stages of construction for each major portion of the Work.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered RFIs.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- 1. Utilize Microsoft Project, for Windows XP operating system.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Start-up Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of

construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

- C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Engineer's approval of the schedule.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to correlate with Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the start-up network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

- a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events.
 10. Stoppages, delays, shortages, and losses.

11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Engineer's responsive action.
- B. Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal.
 - 1. Initial Review: Allow 7 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Allow 7 days for processing each resubmittal.
 - 4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- C. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Unique identifier, including revision number.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Other necessary identification.
- D. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- E. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.
- F. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return submittals, without review received from sources other than Contractor.
1. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
- G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Use only final submittals with mark indicating action taken by Engineer in connection with construction.
- I. Contractor shall transmit all submittals at one time. Partial submittals transmitted at separate times may be returned without review by the Engineer.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit 6 copies of each submittal, unless otherwise indicated. Engineer will return two copies. Mark up and retain one returned copy as a Project Record Document.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with recognized trade association standards.
 - i. Compliance with recognized testing agency standards.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit 6 copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports
- B. Contractor's Construction Schedule
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment.
- F. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- G. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- H. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections.
- I. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

- A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.
- E. Incomplete or partial submittals may be returned without review by the Engineer.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Engineers Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. Refer to Divisions 1 through 26. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Engineer will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or equal product that complies with requirements. Products listed are based on the design package and products of equal or better will be considered as required by the County.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. As a minimum standard.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions will be considered where submitted products meet or exceed products indicated on the drawings and as listed in these specifications. Products of equal or better products will be considered by the County.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, the Owner may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as

performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

NOT FOR BID

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
 2. Project Record Documents.
 3. Operation and maintenance manuals.
 4. Warranties.
 5. Instruction of Owner's personnel.
 6. Final cleaning.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Complete startup testing of systems.
 8. Submit test/adjust/balance records.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 11. Complete final cleaning requirements, including touchup painting.
 12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 - 1. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 3. Submit pest-control final inspection report and warranty.
 - 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data,

whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

- a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 4. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Note related Change Orders and Record Drawings, where applicable.
- D. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.5 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation Data: Include emergency instructions and procedures, system and equipment descriptions, operating procedures, and sequence of operations.
 2. Maintenance Data: Include manufacturer's information, list of spare parts, maintenance procedures, maintenance and service schedules for preventive and routine maintenance, and copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to

receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner with at least 7 days' advance notice.
 - 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline.
 - 1. Include instruction for system design and operational philosophy, review of documentation, operations, adjustments, troubleshooting, maintenance, and repair.

3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Sweep concrete floors broom-clean in unoccupied spaces.
 - g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - h. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - i. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - j. Replace parts subject to unusual operating conditions.

- k. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

NOT FOR BID

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following
1. Operation manuals for systems, subsystems, and equipment.
 2. Maintenance manuals for the care and maintenance of systems and equipment.

1.2 SUBMITTALS

- A. Manual: Submit 6 of each manual in final form at least 7 days before final inspection. Engineer will return copy with comments within 7 days after final inspection.
1. Correct or modify each manual to comply with Architect's comments. Submit 6 copies of each corrected manual within 7 days of receipt of Engineer's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Engineer.
 7. Cross-reference to related systems in other operation and maintenance manuals.

- C. Table of Contents: List each product included in manual, identified by product name, indexed to content of volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.

7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include startup, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
 - D. Systems and Equipment Controls: Describe sequence of operation, and diagram controls as installed.
 - E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.3 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment.
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- F. Comply with Division 1 Section "Closeout Procedures" for the schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
1. Record Drawings.
 2. Record Product Data.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
1. Number of Copies: Submit 6 of marked-up Record Prints.
 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal: Submit one set of plots from corrected Record CAD Drawings and one set of marked-up Record Prints. Engineer will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Engineer will return plots and prints for organizing into sets, printing, binding, and final submittal.
 - b. Final Submittal: Submit 6 sets of marked-up Record Prints, and the following:
 - 1) Record Transparencies: One set.
 - 2) Record CAD Drawing Files and Plots: 6 each.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of black-line white prints of the Contract Drawings and Shop Drawings.
1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

- b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include complete set, identify Drawings included.
 3. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Owners reference during normal working hours.

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

- B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 1.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer.
- C. Narration: Describe scenes on video recording by video recording is recorded. Include description of items being viewed.
- D. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

SECTION 26 01 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents for work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.2 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.

B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

C. Codes and Regulations:

1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE
 - b. National Electrical Manufacturers' Association - NEMA
 - c. Underwriters' Laboratories, Inc. - UL
 - d. National Fire Protection Association - NFPA
 - e. American Society for Testing and Materials - ASTM
 - f. American National Standards Institute - ANSI
 - g. California Electrical Code – CEC, Title 24, Part 3
 - h. California Code of Regulations, Title 8, Subchapter 5
 - i. California Building Code-CBC, Title 24 Parts 1 &2
 - j. State & Municipal Codes in Force in the Specific Project Area
 - k. Occupational Safety & Health Administration – OSHA
 - l. California State Fire Marshal
 - m. California Fire Code- CFC, Title 24 Part 9
 - n. National Electrical Testing Association - NETA
2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.

D. Requirements of Regulatory Agencies:

1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

E. Shop Drawings:

1. See Division 01 for additional requirements.
2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of

materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.

3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.
5. Shop drawings shall be submitted in completed groups of materials (i.e., transformer or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.
 - a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
 - b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
 - c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
 - d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
 - e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
 - f. Reference listings to the specifications' Sections and Article to which each is applicable.
 - g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.
6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.
 - F. Interpretations: The Contractor through the Engineer must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.
 - G. Standard of Quality
 1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.

H. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:

1. General Requirements:

- a. Conduits
- b. Conductors, include all selected insulation types.
- c. Fuses.
- d. Disconnect switches.
- e. Pullboxes, manholes and handholes.
- f. Control devices, standard and special receptacles, switches, outlets and finish device plates.
- g. Circuit Breakers.
- h. Generators and Automatic Transfer Switches.
- i. Distribution Switchboards.
- j. Panelboards.
- k. Lighting Fixtures
- l. Manual Transfer Switch

I. Utility Service: (Existing – NIC)

J. Record Drawings: Refer to Division 01, Contract Closeout.

K. Work Responsibilities:

1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.
2. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the construction or rearrangement of equipment or due to interference with other trades, such changes shall be made without extra cost.
3. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
4. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
5. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the County.
6. Contractor shall be responsible for coordination of coordinated drawings when required by the Engineer.
7. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.

L. Installation General: For special requirements, refer to specific equipment under these requirements.

1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
2. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
3. Protect work, materials and equipment cause whatever and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.
4. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
5. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.
6. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
7. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.

M. Excavation, Cutting and Patching:

1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 31. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

N. Tests

1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of

these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.

3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
 4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
 5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Architect. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
 6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
 7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.
- O. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.
- P. Cleaning Up:
1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
 2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
 3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
 4. Leave the entire installation in a clean condition.
- Q. Completion:
1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
 2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.

- R. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01
- S. Inspection and Acceptance Procedures: The Engineer will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.
- T. Final Completion of Electrical Systems:
1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Deliver to the Engineer, the Record Documents per 1.3 of this section.
 - c. Furnish the required Operating and Maintenance Data/Manuals.
 - d. Clean up of the project pertaining to this Division of the work.
 - e. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Engineer and Owner that systems are complete and operating in conformance with Contract Documents.
 - f. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - g. Submission of warranties and guarantees.
 2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.
 - b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Engineer and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.
 - d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.
- U. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.

- V. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.3 PROJECT RECORD DOCUMENTS

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2011 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.
- C. Quantity:
1. Review sets: As for Shop and Field Drawings.
 2. Record set: Three (3) blackline.
- D. Format: Record Drawings:
1. Pencil, permanent ink or permanent photographic process.
 - a. Front face only of Mylar at least 3.0 mils thick.
 - b. Appliqué film or lettering prohibited.
 - c. Suitable for microfilming. Lettering 1/8" (.8 mm) high minimum.
 2. Disk copy of Record Drawings - 1 copy of each drawing file in format noted above, CD-ROM.
- E. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- F. Warranty Certificates: Comply with Division 01.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

NOT FOR BID

SECTION 26 04 76
ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Enclosed molded case circuit breakers.

1.2 REFERENCES

- A. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.
- B. NEMA AB 1 - Molded Case Circuit Breakers.

1.3 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Include circuit breaker and current limiter ratings, trip current and let-through current curves, outline dimensions, and terminal lug sizes.

1.4 REGULATORY REQUIREMENTS

- A. Use circuit breakers listed by Underwriter's Laboratories, Inc., and suitable for specific application.

1.5 EXTRA MATERIALS

- A. Submit extra materials.
- B. Submit three of each size and type current limiter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton – Cutler Hammer
- B. Or approved equal by Square D or GE.

2.2 MOLDED CASE CIRCUIT BREAKER

- A. Circuit Breaker: NEMA AB 1.
- B. Service Conditions:
 - 1. Temperature: 115 degrees F.

2.3 CONFIGURATION

- A. Configuration: Inverse time automatic tripping.
- B. Field-Adjustable Trip Circuit Breaker: NEMA AB 1; Provide circuit breakers with frame sizes 200 amperes and larger with mechanism for adjusting long time, short time and continuous current and short time, long time pickup current setting for automatic operation.
- C. Field-Changeable Ampere Rating Circuit Breakers: NEMA AB 1; Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.
- D. Current Limiting Circuit Breaker: Provide circuit breaker as indicated on drawings with automatic-resetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.
- E. Solid-State Circuit Breaker: Provide circuit breaker as indicated on drawings with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time trip.

2.4 RATINGS:

- A. Ratings: NEMA AB 1; as indicated on drawings.

2.5 TERMINAL LUGS

- A. Size: NEMA AB 1, copper, suitable for conductor size and quantity indicated on drawings.

2.6 CURRENT LIMITERS

- A. Current Limiter: Designed for application with molded case circuit breaker.
- B. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
- C. Provide interlocks to trip circuit breaker and to prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.

2.7 ENCLOSURE

- A. Enclosure: NEMA AB 1; Type 1 for dry interior locations and Type 3R for exterior or damp locations unless otherwise indicated on drawings.
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel finish, gray color.

2.8 ACCESSORIES

- A. Provide accessories as indicated on drawings to NEMA AB 1.
 - 1. Shunt Trip Device: 120 volts, AC unless otherwise indicated on drawings.
 - 2. Undervoltage Trip Device: 120 volts, AC unless otherwise indicated on drawings.
 - 3. Auxiliary Switch: 120 volts, AC. unless otherwise indicated on drawings.
 - 4. Alarm Switch: 120 volts, AC. unless otherwise indicated on drawings.
 - 5. Electrical Operator: 120 volts, AC. unless otherwise indicated on drawings.
- B. Handle Lock: Include provisions for padlocking.
- C. Provide mechanical trip device.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as shown on Drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

- A. Install enclosed circuit breakers where shown on Drawings, in accordance with manufacturer's instructions.

3.03 ADJUSTING

- A. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.
- B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

3.04 FIELD QUALITY CONTROL

- A. Inspect and test each circuit breaker to NEMA AB 1.
- B. Inspect visually and perform several mechanical ON-OFF operations on each circuit breaker.
- C. Verify circuit continuity on each pole in closed position.
- D. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
- E. Include description of testing and results in test report.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 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. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria is not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.

- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 26 05 19

600 VOLT LV CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.2 REFERENCES

- A. ANSI/NFPA 70 – California Electrical Code.
- B. C.E.C. – California Electrical Code.
- C. InterNational Electrical Testing Association.
- D. OSHA, Definition B, 29 CFR 1910.7.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of C.E.C.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required meeting Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire, new, manufactured not more than 6 months prior to installation, with size, type of insulation, voltage rating and manufacturer's name permanently marked on outer covering at regular intervals.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHOD

- A. Type THHN/THWN insulation for dry interior locations, in raceway.
- B. Type THWN for exterior or wet locations, in raceway.

3.4 INSTALLATION

- A. Provide conductors continuous from outlet to outlet and splice only at outlet or junction boxes.
- B. Circuit all feeders and branch circuits as shown on the drawings. Suggested deviation from the plans must be provided by the Engineer.
- C. Install products in accordance with manufacturers instructions.

- D. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- E. Use stranded conductors for control circuits.
- F. Use conductor not smaller than 12 AWG for power circuits.
- G. Use conductor not smaller than 16 AWG for control circuits.
- H. Low voltage control wiring shall be No. 18 AWG minimum, insulated cable for each conductor. Voltage rating of cable shall be suitable for either Class I or Class II, remote control or signal circuit, as determined by the code and the actual installation.
- I. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (450-m).
- J. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (600-m).
- K. Install all conductors in a single raceway at one time, insuring that conductors do not cross one another while being pulled into raceway. Leave sufficient cable at all fittings or boxes and prevent conductor kinks. Keep all conductors within the allowable tension and exceeding the minimum-bending radius.
- L. Use suitable wire pulling lubricant for building wire 4 AWG and larger. Lubricants for wire pulling shall conform to UL requirements for the insulation and raceway material.
- M. Provide conductor supports as required by Code and recommended by the cable manufacturer. Where required, provide cable supports in vertical conduits similar to OZ Gedney Type CMT and provide the lower end of conduit with OZ Gedney Type KVF ventilators.
- N. No splicing or joints will be permitted in either feeder or branch circuits except at outlet or accessible junction boxes.
- O. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- P. Clean conductor surfaces before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Keep splices in underground junction boxes, handholes, and manholes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.
- R. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- S. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

- T. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- U. Provide all power and control conductors, that terminate on equipment or terminal strips, with solderless lugs or tork and flanged tongue terminals. Provide T & B "Stakon" tongue terminal. This type conductor termination is not required when the equipment is provided with solderless connectors.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Division 26.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.
- C. Conductor Identification: All branch circuit conductors (No. 10 AWG and smaller) throughout the project shall be provided with color-coded insulation as follows:

<u>208Y/120V</u>	<u>Phase</u>	<u>480Y/277</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- D. Conductors No. 8 and larger shall be black with bands of colored nonaging, plastic tape to color code the conductors, utilizing the same scheme as for branch circuits. The bands shall occur within each enclosure where a tap, splice or termination is made.
- E. Color code all control wire insulation and label each termination.

3.6 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. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 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. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. 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.
- D. 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.
- E. 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

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "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. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS and CEC Article 250.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 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 to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with the California Electrical Code (CEC).

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: 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 (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory 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, bolted 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.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.
- B. Chemical-Enhanced Grounding Electrodes (Drawing reference; XIT): 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 (1200 mm) long.
 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Copper Ground Mesh (Mat): #4 copper mesh, 24" square with no overhang. Equal to Harger Lightning and Grounding Products or equal.

PART 3 - EXECUTION

3.1 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 bare copper conductor, No. 4/0 AWG minimum.
1. Bury at least 24 inches (600 mm) below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) 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 1 inch (25 mm), minimum, from wall 6 inches (150 mm) 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, down to specified height above floor, and 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.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements and CEC Article 250.
- 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 (100 mm) 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 (50 mm) above to 6 inches (150 mm) 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 as recommended 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 (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits sized per C.E.C. Table 250-122.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC:
 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. Armored and metal-clad cable runs.
 8. 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.
- C. 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.
- D. 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.

3.4 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. Common Ground Bonding 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 (50 mm) 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.
 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- 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 (300 mm) 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 so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. 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 (18 m) apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and where indicated on the drawings.
1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring (where indicated) not less than 24 inches (600 mm) from building foundation.
- I. UFER Ground (Concrete-Encased Grounding Electrode): Fabricate according to CEC, using a minimum of 40 feet (12 meters) of bare copper conductor not smaller than No. 4/0 AWG.
1. If concrete foundation is less than 20 feet (6 m) 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 grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- C. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less 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.
 - 3. 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.
- D. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 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 ohms.
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.
- E. 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 32

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Nameplates.
- B. Wire and cable markers.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Division 01.
- B. Include schedule for nameplates and tape labels.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a white black background.
- B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, or rivets. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be permitted for any application.

3.2 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with panel and branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on

schematic and interconnection diagrams equipment manufacturer's shop drawings for control wiring.

3.3 NAMEPLATE ENGRAVING

- A. Provide nameplates to identify all circuits in the service distribution and power distribution panelboards; branch circuit panelboards; separately mounted starting switches; disconnecting switches; motor control push-button stations; selector switches; terminal cabinets; telephone cabinets, etc. Clearly identify on the nameplate the equipment such as "Air Handling Unit AH-1" and "Hot Water Cir. Pump P-1" in lieu of abbreviated plan references such as "AH-1" or "P-1".
- B. Provide nameplates of minimum letter height as scheduled below.
- C. Panelboards and Switchboards: 1/4 inch; identify equipment designation, voltage rating, and source.
- D. Individual Circuit Breakers In Panelboards and Switchboards: 1/8 inch; identify circuit and load served, including location.
- E. Individual Circuit Breakers, Enclosed Switches and Motor Starters: 1/8 inch; identify voltage rating, ampere rating and load served including location.
- F. HVAC and Plumbing Control Equipment: 1/8 inch; identify equipment designation and equipment served including location.
- G. Communication Terminal Cabinets: 1/4 inch; identify cabinet designation and type of system.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Samples for Initial Selection: For wireways and surface raceways with factory-applied texture and color finishes.
 - 1. Size: 12" (300mm).
- D. Samples for Verification: For each type of exposed finish required for wireways and surface raceway, prepared on Samples of size indicated below.
 - 1. Size: 12" (300mm).
- E. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- F. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
 - 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.

G. Qualification Data: For professional engineer and testing agency.

H. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- 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:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflec Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

C. Rigid Steel Conduit: ANSI C80.1.

D. Aluminum Rigid Conduit: ANSI C80.5.

E. IMC: ANSI C80.6.

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: ANSI C80.3.

- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, raintight compression with integral insulated throat.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- C. ENT: NEMA TC 13.
- D. RNC: NEMA TC 2, Type EPC-80-PVC, unless otherwise indicated.
- E. LFNC: UL 1660.
- F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- C. Description: Comply with UL 2024; flexible type, approved for riser installation.

2.4 METAL WIREWAYS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R, unless otherwise indicated on drawings or as required for specific installation.
- D. Fittings and Accessories: Include 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.
- E. Wireway Covers: Screw-cover type or Flanged-and-gasketed type for specific installation to maintain NEMA rating.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- 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:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following where specifically noted on plans:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
 - 3. Or approved equal.
- C. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- E. Fittings and Accessories: Include 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.

2.6 BOXES, ENCLOSURES, AND CABINETS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

- F. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- G. Nonmetallic Floor Boxes: Not permitted on project.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- K. Cabinets:
 - 1. NEMA 250, Type 1, 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.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. 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.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Brooks.

2.8 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 SLEEVE SEALS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.10 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.
1. Tests of materials shall be performed by a independent testing agency.
 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

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit or IMC.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC-Schedule 40-PVC, direct buried.
 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.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Traffic rated (Minimum H20) steel.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Traffic rated (H20) steel.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Traffic rated (H20) steel.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Physical Damage: IMC. Includes but not limited to, raceways in the following locations:

- a. Shop Areas.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Kitchen Areas.
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): LFMC.
 6. Damp or Wet Locations: IMC (minimum).
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT unless otherwise noted on drawings.
 8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch (16-mm) trade size for above ground and 1 inch (27-mm) trade size for below grade.
- 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.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- 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 in contact with concrete.
- G. Conduit installed to supply power to all mechanical equipment and rotating electrical equipment shall be waterproof flexible steel conduit. Conduit shall be 12 inches (307-mm) minimum in length for 2" (53-mm) conduit and smaller. 18" (457-mm) minimum length for conduit larger than 2" (53-mm). Conduit shall be 36" (1-m) maximum in length.
- H. Flexible metal conduit shall be used at lighting fixture connections only and no lengths shall exceed 6'-0" (1.75-m).
- I. MC (Metal-Clad Cable): Not allowed on project.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- 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, swab all conduits and vacuum all related boxes.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems" minimum.
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab/grade.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Not Allowed
 - 2. Change from RNC, Type EPC-80-PVC to PVC coated rigid steel conduit or RGS before rising above the floor through slab.
- I. 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.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. 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 12 inches (300-mm) of slack at each end of pull wire. Provide permanent nameplate tags identifying location of other end of raceway. In wet or corrosive outdoor or underground locations, use brass, bronze or copper 16 GA tags or lead tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on tags with steel punch dies clear and complete identifying information.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 1-Inch (25-mm) minimum trade size and larger: Install raceways in maximum lengths of 75 feet (23-m).

2. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
 3. All bend radiuses for conduit shall comply with TIA/EIA guidelines.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by CEC.
- N. Expansion-Joint Fittings for RNC: Not permitted on project.
- O. Firmly support and fasten conduit in place. Support rigid metal conduit and electrical metallic tubing at maximum intervals of 10 feet (3-m) and within 12 inches (300-mm) of every outlet box, cabinet or fitting. Support flexible metal conduit at maximum intervals of 4'-0" (1.25-m) and within 12 inches (300mm) of every outlet box and fitting except for lengths on not over 3'-0" (1-m) at connections where flexibility is required.
- P. Do not strap or fasten rigid conduit or electrical metallic tubing to mechanical equipment or equipment subject to vibration or mounted on shock absorbing bases, including sprinkler or pneumatic pipe or tubing. Provide independent support as required.
- Q. Provide independent support for conduit rising from floor for motor connections if over 18 inches (457-mm) above floor. Do not attach to motors, ductwork, or mechanical equipment.
- R. Flexible Conduit Connections: Use maximum of 72 inches (1830-mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- S. Exposed conduit to view shall be installed parallel to and perpendicular to the building structure. Conduits installed above suspended ceilings shall not be secured to ceiling support wires. Support electrical and communication conduits and fixtures independent of ceiling suspension systems.
- T. 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.
- U. Outlet boxes exposed to view (except in electrical or mechanical rooms) shall be smooth sided one-piece steel type equal to Wiremold V5744 series or equal.
- V. Set metal floor boxes level and flush with finished floor surface. Coordinate with Architectural floor finishes prior to installation of floor boxes so that finished floor box with cover will be flush with floor service even when floors are exposed concrete.

- W. Set metallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- X. Coordinate with Architectural drawings for tackable wallboards and install box rings so that no space exists between device and wall plate.
- Y. No non-metallic conduit is allowed above grade.
- Z. Conduit and boxes installed in areas with corrosive atmosphere (swimming pool equipment areas, etc.) shall be coated with a bitumasitc coating, zinc-rich paint, acrylic, urethane or weather stable epoxy-based resin. Provide minimum of two coats.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A.
 1. Install top of duct bank minimum 24 inches (600-mm) below finished grade. Adjust depth to avoid interference with gravity flow systems of any kind. Maintain minimum 12 inches (300-mm) clearance between duct bank and any gravity flow system.
 2. Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches (100-mm) in 100 feet (300-m). Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet (50-m), except that manufactured bends may be used at ends of short runs of 100 feet (300-mm) or less, and then only at or close to the end of run.
 3. Terminate conduit in end bell at manhole and pullbox entries.
 4. Use suitable separators and chairs installed not greater than 4 feet (25-m) on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete or slurry placement.
 5. Provide minimum 3 inches (75-mm) concrete 2 sack slurry cover at bottom, top, and sides of duct bank. Refer to Division 3 section for additional information.
 6. Provide two No. 4 steel reinforcing bars in top of bank under paved driving areas.
 7. Encase non-metallic primary and secondary feeders, telephone, fire alarm communications and data conduit installed underground 2 inches (50-mm) or larger in a concrete or slurry duct bank unless noted otherwise in the Contract Documents. Space the external surfaces of conduit within a bank a minimum of 3 inches (75-mm) apart except that sound, telephone, data and intercommunication circuits contained within non-metallic conduit shall have a minimum separation of 12 inches (300-mm) from any light or power circuits that parallel them within a bank. Use appropriate manufactured plastic spacers to insure the minimum required concrete or slurry coverage. All concrete or slurry duct conduit banks shall contain a warning tape 12 inches (300-mm) above ductbank.
 8. Numbers and sizes of ducts shall be as indicated. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Manufactured steel 90-degree duct bends shall be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches (450-mm) for ducts of less than 3-inch (75-mm) diameter, and 36 inches (900-mm) for ducts 3 inches (75mm) in diameter 48 inches (1.2-m) for ducts or greater in diameter unless noted otherwise in the Contract Documents. Long sweep bends

having a minimum radius of 25 feet (7.5-m) shall be used for a change of direction of more than 5 degrees, horizontally or vertically. Both curved and straight sections shall be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes, pull-boxes or handholes. Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches (75-mm) in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches (300mm) below finished grade levels of such lines.

9. Ducts shall be kept clean of concrete or slurry, dirt or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches (300-mm) long and have diameters 1/4 inch (6.2-mm) less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.4 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 in unpaved areas.
- D. Install handholes and boxes with bottom depth as required to meet elevation of incoming conduits.
- 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 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.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270-mm) and no side greater than 16 inches (400-mm), thickness shall be 0.052 inch (1.3-mm).
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270-mm) and 1 or more sides equal to, or greater than, 16 inches (400-mm), thickness shall be 0.138 inch (3.5-mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50-mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Penetration Firestopping."

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. CEC: California Electrical Code.
- E. CBC: California Building Code.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:

- a. Electrical equipment shall be seismically anchored to conform to C.C.R. Title 24, 2010 CBC Section 1632A and Table 16A-O, Anchorage details not shown on the approved plans or otherwise approved by the County are subject to field approval by the Engineer and/or Structural Engineer of record and field approval by the County. All conduits shall be supported and braced in accordance with SMACNA Guidelines, the CEC and as approved by the County.

1.5 SUBMITTALS

- A. Product Data: For the following:
 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
- B. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- C. Welding certificates.
- D. Qualification Data: For Testing Agency.
- E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

- E. Comply with CEC.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- D. Pads : Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment. Refer to drawing details for locations.
 - 1. Resilient Material: Oil- and water-resistant neoprene.

2.2 SEISMIC-RESTRAINT DEVICES

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti Inc.
 5. Loos & Co.; Seismic Earthquake Division.
 6. Mason Industries.
 7. TOLCO Incorporated; a brand of NIBCO INC.
 8. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to the County.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 603 galvanized steel cables in concealed spaces and ASTM A 492 stainless-steel cables in areas exposed to view in public spaces. Both shall have end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- H. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior

applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to the County.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 3. Install seismic-restraint devices using methods approved by the County.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 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.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by the County.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 05 72

ACCEPTANCE TESTING

PART 1 - GENERAL

- 1.1 It is the intent of these acceptance tests to assure that all Contractor supplied equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with designed specifications.
- A. The acceptance tests and inspections shall determine suitability for energization of switchgear and cables.
- B. Items that shall be checked, inspected, and tested include, but are not limited to, the following:
1. Relays.
 2. Power/Lighting panelboards.
 3. 600V rated cable, and 5kV rated cable.
 4. Transformers.
- 1.2 APPLICABLE CODES
- A. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
1. California Electrical Code - CEC 2010 Edition.
 2. National Electrical Manufacturer's Association - NEMA.
 3. American Society for Testing and Materials - ASTM.
 4. Institute of Electrical and Electronic Engineers - IEEE.
 5. National Electrical Testing Association - NETA.
 6. American National Standards Institute - ANSI:
 - a. C2, National Electrical Safety Code
 - b. Z244-1, American National Standard for Personnel Protection
 7. State Codes and Ordinances.
 8. Insulated Cable Engineers Association - ICEA.
 9. Association of Edison Illuminating Companies - AEIC.
 10. Occupational Safety and Health Administration:
 - a. Part 1910, Subpart S, 1910.308
 - b. Part 1926, Subpart V, 1926.950 through 1926.960
 11. National Fire Protection Association - NFPA:
 - a. CEC, Electrical Equipment Maintenance
 - b. CEC, Electrical Safety Requirements for Employee Workplaces
 - c. ANSI/NFPA 70, California Electrical Code 2010 Edition
 - d. ANSI/NFPA 78, Lightning Protection Code

- e. ANSI/NFPA 101, Life Safety Code
- f. 2005 Title 24 Energy Guidelines, Chapter 8

12. All inspections and tests shall utilize the following references:

- a. Project Design Specification.
- b. Project Design Drawings.
- c. Manufacturer's instruction manuals applicable to each particular apparatus.

1.3 QUALIFICATIONS OF TESTING AGENCY

- A. The testing firm shall be an independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. The testing firm and all the testing personnel shall have been engaged in such practices for a minimum of ten years.
- D. The testing firm shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Parts 1907, 1910, and 1936. Full membership in the National Electrical Testing Association constitutes proof of such criteria.
- E. The lead, on site, technical person shall be currently certified by the National Electrical Testing Associate (NETA) in Electrical Power Distribution System Testing.
- F. Testing firm shall utilize only full-time technicians who are regularly employed by the firm for testing services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians may assist, but may not perform testing and/or inspection services.
- G. The testing firm shall submit proof of the above qualifications.
- H. The testing firm shall be an independent organization as defined by OSHA Title 29, Part 1936 and the National Electrical Testing Association.
- I. All instruments used by the testing firm to evaluate electrical performance shall meet NETA's Specifications for Test Instruments. (See Section 1.7 of this specification).
- J. The terms used herewith such as Test Agency, Testing Laboratory, or Contractor Test Company, shall be construed to mean testing firm.

1.4 RESPONSIBILITIES

- A. The Contractor shall notify the Owners Representative prior to commencement of any testing.

- B. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported.
- C. The testing firm shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- D. A stable source of 60 hertz power shall be provided for testing purposes by the Contractor. Owners Representative shall witness all tests and a minimum of 14 days notice shall be provided.

1.5 TEST EQUIPMENT

A. Test Instrument Calibration

- 1. The testing firm shall have a calibration program that assures that all applicable test instrumentation is maintained within rated accuracy.
- 2. The accuracy shall be directly traceable to the National Bureau of Standards.
- 3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog - 6 months maximum
 Digital - 12 months maximum
 - b. Laboratory Instruments – 2 months
 - c. Leased specialty equipment - 12 months (where accuracy is guaranteed by lessor)
- 4. Dated calibration labels shall be visible on all test equipment.
- 5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
- 6. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.
- 7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

1.6 TEST REPORTS

A. The test report shall include the following:

- 1. Summary of project.
- 2. Description of equipment/device tested.
- 3. Description of test, including date, time, and duration of test.
- 4. Test results.
- 5. Conclusions and recommendations.
- 6. Appendix, including appropriate test forms.
- 7. Identification of test equipment used.
- 8. Signature of responsible test organization authority.
- 9. Signature of the person witnessing the tests.
- 10. Furnish five copies of the complete report to the Owners Representative no later than thirty (30) days after completion of project unless otherwise directed.

1.7 SAFETY AND PRECAUTIONS

- A. Safety practices shall include, but are not limited to, the following requirements:
 - 1. Occupational Safety and Health Act of 1970 - OSHA.
 - 2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
 - 3. Applicable State safety operating procedures.
 - 4. NETA Safety/Accident Prevention Program.
 - 5. District's safety practices.
 - 6. National Fire Protection Association - NFPA 70E.
 - 7. ANSI Z244.1 American National Standards for Personnel Protection.
- B. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
- C. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

PART 2 - PROTECTIVE DEVICE COORDINATION STUDY

- A. A protective coordination study shall be performed using SKM's Dapper or equal software to select or check the selection of power fuse ratings, protective relay characteristics and settings, ratios, and characteristics of associated voltage breaker trip characteristics and settings.
- B. The coordination study shall include all voltage classes of equipment indicated on the single line diagram drawings. The entire electrical system shall be included in the coordination study. Verify characteristics and settings of existing devices in the field and from the manufacturer.
- C. The time-current characteristics of the specified protective devices shall be plotted on the appropriate log-log paper. The plots shall include complete titles, representative one-line diagrams of both buildings and legends, associated relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves, and fuse curves. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, cable damage curves, symmetrical and asymmetrical fault currents. All requirements of the current California Electrical Code shall be adhered to. Reasonable coordination intervals and separation of characteristic curves shall be maintained. Separate coordination plots for phase and ground protective devices shall be provided on a system basis. Separate curves shall be used to clearly indicate the coordination achieved for feeder breakers with downstream fuses and circuit breakers in switchgear and substations. There shall be a maximum of six protective devices per plot.
- D. The selection and setting of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. Discrepancies, problem areas, or inadequacies shall be promptly brought to the project Owners Representative's attention.

- E. Five copies of coordination curves and tabulated data indicating selection and settings of protective devices shall be submitted to the Owners Representative for approval.

PART 3 - EQUIPMENT VERIFICATIONS, TESTS AND CALIBRATIONS

3.1 GENERAL

- A. As part of the contract, the Contractor shall perform tests of installed work as herein specified and specified in other Sections of these Specifications.
- B. The Contractor shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections.
- C. All tests shall be performed in compliance with the recommendations and requirements of the National Electrical Testing Association, Inc. (NETA), and applicable codes and standards.
- D. Upon completion of the tests and inspections noted in these Specifications, a label shall be attached to all serviced devices. These labels shall indicate date serviced and the service company responsible.
- C. The test and inspections shall determine suitability for continued reliable operation.
- D. All tests shall be conducted in the presence of the Owners Representative. Provide a minimum of two weeks notice to the Owners Representative.
- E. Furnish the necessary equipment and personnel to perform all required tests of all wiring and connections for continuity, short circuit, and improper grounds. Included, but not limited to, the following systems: substations, air interrupting switches, low voltage main and feeder circuit breakers, interlocking controls, panelboards, distribution transformers, branch circuits.

3.2 SWITCHGEAR, SUBSTATIONS, DISTRIBUTION BOARDS, AND EMERGENCY SYSTEM-GENERAL

- A. Visual and mechanical inspection:
 - 1. Inspect for physical damage and code violations.
 - 2. Clean interior and exterior surfaces.
 - 3. Inspect for proper alignment, anchorage, and grounding.
 - 4. Check tightness of accessible bolted bus joints by torque wrench method. Tighten connections in accordance with industry standard torque levels.
 - 5. Make closure attempt on locked open devices. Make opening attempt on locked closed devices.
 - 6. Make exchange with devices operated in off-normal positions.
- B. Electrical tests:

1. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground.
2. Inspect all accessible bus joints and cable connections by infrared scanner to detect loose or high-resistance connections and other circuit anomalies.
3. Inspect correctness of control wiring.

3.3 BATTERY SYSTEM

A. Visual and mechanical inspection:

1. Inspect for physical damage, anchorage, electrolyte leakage and level.
2. Check intercell bus link and cable connection integrity for tightness and corrosion.

B. Electrical tests:

1. Measure system charging voltage and each individual cell voltage.
2. Measure electrolyte specific gravity.
3. Perform infrared scan of the intracell links cable connections under current discharge conditions.

3.4 INSTRUMENT TRANSFORMER

A. Visual and mechanical inspection:

1. Inspect for physical damage and connection tightness.
2. Check transformer nameplate with singleline diagram.
3. Check proper operation of grounding or shorting devices.

B. Electrical tests:

1. Measure current transformer ratio by primary current injection.
2. Measure potential transformer ratio.
3. Measure insulation resistance primary-to-ground, secondary-to-ground and primary-to-secondary.
4. Verify secondary wiring connections by secondary current injection.
5. Verify transformer polarity markings.
6. Perform current transformer saturation test. Plot transformer voltage current curve.

3.5 CONTROL POWER TRANSFORMERS - ENCAPSULATED TYPE

A. Visual and mechanical inspection:

1. Inspect for physical damage, proper installation, anchorage, and grounding.
2. Clean interior and all bushing and insulator surfaces.
3. Verify proper auxiliary device operation such as fans and indicators.
4. Check tightness of accessible bolted electrical joints. Tighten connections in accordance with industry standards.

B. Electrical tests:

1. Perform insulation resistance tests winding-to-winding and winding-to-ground. Apply appropriate guard circuit over all bushings.
2. Perform dielectric absorption test winding-to-winding and winding-to-ground for ten (10) minutes. Compute the polarization index.
3. Perform turns ratio test between windings for all top positions.
4. Perform insulation power factor tests on all high and low-voltage windings.
5. Check output voltages.

3.6 PROTECTIVE RELAYS

A. Visual and mechanical inspection:

1. Inspect relays for physical damage, presence of foreign material, moisture, condition of spiral spring, disc clearance and corrosion.
2. Clean cover glass interior and relay components.
3. Check for freedom of movement, proper travel and alignment, and tightness of mounting hardware and top screws.

B. Electrical test:

1. Perform insulation resistance tests on each circuit branch to frame.
2. Perform the following tests at the settings specified by Owners Representative:
 - a. Pickup parameters on each operating element.
 - b. Timing at three (3) points on time dial curve.
 - c. Pickup target and seal in units.
 - d. Special test as required to check operation of restraint, and other elements per manufacturer's instructions.
3. Perform phase angle and magnitude contribution tests on all differential type relays after energization to vectorially prove proper polarity and connection.
4. Check polarity and correctness of control wiring.

C. Relay calibration and tests:

1. Two relay wiring tests shall be made.
 - a. Primary circuit polarity test shall include a DC test from the current transformer to each terminal block and relay terminal.
 - b. Relay and circuit breaker operation test by application of power from the portable relay test set.

D. Relay testing shall be accomplished after completion of the switchgear installation, using standard portable test set equipment and the relay manufacturer's testing directions and parameters to determine conformance of the relay to the time-overcurrent information given in the manufacturer's performance curves and the tap settings provided by coordination study. Overcurrent relay testing shall include:

1. Zero set tests.
 2. Pickup tests.
 3. Time-current characteristic (operation at currents 3 and 4 times the directed tap settings), and instantaneous at the directed tap setting.
 4. Target and seal-in operation.
- E. Target differential relays shall be tested similarly, except for the following additional tests:
1. Low voltage “through-currents” of approximately “full load” and “fault” magnitudes shall be circulated in HV busses. Bus differential relays shall not trip.
 2. Low voltage currents shall be circulated within the differential zones of “low-fault” and “high-fault” magnitudes. Bus differential relays shall initiate tripping momentarily.

3.7 LOW VOLTAGE CIRCUIT BREAKERS

A. Visual and mechanical inspection:

1. Inspect for physical condition.
2. Inspect alignment and grounding.
3. Perform mechanical operator and contact alignment tests on the breaker and its operating mechanism in accordance with manufacturer’s instructions.
4. Perform insulation resistance test on control wiring.
5. Clean mechanism, insulating surfaces and contacts.

B. Electrical tests:

1. Measure contact resistance.
2. Trip overcurrent protective device by operation of each protective device.
3. Perform an insulation resistance test phase-to-ground, phase-to-phase and across open contacts.
4. Perform insulation resistance test in accordance with Doble procedure.
5. Perform timing test with Travel Analyzer to insure proper contact overtravel and pressure.

3.8 CABLES, LOW VOLTAGE (600 VOLTS AND LESS)

A. Visual and mechanical inspections:

1. Inspect cables for physical damage and proper connection.
2. Torque test cable connection. Tighten connections in accordance with industry standards.
3. Perform infrared scan of all connections under loaded conditions.

B. Electrical tests:

1. Perform insulation resistance test of each cable with respect to ground and adjacent cables.

3.9 GROUNDING SYSTEMS

A. Visual and mechanical inspection:

1. Inspect ground system connections for completeness and adequacy.

B. Electrical tests:

1. Perform fall-of-the-potential test per IEEE No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.

C. INFRARED INSPECTION

1. All doors and cover shall be removed and upon completion of test be reinstalled by testing agency technicians.
2. A load bank shall be furnished to circulate low voltage currents of 400A magnitude through each bus, main breaker and feeder breaker. After two hours infrared scans shall be made of all bus joints. Problem area shall be photographed before and after corrections. After corrections, another current test of two hours duration shall be made. Again an infrared scan shall be made to confirm correct operation.
3. Upon completion, the switchgear shall be energized at 12kV. After 4 hours, infrared scans shall be made to determine areas of excessive corona. Problem area shall be treated the same as under B., above.
4. Upon completion of infrared scans, all covers and doors shall be reinstalled.

END OF SECTION

SECTIONS 26 06 01

3-WAY MANUAL TRANSFER SWITCH

PART 1 – GENERAL REQUIREMENTS

1.1 SCOPE

- A. Contractor shall furnish, deliver, install and test the 3-way manual transfer switches as specified herein and in accordance with the drawings.

1.2 QUALITY ASSURANCE

- A. 3-way manual transfer switch shall be fabricated using UL listed components that have been tested to the UL 1008 standard.
- B. 3-way manual transfer switch manufacturer shall provide a complete factory assembled, wired and tested 3-way manual transfer switch.
- C. 3-way manual transfer switch shall be factory Hi-pot tested for a period of not less than 60 seconds.
- D. 3-way manual transfer switch installation shall meet all applicable NEC standards.

1.3 SUBMITTALS

- A. Contractor shall submit manufacturer's drawings and data of 3-way manual transfer switches for Engineer's approval prior to start of fabrication. Drawings and data shall include, as a minimum, dimensioned general arrangement drawings and wiring diagrams, UL listing information for key components including circuit breakers and receptacles, component data, mounting provisions, conduit entry locations and installation instructions.
- B. Upon installation of 3-way manual transfer switches Contractor shall submit manufacturer's Operating & Maintenance Manual which shall include as a minimum:
 - 1. Certified as-built General Arrangement drawings and Wiring Diagram.
 - 2. Materials / Component List including part numbers.
 - 3. Maintenance and service requirements.
 - 4. Certificate of Compliance and hi-pot test data.

1.4 WARRANTY

- A. 3-way manual transfer switches shall be covered by manufacturer's warranty for a minimum period of (1) one year after shipment from manufacturer.

PART 2 – PRODUCT

2.1 GENERAL

- A. All equipment shall be new.
- B. 3-way manual transfer switch manufacturer must have produced and sold manual transfer switches as a standard product for a minimum of (3) years.
- C. 3-way manual transfer switches shall be molded case circuit breaker type; knife switch or fused switches are not acceptable.
- D. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.
- E. 3- way manual transfer switches shall be TripleSwitch as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.

2.2 3-WAY MANUAL TRANSFER SWITCHES

- A. 3-way manual transfer switch shall consist of (3) mechanically-interlocked molded case circuit breakers, male cam-style inlet connectors, female cam-style outlet connectors, power distribution blocks and grounding terminals, all housed within a padlockable enclosure.
- B. 3-way manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for both portable generator cables with female cam-style plugs and for load bank cables with male cam-style plugs shall be via cable entry openings in the bottom of enclosure. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be light gray RAL 7038.
- C. Cam-style male connectors (inlets) and cam-style female connectors (outlets) shall be UL Listed single-pole separable type and rated 200 amps at 600VAC. All cam-style connectors shall be color coded. Cam-style connectors shall be provided for each phase and for ground, and shall also be provided for neutral. Each of the phase cam-style connectors and the neutral cam-style connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. None of the cam-style connectors shall be accessible unless all (3) molded case circuit breakers are in the “OFF” position and the main access door is open.
- D. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.

- E. Molded case circuit breakers shall be UL Listed 4-pole and the short circuit interrupt rating shall be a minimum of 42kAIC at 208VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall control the connection between the permanent generator and the automatic transfer switch. The second circuit breaker shall control the connection between the permanent generator and the load bank female cam-style connectors. The third circuit breaker shall control the connection between the automatic transfer switch and the portable generator male cam-style connectors. All (3) molded case circuit breakers shall include UL Listed door-mounted operating mechanisms, preventing the opening of the main access door unless all (3) breakers are in the "OFF" position. All (3) molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (3) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only certain breakers can be closed at any given time.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Prior to installation of 3-way manual transfer switches, Contractor shall examine the areas and conditions under which the 3-way manual transfer switch is to be installed and notify the Engineer in writing if unsatisfactory conditions exist.
- B. 3-way manual transfer switch shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".
- C. Conduit entry into the 3-way manual transfer switch shall be by Contractor; Contractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the 3-way manual transfer switch. The incoming hub size shall match the conduit size for feeders and ground as shown on the drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the drawings. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the 3-way manual transfer switch enclosure.
- D. Contractor shall terminate feeder conductors, load conductors and ground per the manufacturer's instructions. Use copper wire only for all conductors and grounds. All field wiring terminations shall be torqued as required per the instructions on the 3-way manual transfer switch's power distribution blocks, circuit breakers & ground lugs.

3.2 FIELD TESTING

- A. Prior to energizing 3-way manual transfer switch, the Contractor shall perform the following checks and tests as a minimum:

1. Verify mounting and connections are complete and secure.
2. Verify internal components and wiring are secure.
3. Perform continuity check of all circuits.
4. Perform 1,000 VDC megger test on feeder, load and ground cables.
5. Verify deadfront is secure.
6. With the 3-way manual transfer switch deadfront in place and the main access door closed and properly latched, actuate all (3) Operator Mechanisms; verify:
 - a) With the breaker controlling the connection between the permanent generator and the automatic transfer switch (ats) in the "on" position, neither of the other (2) breakers can be turned to the "on" position.
 - b) With the breaker controlling the connection between the permanent generator and the automatic transfer switch (ats) in the "off" position, the other (2) breakers can be turned "on" or "off", independent of each other.
 - c) With the breaker controlling the connection between the permanent generator and the automatic transfer switch (ATS) in the "OFF" position and with either or both of the other (2) breakers in the "ON" position, the breaker controlling the connection between the permanent generator and the automatic transfer switch (ATS) cannot be turned "ON".
7. Confirm operation of the 3-way manual transfer switch ground receptacle by attaching a plug to the 3-way manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.
8. Once normal power has been applied, confirm operation of 3-way manual transfer switch by following directions on main access door.

END OF SECTION

SECTION 26 06 22

AUTOMATIC TRANSFER SWITCH BYPASS ISOLATION OPEN TRANSITION 200 AMP, 3 PHASE, 4 WIRE, 4 POLE, 208/120 VOLT, NEMA 3R

PART 1 - GENERAL

1.1 SCOPE

- A. It is the intent of this specification to secure a transfer switch that has been prototype tested, factory built, production tested and site tested. A transfer switch with the number of poles, voltage and current ratings shown on the plans and specified herein shall be provided. All interconnecting contacts, wiring etc. shall be provided as a complete and operable system.

1.2 CODES AND STANDARDS

- A. The automatic transfer switch shall conform to the requirements of:
1. UL 1008: Underwriters Laboratories standard for automatic transfer switches
 2. CSA: C22.2 No. 178 certified
 3. IEC: 947-6-1 certified at 480 VAC
 4. NFPA 70: California Electrical Code including use in emergency and standby systems in accordance with Articles 517, 700, 701, 702
 5. NFPA 99: Essential electrical systems for health care facilities
 6. NFPA 101: Life safety code
 7. NFPA 110: Standard for emergency and standby power systems
 8. IEEE 241: I.E.E.E. recommended practice for electrical power systems in commercial buildings
 9. IEEE 446: I.E.E.E. recommended practice for emergency and standby power systems
 10. NEMA ICS10: AC automatic transfer switch equipment
 11. UL 50/508: Enclosures
 12. ICS 6: Enclosures
 13. ANSI C33.76: Enclosures
 14. NEMA 250: Enclosures
 15. IEEE 472: (ANSI C37.90A): Ringing wave immunity
 16. EN55022 (CISPR11): Conducted and radiated emissions (Exceeds EN55011 & MILSTD 461 Class 3)
 17. EN61000-4-2: (Level 4): ESD immunity test Class B:
 18. EN61000-4-3: (ENV50140): Radiated RF, electromagnetic field immunity
 19. EN61000-4-4: Electrical fast transient/burst immunity test
 20. EN61000-4-5: IEEE C62.41: Surge immunity test (1.2 x 50 s, 5 & 8 kV)
 21. EN61000-4-6: (ENV50141): Conducted immunity test

22. EN61000-4-11: Voltage dips and interruption immunity

1.3 APPROVED MANUFACTURERS

- A. The automatic transfer switch shall be ASCO. Alternate manufactures shall submit a request two weeks prior to bid and include a written list of deviations from this specification to be considered for approval.
- B. Or equal.

PART 2 - PRODUCT

2.1 PERFORMANCE AND CONSTRUCTION

- A. A bypass-isolation transfer switch shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch that could not otherwise be tested, inspected and maintained without interrupting the load. Bypass of the load to either the normal or emergency power source with complete isolation of the automatic transfer switch shall be possible regardless of the status of the automatic transfer switch. The bypass-isolation switch shall permit simple operation by one person through the movement of a maximum of two handles. The entire system shall consist of two elements: the automatic transfer switch and the bypass-isolation switch furnished completely factory interconnected and tested.
- B. The operating speed of the bypass-isolation switch contacts shall be independent of the speed of operation of the bypass handle.
- C. The isolation handle shall provide three positions: Automatic, Test and Isolate. The Test position shall permit electrical testing of the automatic transfer switch without disturbing the load. The Isolate position shall completely isolate the transfer switch from both sources and load without actual removal of the line or load conductors and allow its removal for inspection and maintenance. The transfer switch shall be arranged for draw out operation to facilitate its removal. Also, while in the Test or Isolate positions, the bypass-isolation switch shall function as a manual transfer switch to allow load transfer to either source of power regardless of the position or condition of the transfer switch.
- D. The load shall not be interrupted during bypass-isolation functions. The addition of load-break contacts that cause load interruption is not acceptable. The bypass-isolation switch contacts shall not be in the system current path except during actual bypass operation.
- E. The complete bypass-isolation transfer switch shall be tested to ensure proper operation of the individual components, correct overall sequence of operation and to

ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

- F. The bypass-isolation transfer switch shall be the product of one manufacturer and completely factory interconnected and tested so that only the services and load connections to the bypass-isolation switch are required for field installation. All interconnections between the transfer switch and the bypass-isolation switch shall be silver-plated bus bar.
- G. The automatic transfer switch shall be of double throw construction operated by a reliable solenoid driven mechanism. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.
- H. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the CEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability will not be considered.
- I. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.
- J. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Each ATS shall be in strict accordance and listed to UL 1008 withstand standards, including 3 cycle ratings.
- K. A dielectric test at the conclusion of the withstand and closing tests shall be performed.
- L. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 208 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- M. All relays shall be continuous duty industrial type with wiping contacts. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
- N. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

- O. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
- P. Switches composed of molded case breakers, lighting contactors or components thereof will not be acceptable.
- Q. The current rating shall be a continuous rating when the switch is installed in an enclosure, and shall conform to NEMA temperature rise standards.
- R. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.
- S. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- T. Unless specified otherwise on the drawings, the switch shall be mounted in a NEMA 3R enclosure.

2.2 CONTROL

- A. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities:
 - 1. Easy-to-view 4x20 LCD display with long lasting LED indicators.
 - 2. Control panel shall display voltage and frequency of both sources.
 - 3. The user shall be able to view the last 16 recorded events.
 - 4. Capability for external communication and network interface.
 - 5. Adjustments to all settings shall be made from the front of the panel without opening the door.
- B. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position, source availability, sequence indication and diagnostics.
- C. All programmable and control functions shall be pass code protected and accessible through the keypad.
- D. The control panel shall be provided with a simple user interface for transfer switch monitoring, control and field changeable functions and settings
- E. Touch pad test switch with Fast Test/Load/No Load selection capability to simulate a normal source failure.

- F. The controller shall include a built in synchroscope to display the phase angle differential and ensure disturbance-free transfer operation between sources.
- G. The controller shall provide digital timer adjustments with 1-second resolution. Voltage and Frequency shall be adjustable to 1% resolution to facilitate accurate transfer.
- H. To ensure reliable and consistent user operation the controls must be equipped with nonvolatile memory and allow automatic daylight savings time adjustment.
- I. A single controller capable of all transfer modes, open/delayed/closed and bypass isolation, shall be provided. Real time display of transfer status and active timers must be supplied.
- J. The bypass-isolation transfer switch shall be furnished with a detailed step-by-step operating instruction plate as well as the following functional diagnostic lights:
 - 1. Normal source available
 - 2. Emergency source available
 - 3. Bypass switch in normal position
 - 4. Bypass switch in emergency position
 - 5. Automatic transfer switch in test position
 - 6. Automatic transfer switch isolated
 - 7. Automatic transfer switch inhibit
 - 8. Automatic transfer switch in normal position
 - 9. Automatic transfer switch in emergency position

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION

- A. The open transition switch shall transfer the load preventing parallel mode, thus momentarily disconnecting both sources of power. A open transition transfer shall occur only when both sources are available and within specified limits. The transfer switch shall operate in an open transition mode when the power source servicing the load fails.
- B. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the normal source.
- C. When the voltage of any phase of the normal source is reduced to 80% of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
- D. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the emergency source.

- E. When the emergency source has reached a voltage value of 90% nominal, achieved frequency within 95% of the rated value and has reached the end of the adjustable delay, the load shall be transferred to the emergency source.
- F. When the normal source has been restored to not less than 95% and not more than 105% of nominal voltage on all phases, proper phase rotation is verified, and after a time delay of 0-30 minutes, the load shall be transferred to the normal source in a closed transition operation. The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- G. If the operating engine generator should fail while carrying the load, transfer shall be made to the second (standby) generator within 10 seconds, if the second generator should fail, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
- H. During open transition operation, the control circuit shall monitor interconnect time. Should connection exceed 100 ms, the set of power contacts just closed shall be reopened and an alarm circuit shall be energized. If the main contacts fail to open, the control system shall energize a 24 VDC shunt trip circuit to the standby feeder breaker to disconnect this source and the alarm circuit shall be closed. 24 VDC from the engine batteries shall be supplied for the shunt trip and alarm backup circuits.
- I. A sync check function shall be provided for open transition operation. The monitor shall control transfer and retransfer between live sources and operate by sensing the zero voltage point. It shall be factory set to accomplish transfer within 5 electrical degrees and +/-5% voltage differential. If closed transition transfer is not accomplished within 60 seconds, an alarm message shall be displayed to indicate the failure
- J. Open transition transfer in conjunction with over/under-voltage, phase rotation and angle sensing shall be accomplished when both sources are within specified parameters without any power interruption through passive synchronization. An electronic isochronous governor shall be provided on the both emergency sources.
- K. The bypass-isolation switch shall be equipped with an independent engine start circuit. Should a utility outage occur while operating the bypass in normal or isolated modes, the engine will automatically start and allow immediate selection to emergency bypass.

3.2 STANDARD ACCESSORIES

- A. Adjustable time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds factory set at 3 seconds.
- B. Adjustable time delay on retransfer to normal source, programmable 0-60 minutes factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

- C. A time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second.
- D. An exerciser timer with momentary test pushbutton shall be incorporated within the microprocessor and shall be capable of starting the engine generator set and transferring the load (when selected) for exercise purposes on a daily, weekly or monthly basis. The exerciser shall contain a battery for memory retention during an outage.
- E. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.
- F. A set of customer contacts shall be provided to indicate both emergency and normal source position.
- G. An adjustable over/under frequency and voltage sensor for both emergency and normal sources.
- H. Indication of switch position and source acceptability shall be provided for both emergency and normal sources.
- I. An engine start contact with an adjustable cool down timer.
- J. A three phase Voltage Imbalance Monitor shall detect an imbalance and initiate a transfer to the alternate source. Adjustable 5-20% of nominal with a time delay of 10-30 seconds for nuisance conditions.
- K. Phase rotation sensing and display shall be provided to monitor both sources.
- L. The following optional Exerciser Package shall be included:
 - 1. Additional Auxiliary Contact (A3) - Closed when the transfer switch is in Source 2 position.
- M. The following additional accessories shall be included:
 - 1. Heater and Thermostat (HT).
 - 2. Universal Motor Load Disconnect (UMD) - Auxiliary contacts opens 0 – 5 minutes prior to transfer in either direction, re-closes after transfer. Can be configured for pre-transfer, post transfer or both.
 - 3. Sequential Universal Motor Load Disconnect (A62) – Multiple auxiliary contacts open prior to transfer in either direction, re-closes after transfer. Can be configured for pre-transfer, post transfer or both.
 - 4. Communications interface card (ZNETM) – RS-485 Modbus
 - 5. Test Switch (6A) - Maintained
 - 6. Digital Meter (M84) – Includes M83 functions plus unbalance 128 samples/cycle data logging, waveform capture and sag/swell capture.
 - 7. Additional Auxiliary Contacts (A3) - Closed when the transfer switch is in Source 2 position.

8. Additional Auxiliary Contacts (A4) - Closed when the transfer switch is in Source 1 position.
9. Alarm panel (CTAP) – Alarm on transfer to emergency w/silence button & light
10. Disconnect Switch (DS) - Inhibits transfer in either direction when in inhibit.
11. Extended warranty (ATSEW) - annual parts and labor warranty (1-3) years for a total of 5 years max.)
12. Protective Cover (OCVR) - Lockable see-through microprocessor and meter cover for NEMA 3R or 12.
13. Battery Charger (B9) – 5 amp float charger. Specify input/output voltage.
14. Fan Contact (F) – Contact closes when engine runs.
15. Inhibit transfer (Q3) – Provides additional relay (specify voltage) to inhibit transfer to Emergency.
16. Inhibit transfer (Q7) – Provides additional relay (specify voltage) to inhibit transfer to Normal.
17. Load Shed (R15) – Provisions to transfer source 2 or Emergency to normal or neutral (delayed switches only) position. Specify voltage.
18. Keyed Engine Mode Switch (SW1K) – Three position keyed engine selector switch (auto/test/off).
19. Automatic or Manual Selector (S12) – Provide ability to manually transfer to Normal or Emergency sources.
20. Auxiliary Contact (AB3) – Closed in emergency bypass.
21. Auxiliary Contact (AB4) – Closed in normal bypass.
22. Back-up battery source to allow the ATS to operate properly.

3.3 GENERAL

- A. The transfer switch shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes.

3.4 FACTORY TESTS

- A. The transfer switch manufacturer shall perform a complete functional test on the switch, controller and accessories prior to shipping from the factory. A certified test report shall be available upon request.

3.5 SERVICE

- A. The manufacturer shall maintain a national service organization that is factory trained and certified for transfer switch equipment. In addition, the service organization shall be available 24 hours per day, 365 days per year.

3.6 WARRANTY

- A. The automatic transfer switch shall be warranted against defective workmanship for a period of two years, including both parts and labor.

END OF SECTION

NOT FOR BID

SECTION 26 08 50

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. No series rated equipment is allowed.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. 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. Coordination-Study Report.
- E. Submit study prior to construction.

1.4 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 not acceptable.

- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
- B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a product by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. 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.

PART 3 - EXECUTION

3.1 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.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 1. Product Data for overcurrent protective devices specified in other Division 26 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. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 4. 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 interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Switchgear and switchboard bus.
 2. Medium-voltage controller.
 3. Motor-control center.
 4. Distribution panelboard.
 5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 or IEEE 241 and IEEE 242.
 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.

- d. IEEE C57.12.00.
 - e. IEEE C57.96.
2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 3. 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.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 or IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- C. 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.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves 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.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to 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:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Distribution panelboards and Utility Service metering where noted on plans.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Transient voltage suppression panelboards.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.

- b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:
 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 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."
 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.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports including the following:
 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.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Operation and Maintenance Data: For panelboards and components 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. 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.

1.5 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. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NEMA PB 1.
- G. Comply with CEC.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 110 deg F (43 deg C).
 - 2. 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 and Owner no fewer than 14 days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Architects and Owners written permission.

1.7 COORDINATION

- 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, and encumbrances to workspace clearance requirements.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 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.
 1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton - Cutler/Hammer, or approved equal by:
 - b. Square D.
 - c. General Electric.

2.2 MANUFACTURED UNITS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.
 1. Rated for environmental conditions at installed location.

- a. Outdoor Locations: NEMA 250, Type 3R unless noted otherwise.
 - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - c. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
 7. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
 8. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
 9. Identifying nameplate with full description as specified in Section 260532.
- C. Phase and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
 3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 5. Split Bus: Vertical buses divided into individual vertical sections.
- D. Conductor Connectors: Suitable for use with conductor material.
1. Main and Neutral Lugs: Compression type.
 2. Ground Lugs and Bus Configured Terminators: Compression type.
 3. Feed-Through Lugs: Compression type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- F. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device allowable, branch devices allowable, and UL connected short-circuit rating. Series rated panels and related circuit breakers are not acceptable.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- B. Main Overcurrent Protective Devices: Circuit Breaker.
- C. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on type circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on type circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 LOAD CENTERS

- A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.
 - B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.
- ### 2.08 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: 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-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.

- c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t 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 two-pole configurations with 5-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 10. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses." ACCESSORY COMPONENTS AND FEATURES
- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
 - B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.

- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish. Where panelboards are recessed into fire rated walls, notify Architect immediately of condition and provide additional furring of wall (and related drywall) to bring panelboard front flush with finished surface.
- E. Install overcurrent protective devices and controllers.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub out 1-inch (27-GRC) empty conduits where noted on plans.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing in a neat and professional manor.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads (after balancing panelboard loads). Obtain approval from Architect of description or areas served before installing. The Contractor shall be responsible for updating directories to indicate actual area served which is not necessarily the description indicated on the bid documents. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws or rivets. Refer to Section 260532 for additional requirements.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.
- E. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris prior to pulling any conductors; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Time switches.

1.2 REFERENCES

- A. NEMA WD 1 - General-Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Single Pole Switch:
 - 1. Hubbell, Model 2121-W.
 - 2. Leviton, Model 5621-2W.
 - 3. Equal by Arrow Hart or Bryant.
- B. Double Pole Switch:
 - 1. Hubbell, Model 2122-W.
 - 2. Leviton, Model 5622-2W.
 - 3. Equal by Arrow Hart or Bryant.
- C. Three-way Switch:
 - 1. Hubbell, Model 2123-W.
 - 2. Leviton, Model 5623-3W.
 - 3. Equal by Arrow Hart or Bryant.

- D. Substitutions: Under provisions of Division 01.
- E. Description: NEMA WD 1, heavy-duty specification grade, AC only general-use quiet type rocker switch, UL approved for tungsten lamp loads or inductive loads without derating.
- F. Device Body: White plastic with rocker handle.
- G. Ratings: 20A., 120-277V A.C. or as required to match with specific branch circuit and load characteristics.
- H. Lock type switches shall be Hubbell #1221L only per District standards.

2.2 RECEPTACLES

A. Duplex Convenience Receptacle:

- 1. Hubbell
- 2. Leviton
- 3. Arrow Hart
- 4. Bryant.

B. GFCI Receptacle:

- 1. Hubbell
- 2. Leviton
- 3. Arrow Hart
- 4. Bryant.

C. Surge Protected Outlets:

- 1. Hubbell
- 2. Leviton
- 3. Arrow Hart
- 4. Bryant.

D. Substitutions: Under provisions of Division 01.

E. Description: NEMA WD 1; heavy-duty general-use receptacle. 20 Amp, 125V, 2-pole, 3-wire style line series.

F. Device Body: Plastic.

G. Configuration: NEMA WD 6; type as specified and indicated.

H. Convenience Receptacle: Type 5-20R

I. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Plates shall be brushed stainless steel and supplied for every local switch and receptacle.
- B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device cover.
- C. Locking Weatherproof Cover Plate: Pass & Seymour #WP26-L or equal at locations Indicated on drawings.
- D. Plates shall be engraved and filled, when used for:
 - 1. More than two gangs.
 - 2. Equipment that cannot be seen from the locations.
 - 3. All lock type switches.
 - 4. All receptacles other than 120 volts.
 - 5. All pilot switches.
 - 6. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
 - 7. Manual motor starting switches.
 - 8. Where so indicated on the drawings.
 - 9. As required on all control circuit switches, such as heater controls, etc.

2.4 TIME SWITCHES

- A. Manufacturers:
 - 1. Tork.
 - 2. Paragon.
 - 3. Intermatic.
- B. Description: AC electronic time clock, 7 day.
- C. Input voltage: 120V.
- D. Poles: 40A, 120V, number as indicated. (4 pole minimum)
- E. Enclosure: Type as required to meet installation.
- F. Configuration: 365 Day Astronomic, electronic, programmable.
- G. Accessories: Photocell control as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and will be completely covered by wall plates.

- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top
- E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- F. Install decorative plates on switches, receptacles, etc., and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished area, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260533 to obtain mounting heights specified and indicated on drawings.
- B. Install wall switches as indicated on drawings.
- C. Install convenience receptacles 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.

- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION

NOT FOR BID

SECTION 26 32 13

EMERGENCY GENERATOR SET

PART 1 - GENERAL

1.1 REFERENCES AND STANDARDS

The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below:

- CSA C22.2 No14
- CSA 282
- CSA 100
- EN61000-6
- EN55011
- FCC Part 15 Subpart B
- ISO8528
- IEC61000
- UL508
- UL2200
- UL142
- Designed to allow for installed compliance to NFPA 70, NFPA99 and NFPA 110

1.2 RELATED SECTIONS

- A. Division 22 – Plumbing
- B. Division 26 - Electrical
- C. Division 33 - Concrete

1.3 WORK INCLUDED

- A. Installation
The work includes supplying and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories and automatic transfer switches specified under a separate section.
- B. Fuel System
The CONTRACTOR shall provide a full tank of diesel fuel for the completion of all testing.
- C. System Test
A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.

D. Requirements, Codes and Regulations

The equipment supplied and installed shall meet the requirements of the CEC and all applicable local codes and regulations. All equipment shall be of new and current production by a MANUFACTURER who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.4 SUBSTITUTION

Proposed deviations from the specifications shall be treated as follows:

A. Substitution Time Requirement

Requests for substitutions shall be made a minimum of ten (10) days prior to bid date. Manufacturers catalog data shall accompany each request and authorized acceptance shall be addenda only.

B. Substitution Responsibility

The power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around Generac supplied equipment. Should any substitutions be made, the CONTRACTOR shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result from such substitutions.

1.5 SUBMITTALS

Engine-generator submittals shall include the following information:

1. Factory published specification sheet.
2. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.
3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
4. Weights of all equipment.
5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.
7. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.
8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
9. Generator resistances, reactance's and time constants.
10. Generator locked rotor motor starting curves.
11. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at

- the specified site conditions with the specified loads.
12. Manufacturer's and dealer's written warranty.

1.7 SYSTEM RESPONSIBILITY

- A. Generator Set Distributor
The completed engine generator set shall be supplied by the Manufacturer's authorized distributor only.
- B. Requirements, Codes and Regulations
The equipment supplied and installed shall meet the requirements of CEC and all-applicable local codes and regulations. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.
- C. Automatic Transfer Switch
The automatic transfer switch(s) specified in another section.
- D. Permitting of Generator Sets: Contractor shall coordinate with County Fleet Services to obtain SCAQMD permits for generators. Contractor shall coordinate with County Fleet Services to verify that generator meet current regulation requirements prior to submittals and purchase. Permits shall be in place prior to delivery of generator units. Generators shall comply with the South Coast Air Quality Management District (SCAQMD) and State Emission regulations at the time of installation/commissioning. Cost of permits by County.

1.8 WARRANTY

- A. Two Year Standby (ISO 8528-1: ESP) Generator Set Warranty
The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.

1.9 PARTS AND SERVICE QUALIFICATIONS

- A. Service Facility
The engine-generator supplier shall maintain 24-hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24hrs and 95% within 48 hours.
- B. Service Personnel
The dealer shall maintain qualified factory trained service personnel.

PART 2 - PRODUCT SPECIFICATIONS

2.1 GENERAL REQUIREMENTS

A. Genset Requirements

The generator set shall be Standby Duty rated at 50.0 kW, 67.5 kVA, 1800 RPM, 0.8 power factor, 208 V, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 122F (50.0C) and altitude of 2000.0 feet (610 m).

Standby Power Rating:

Power is available for the duration of an emergency outage

Average Power Output = 70% of standby power

Load = Varying

Typical Hours/Year = 200 Hours

Maximum Expected Usage = 500 hours/year

Typical Application = Standby

B. Material and Parts

All materials and parts comprising the unit shall be new and unused.

C. Engine

The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the South Coast Air Quality Management District (SCAQMD) and State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified kW / bHP rating. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder. Emissions requirements / certifications of this package: EPA Stationary Emergency.

1. Engine Governing

The engine governor shall be a electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10%, from no load to full rated load. Steady state frequency regulation shall be +/- 6 RPM. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

2.2 GENERATOR

A. Generator Specifications

The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300% of rated current based on the 125C (Class H) or 105C (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be independent of main stator windings (either permanent magnet or auxiliary windings). The generator shall comply with SCAQMD Rule 1470.0 and shall contain a Diesel Particulate Filter (DPF) as needed to comply with California Code.

B. Voltage Regulator

1. Digital Voltage Regulator

The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

The voltage regulator shall communicate with the Generator Control Panel via a J1939 communication network with generator voltage adjustments made via the controller keypad. Additionally, the controller shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through the controller. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a windows compatible environment.

C. Motor Starting

Provide locked rotor motor starting capability of 30 skVA at 30% instantaneous voltage dip as defined per NEMA MG 1. Sustained voltage dip data is not acceptable.

2.3 CIRCUIT BREAKER

A. Circuit Breaker Specifications

Provide a generator mounted 100% circuit breaker, molded case, Qty.(1) 175 amp trip, 3 pole, NEMA 1/IP22. Breaker shall utilize a solid state trip unit. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.4 CONTROLS – GENERATOR SET MOUNTED (EMCP 4.2)

Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

A. Environmental

The generator set control shall be tested and certified to the following environmental conditions:

1. -40°C to +70°C Operating Range
2. 100% condensing humidity, 30°C to 60°C
3. IP22 protection for rear of controller; IP55 when installed in control panel
4. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
5. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
6. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
7. Shock: withstand 15G

B. Functional Requirements

The following functionality shall be integral to the control panel.

1. The control shall include a minimum 33 x 132 pixel, 24mm x 95mm, positive image, transfective LCD display with text based alarm/event descriptions.
2. The control shall include a minimum of 3-line data display
3. Audible horn for alarm and shutdown with horn silence switch
4. Standard ISO labeling
5. Multiple language capability
6. Remote start/stop control
7. Local run/off/auto control integral to system microprocessor
8. Cooldown timer
9. Speed adjust
10. Lamp test
11. Emergency stop push button
12. Voltage adjust
13. Voltage regulator V/Hz slope - adjustable
14. Password protected system programming

C. Digital Monitoring Capability

The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units

Engine

1. Engine oil pressure
2. Engine oil temperature
3. Engine coolant temperature
4. Engine RPM
5. Battery volts
6. Engine hours
7. Engine crank attempt counter

8. Engine successful start counter
9. Service maintenance interval
10. Real time clock
11. Engine exhaust stack temperature
12. Engine main bearing temperature

Generator

1. Generator AC volts (Line to Line, Line to Neutral and Average)
2. Generator AC current (Avg and Per Phase)
3. Generator AC Frequency
4. Generator kW (Total and Per Phase)
5. Generator kVA (Total and Per Phase)
6. Generator kVAR (Total and Per Phase)
7. Power Factor (Avg and Per Phase)
8. Total kW-hr
9. Total kVAR-hr
10. % kW
11. % kVA
12. % kVAR
13. Generator bearing temperature
14. Generator stator winding temperature

Voltage Regulation

1. Excitation voltage
2. Excitation current

D. Alarms and Shutdowns

The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

Engine Alarm/Shutdown

1. Low oil pressure alarm/shutdown
2. High coolant temperature alarm/shutdown
3. Loss of coolant shutdown
4. Overspeed shutdown
5. Overcrank shutdown
6. Emergency stop shutdown
7. Low coolant temperature alarm
8. Low battery voltage alarm
9. High battery voltage alarm
10. Control switch not in auto position alarm
11. Battery charger failure alarm

Generator Alarm/Shutdown

1. Generator phase sequence

2. Generator over voltage
3. Generator under voltage
4. Generator over frequency
5. Generator under frequency
6. Generator reverse power (real and reactive)
7. Generator overcurrent

Voltage Regulator Alarm/Shutdown

1. Loss of excitation alarm/shutdown
2. Instantaneous over excitation alarm/shutdown
3. Time over excitation alarm/shutdown
4. Rotating diode failure
5. Loss of sensing
6. Loss of PMG

E. Inputs and Outputs

Programmable Digital Inputs

The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

Programmable Relay Outputs

The control shall include the ability to operate programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.

Programmable Discrete Outputs

The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which are capable of sinking up to 300mA.

F. Maintenance

All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control

1. Engine running hours display
2. Service maintenance interval (running hours or calendar days)
3. Engine crank attempt counter
4. Engine successful starts counter
5. 40 events are stored in control panel memory
6. Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
 - a. Day of week
 - b. Time of day to start
 - c. Duration of cycle

G. Remote Communications

Remote Communications

The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

Remote Monitoring Software

The control shall provide Monitoring Software with the following functionality

1. Monitor up to eight (8) generator sets, plus ATS and UPS.
2. Provide access to all data and events on generator set communications network
3. Provide remote control capability for the generator set(s)
4. Ability to communicate via Modbus RTU or remote modem

H. Local and Remote Annunciation

Local Annunciator (NFPA 99/110, CSA 282)

Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.

1. Annunciators shall be networked directly to the generator set control
2. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
3. Provide the following individual light indications for protection and diagnostics
 - a. Overcrank
 - b. Low coolant temperature
 - c. High coolant temperature warning
 - d. High coolant temperature shutdown
 - e. Low oil pressure warning
 - f. Low oil pressure shutdown
 - g. Overspeed
 - h. Low coolant level
 - i. EPS supplying load
 - j. Control switch not in auto
 - k. High battery voltage
 - l. Low battery voltage
 - m. Battery charger AC failure
 - n. Emergency stop
 - o. Spare
 - p. Spare

Remote Annunciator (NFPA 99/110, CSA 282)

Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.

1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
2. Ability to be located up to 4000 ft from the generator set

2.5 COOLING SYSTEM

The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110 F* ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.6 FUEL SYSTEM

A. Fuel System

The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi. Connections for adjacent remote fuel tank shall be provided.

B. Fuel Sub Base Tank

Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base of 96 hour capacity shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall meet UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided. The tank shall be provided full of fuel after installation.

2.8 STARTING SYSTEM

A. Starting Motor

A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater

Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

C. Batteries

Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system.

D. Battery Charger

Battery Charger - A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

2.9 ENCLOSURE

A. Attenuated Enclosure

The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.

1. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 77 dba @ 23 ft with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.
2. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

PART 3 - EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

3.2 START-UP AND TESTING

Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

Perform a 4 hour load bank test at a 1.0 PF at full nameplate rating. Loadbank, cables and other equipment required for this test to be supplied by the genset supplier.

3.3 OPERATION AND MAINTENANCE MANUALS

Provide four (4) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.4 TRAINING

A. On-Site Training

Provide on-site training to instruct the owner's personnel in the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Remove surface debris.
- B. Remove paving, curbs, foundations and surface improvements.
- C. Clear site of plant life and grass.
- D. Remove trees and shrubs.
- E. Remove root system of trees and shrubs.

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris. Burning debris on site not permitted.
- B. Coordinate clearing work with utility companies.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are tagged or identified.

3.2 PROTECTION

- A. Protect utilities that are designated to remain from damage.
- B. Protect trees, plant growth and features designated to remain as final landscaping.
- C. Protect bench marks and designated existing structures from damage or displacement.

- D. Erect barricades in accordance with Title 8, Subchapter 4, Construction Safety Orders, California Code of Regulations.
- E. Protect existing items not indicated to be altered.

3.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove paving, curbs, foundations and surface improvements. Patch and repair surfaces not indicated to be removed.
- C. Remove trees and shrubs indicated. Remove stumps, main root ball, root system to full depth.
- D. Clear undergrowth, grass and deadwood. Protect plant material not scheduled for removal.
- E. Keep site free of dust by sprinkling with water. Maintain adequate water trucks, hoses and water supply.

3.4 REMOVAL

- A. Remove debris, rock and extracted plant life from site as work progresses. Dispose legally.
- B. Burial of removed materials not permitted.
- C. Use of Owner's disposal system not permitted. Do not use disposal system belonging to any other property Owner.
- D. Loose fill material, buried trash, abandoned underground structures or deleterious materials of any kind encountered shall be identified and removed to expose natural earth.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Remove topsoil and subsoil; stockpile for later reuse.
- B. Excavation for foundations, slabs-on-grade, paving, and landscaping.
- C. Fill and backfilling to required elevations.
- D. Consolidation and compaction.
- E. Site Contouring.

1.2 REFERENCES

- A. Geotechnical Report.
- B. Standard Specifications for Public Works Construction (SSPWC) ("Green Book, latest edition as adopted by serving jurisdictional authority).
- C. ASTM C136 - Method for Sieve Analysis of Fine and Course Aggregates.
- D. ASTM D1556 - Test Method for Density of Soil in Place by the Sand - Cone Method.
- E. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
- F. ASTM D2922 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- G. ASTM D3017 - Moisture Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 013300.
- B. Accurately record location of utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.4. PROTECTION

- A. Protect trees, shrubs, lawns, rock outcropping, and other features remaining as portion of final landscaping.
- B. Protect benchmarks, existing structures, fences, roads, sidewalks, paving and curbs.

- C. Protect above or below grade utilities, which are to remain.

1.5 PUBLIC AGENCY STANDARDS

- A. Perform all earthwork and related structures and devices indicated as public agency standards in accordance with the standard plans and specifications of that agency.
- B. Where earthwork is constructed in public streets or rights of way, construct in accordance with the standard plans and specifications of the authority having jurisdictions and in the presence of a representative of that agency.
- C. Secure and pay for all necessary permits for work performed. The Owner will pay for associated inspection fees.
- D. Upon completion of the work, provide the Owner with written certification of acceptance of work by the governing agency having jurisdiction.

PART 2 – PRODUCTS

2.1 FILL MATERIAL

A. On-Site Fill Materials:

1. On site, granular, low-expansive fill material free of vegetation, organic material, debris and other deleterious material, and complying with the following criteria.
2. Grading:
 - a. Limit maximum dimension of rock to 3 inches in any dimension at all fills, unless otherwise approved by Geotechnical Engineer.
 - b. Limit maximum dimension of rock to 1 inch in any dimension at all fills located in landscaped areas within 12 inches of surface.
 - c. Provide soil fill with no more than 30 percent passing the #200 sieve.
 - d. Provide soil fill with minimum 40 percent by weight material smaller than 3/4 inch.
3. Expansion Index: Classified as "Very Low", with a maximum value of 20 per UBC Table 18-I-B.
4. Hazardous Materials: Provide certification based on test data that soil materials pass Phase 1 and Phase 2 testing per ASTM E 1527 and all additional federal, state or local regulations, including California DTSC regulations.
5. Obtain approval of Geotechnical Engineer of all fill materials prior to placing.

B. Import Soils

1. Comply with criteria specified in 2.1 above, and the following additional requirements.
2. Expansion Index: Classified as "Very Low", with a maximum value of 20 per UBC Table 18-I-B.
3. Sulphate Content: Limit to maximum 1,000 PPM and as approved by Geotechnical Engineer.
4. Electrical Resistivity: Minimum value in excess of 2,000 ohm cm when saturated

with distilled water, in accordance with California Test Method 643 or soil resistivity box procedure per ASTM G 57.

5. Agricultural Suitability: Obtain approval of Architect of all fill materials used in landscaped areas prior to placing, including providing soil test/analysis results.
6. Use of clay or adobe soil is not acceptable.
7. Obtain approval of Geotechnical Engineer of all imported fill materials prior to delivery on site.

C. Topsoil: Defined as the upper 4 inches of on-site material, after completion of clearing operations specified in Section 311000.

D. Concrete: Lean concrete, with a compressive strength of 1000 psi.

2.2 DESIGN CRITERIA

A. General

1. All public improvements shall be constructed per the referenced standards, the improvement drawings, and as specified in this section.
2. Where criteria shown on drawings or specified in this specification exceed that of the referenced standards, the more stringent criteria shall apply.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Prior to work of this section, carefully inspect previously installed work. Verify all such work is complete to the point where this installation may properly commence.
2. Verify that work of this section may be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.
 - a. Verify that survey benchmark and intended elevations for the Work are as indicated.
 - b. Identify required lines, levels, contours, and datum.
 - c. Identify known utilities. Stake and flag locations.
 - d. Maintain and protect existing utilities remaining which pass through work area.
 - e. Verify fill materials to be reused are acceptable.
 - f. Prior to placement of fill material, verify scarification and compaction of excavated surface is complete.
3. In the event of discrepancy, immediately notify the Architect.
4. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

B. Preparation

1. Provide all staking and field engineering required to implement the work as shown

- on the drawings.
2. Protect all stakes and benchmarks. Replace all stakes and benchmarks damaged during the course of construction at no cost to Owner.
 3. Set grade stakes using instrument technology, at 50 foot grid interval at areas with gradients greater than 2 percent.
 4. Set grade stakes, using instrument technology, at 25 foot grid interval at areas with gradients less than 2 percent.
 5. Provide all equipment of such type, function and design as required to achieve specified values. Where necessary, provide rubber tired and vibratory sheepsfoot compaction equipment.
- C. When the Geotechnical Engineer determines existing soils in excavated areas do not provide sufficient bearing capacity or are otherwise unacceptable, remove such soils as necessary to expose soils with adequate capacity and characteristics, as approved by the Geotechnical Engineer.

3.2 TOPSOIL EXCAVATION

- A. After completion of clearing and grubbing, remove existing topsoil in excavated areas of work and where fill is to be placed on existing grade. Remove topsoil to depth of 4 inches. Stockpile on site for spreading at landscaped areas.
- B. Stockpile topsoil to depth not exceeding 4 feet with 1:2 slope banks. Cover and protect from erosion.

3.3 SUBSOIL EXCAVATION

- A. Excavate soil in work areas under this contract as specified in this Section.
 1. Stockpile excavated material for reuse. Segregate material complying with specified criteria as suitable for re-use as compacted fill after completion of grading, remove unsuitable and excess soils from site in conformance with the regulations of jurisdictional authority.
- B. Excavate subsoil required to accommodate building foundation, slabs-on-grade, paving, landscaped areas, site contouring and site structures.
 1. Excavate as required to accommodate spreading of previously removed topsoil in upper 4 inches.
- C. Grade top perimeter of excavation to prevent surface water from draining into, or eroding excavation.
- D. Grade surfaces to provide positive drainage and prevent water ponding, prevent drainage onto adjoining properties and to implement the work.
 1. Provide all field engineering and layout to construct work as shown on drawings, including establishing final grades, slope transitions, drainage paths and swales, and related engineering work.
 2. Construct all drainage courses, swales, toes and tops of slopes, and related earthwork operations necessary to maintaining drainage and access as shown on

drawings or required by jurisdictional authority.

E. Excavate areas as follows:

1. All landscaped, track and playground areas.
 - a. Excavate existing soils at Area 2 to a minimum depth of 1.0 feet below existing grade or finished soil grade, whichever is lower.
 - b. At Area 3, contour site as shown on landscaped drawings and rip existing soils to a minimum depth of 1.5 feet below existing grade or finished soil grade, whichever is lower.
2. Asphalt and Concrete Paving Areas.
 - a. Excavate existing to a minimum depth of 1.0 foot below existing grade or finished soil grade, whichever is lower.
 - b. Excavate a minimum of two feet beyond paving edge.
3. Utilize excavation methods adjacent to existing structures that prevent the loss of material from beneath foundations, including concrete underpinning where required.
4. Rock Considerations:
 - a. Remove all rock of any kind, including material requiring removal by use of heavy earthwork equipment, hydro-hammers, or blasting within upper five feet of finished or existing grade, whichever is lower.
 - b. A contract adjustment will be made for removal of rock below five foot depth.
5. Prior to scarification and compaction, obtain Geotechnical Engineer review and acceptance of excavated surface, and remove additional materials as required.

3.4 COMPACTION OF EXCAVATED SURFACES

A. Prepare areas designated to receive subsequent fill and backfill materials, Portland cement or asphaltic concrete paving as follows:

1. Scarify subgrade to a depth of 6 inches.
2. Water, mix and aerate as necessary to moisture condition within 1 percent minimum to 3 percent maximum optimum moisture content.
3. Compact to a relative compaction of 90 percent based on ASTM D 1557.
4. Compact to a relative compaction of 95 percent at paving areas based on ASTM D 1557.

B. Prepare areas designated to receive landscaping as follows:

1. Scarify subgrade to a depth of 6 inches.
2. Water, mix and aerate as necessary to moisture condition within 1 percent minimum to 3 percent maximum optimum moisture content.
3. Compact to a relative compaction of 90 percent based on ASTM D 1557.

3.5 FILL PLACEMENT

- A. Place fill with specified materials at locations as scheduled below.
 - 1. Provide all cribbing, shoring, and sheathing required to perform work. Comply with all applicable regulations for design, installation, maintenance and removal of such construction products, including obtaining any required permits.
- B. Do not place fill over porous, wet, or spongy subgrade.
- C. Systematically backfill to allow maximum time for natural settlement.
- D. Use equipment and procedures outlined in Green Book Section 300-4// and as specified. Green Book Section 300-4.9 is not applicable.
 - 1. Place and compact materials in continuous layers not exceeding 6 inches compacted depth using methods which do not disturb or damage foundations, perimeter drainage and waterproofing systems, or utilities in trenches.
 - 2. Rock encountered may be broken into material complying with fill characteristics, at Contractors option. Otherwise remove all rock exceeding fill dimensions from site.
 - 3. Compact all fill material as scheduled in this Section per ASTM D 1557.
 - 4. Overfill all slope banks and compact. After compaction, trim to grade and contour as shown on drawings.
- E. Where occurs, place fill concurrently on both sides of foundation elements in maximum 6 inch compacted layers. Compact to 90 percent of maximum density per ASTM D 1557 with mechanical tampers.
- F. Compaction by flooding or jetting is prohibited.
- G. Maintain moisture content of fill materials to within 2 percent of optimum and as required to attain required compaction density.
- H. Slope grade as shown on drawings.
- I. Make grade changes gradual, blending slope into level areas. After completion of grading operation, proof roll earthwork areas. Repair low or spongy spots developed during rolling operation.
- J. Extend compacted fill to design surfaces of slopes and compact surface.
- K. Remove all excess soils and dispose off site in a legal manner.
- L. Provide all fill material required to achieve grades, slopes and contours as shown on drawings at no additional expense to Owner.

3.5 FIELD QUALITY CONTROL

- A. Geotechnical Engineer shall verify the suitability of soil materials.
- B. Field inspection and testing will be performed, supervised, and conducted by the Owners Geotechnical Engineer.

- C. Perform earthwork under the continuous observation of the Owner's Geotechnical Engineer. Earthwork fill operations shall comply with the requirements of Part 2, Title 24, CCR.
- D. Tests and analysis of fill material will be performed in accordance with ASTM D1557.
 - 1. The Geotechnical Engineer will review and approve all fill materials, including on-site materials and imported materials.
 - 2. The Geotechnical Engineer will submit reports to the Owner, and Engineer, comparing results of testing with the requirements of this section and documenting location and scope of tested materials.
- M. Compaction testing will be performed in accordance with ASTM D1556 or other referenced methods.
- N. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.7 TOLERANCES

- A. Final elevations shall comply with grades as shown on drawings.
- B. Not more than one point within any 50 x 50 foot area shall exceed required elevations, measured to a tolerance of plus or minus 0.1 feet.

3.8 PROTECTION

- A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- B. Protect finished work accordingly.
- C. Re-compact fills subjected to vehicular traffic.

3.9 DUST CONTROL

- A. Maintain all streets and public ways free of dust and mud as directed by local jurisdictional authority, including use of wash down and street sweeper equipment.

3.10 FILL SCHEDULE

- A. Site Contouring and playground/athletic areas:
 - 1. Place fill materials as required to achieve site grades and profiles as shown on drawings and as required for drainage.
 - 2. In landscaped areas, place stockpiled topsoil as the final 4 inches of fill.
 - 3. Compact to 90 percent relative compaction.
- B. Paving Areas.
 - 1. Place approved fill material, placed to depth as necessary to achieve required subgrade elevations.

2. Compact upper 6 inches to 95 percent relative compaction, and 90 percent for remainder.
- C. Fill to Correct Over-excavation:
1. Concrete as specified or fill material as directed by, and at the discretion of, the Geotechnical Engineer.

END OF SECTION

SECTION 31 30 00
ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Asphaltic concrete paving and surface sealer.
- B. Sub-base preparation.
- C. Aggregate base course.
- D. Concrete parking bumpers.
- E. Plastic parking bumpers and speed bumps.
- F. Related Section
 - 1. Section 315000, Pavement Marking.
- G. Slurry sealing.
- H. Patching and Repair of asphaltic concrete paving.

1.2 REFERENCES

- A. ASTM D1557 - Laboratory compaction characteristics of soil using modified effort.
- B. SSPWC - Standard Specifications for Public Works Construction, Latest Edition, with Special Provisions, Performance Grade Paving Asphalt
- C. AQMD Air Quality Management District, Local Regulations, Cutback Asphalt.
- D. SCAQMD – South Coast Air Quality Management District
 - 1. SCAQMD-1108 – SCAQMD Rule 1108, Cutback Asphalt
- E. CSS - Caltrans Standard Specifications, Latest Edition.
- F. ASTM D2026 - Standard Specification for Cutback Asphalt
- G. ASTM D2397 - Standard Specification for Cationic Emulsified Asphalt.
- H. ASTM D977 - Standard Specification for Emulsified Asphalt.
- I. ISSA - International Slurry Seal Association – Recommended Performance Guidelines for Emulsified Asphalt Slurry Seal, A105.

- J. ASTM D3910 - Design, Testing, and Construction of Slurry Seal.
- K. AASHTO - American Association of State Highways and Transportation Officials, AASHTO MP 1 – Performance Graded Asphalt Binders.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with Sections 200, 203 and 302, SSPWC.
- B. Obtain materials from same source throughout, using batch plant method for proportioning and mixing.

1.4 SUBMITTALS

- A. Product data, mix design per Administrative Requirements Section.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when base surface temperature is less than 40 degrees F or surface is wet or frozen.
- B. Conform to AQMD, Local Regulations.

1.6 SOILS INFORMATION

- A. Geotechnical Investigation has been prepared under direction of Owner. Investigation is hereby referenced as information for Work of this Section. Owner assumes no responsibility for conclusions Contractor may draw, from information provided. Contract Documents take precedence over recommendations that may be contained in investigation and Contractor must obtain approval for deviations from Contract Documents. Copy of investigation is available at Architect's office.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphalt Binder: AASHTO MP1, Performance Grade 64-10 South and Central Coast, Inland Valleys regions Grade 70-10, Desert regions 64-16, Mountain regions Grade 64-28NV , and shall conform to the testing requirements of Table 203-1.2 (B), Section 203 SSPWC.
- B. Asphalt Aggregate: Uniformly graded in accordance with Section 203-6.4, SSPWC.
- C. Crushed Aggregate Base (CAB): 3/4 inch maximum grading, crushed rock and rock dust conforming to requirements of Section 200-1.2, SSPWC, with 3/8 inch sieve requirement waived, or Class 2 Aggregate Base as defined in Section 26, CSS.

2.2 ACCESSORIES

- A. Primer: ASTM D2026, cutback type, slow curing, Grade SC 250. Grade SC-70 may be used when approved by Architect.
- B. Tack Coat: ASTM D977, slow setting emulsified asphalt SS-1h. ASTM D2397 for CQS-1H, slurry Seal.
- C. Seal Coat: Conform to Section 203-9, SSPWC.
 - 1. GUARDTOP by Industrial Asphalt/Vulcan Material Co., Inc., Irwindale, CA.
 - 2. SATIN SEAL by Blue Diamond Co., Long Beach, CA.
 - 3. Or equal, as approved in accordance with Division 01, General Requirements for Substitutions.
- D. Soil Sterilizer: Spike 80DF. Non-selective weed and grass killer, by Dow-AgroSciences, Indianapolis, IN, EPA Reg. No. 62719-107, or equal, as approved in accordance with Division 01, General Requirements for Substitutions.
 - 1. Active Ingredients:

a. Tebuthiuron	80 percent
b. Inert Ingredients	20 percent
	<hr style="width: 100px; margin: 0 auto;"/>
Total	100 Percent
- E. Headers: Foundation grade redwood, minimum 2 x 4 inch. Stakes shall be minimum 2 x 3 inch in accordance with Section 302-5.5 SSPWC.
- F. Raised Pavement Markers: per Section 32 17 23.

2.3 ASPHALT PAVING MIX

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Mix: Section 203-6.4 SSPWC, 1/2 inch maximum aggregate size, medium gradation curve, as required by outside temperatures at time of laying.
 - 1. Single Course: C2 (Dense Medium) or D2 Dense Fine aggregate, Performance Grade 64-10 asphalt.
 - a. Areas where hand spreading is required: Use 3/8 inch mix.
- C. Mix: Section 203-6.4 SSPWC, 3/4 inch base course, 1/2 inch surface course aggregate size.
 - 1. Base Course: B (Dense Medium Coarse), Performance Grade 64-10 asphalt.
 - 2. Surface Course: C2 (Dense Medium), Performance Grade 64-10 asphalt.
 - a. Areas where hand spreading is required: Use 3/8 inch mix.

- D. Recycled Asphalt Concrete (RAC): Reclaimed Asphalt Pavement (RAP), aggregate and asphalt per SSPWC Section 203-7.
- E. Slurry Mix Design: ISSA Type II (General) 1/4" thick.

PART 3 - EXECUTION

3.1 SUB-GRADE

- A. Bring areas to be surfaced to required subgrades by cutting and filling with suitable equipment.
- B. Scarify subgrade to minimum depth of 6 inches. Bring to optimum moisture content and compact to minimum 90 percent density in accordance with ASTM D1557 by rolling with power roller. Provide hard, even surface to receive subsequent base and paving.
- C. Finish subgrade to required grades with allowance for compression and for thickness of base course and finish paving thickness.

3.2 SOIL STERILIZATION

- A. After subgrade has been compacted and approved by Geotechnical Engineer, treat areas to be paved with specified soil sterilizer. Conform to following:
 - 1. Apply 7.5 lbs. of solution per acre for each 15 gallons of water, spray apply per manufacturer's instructions.
- B. Exercise caution during storage of material and during application. Prevent injury to humans, animal life, adjacent plant life and property. Keep soil sterilization materials minimum three feet from tree wells or any plant life.
- C. Legally dispose of containers.

3.3 BASE COURSE

- A. Place and compact aggregate base upon finished subgrade in conformance with Section 301-2 SSPWC. Compaction: 95 percent.
- B. Thickness of Base After Compaction: As indicated on Drawings but not less than 4 inches if not indicated.

3.4 PREPARATION - PRIMER AND TACK COATS

- A. Apply primer coat on base course surfaces in conformance with Section 302-5.3, SSPWC, at rate of 0.10 to 0.25 gallons per sq. yd. Allow to cure prior to application of asphalt course.
- B. Apply tack coat to contact surfaces of cold joints, curbs, gutters, manholes and adjacent materials, and over existing asphalt surfaces in conformance with Section 302-5.4, SSPWC.
- C. Coat surfaces of catch basin frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.5 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install redwood headers.
- B. Place asphalt in conformance with Section 302-5, SSPWC. Conform to temperature maximums and minimums specified therein. Materials shall not be applied which have cooled below lower limit allowable.
 - 1. Install 3/8" mix for single course asphalt payment.
- C. Place to thickness as indicated on drawings but not less than 3 inches if not indicated.
- D. Install drainage grilles and frames in correct position and elevation.
- E. Compact pavement by rolling with equipment specified in Section 302-5.6, SSPWC. Do not displace or extrude pavement from position.
- F. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks, rock pockets, ridges or depressions.

3.6 SEAL COAT

- A. Apply seal coat 30 days or more after surface course application, in accordance with manufacturer's recommendations.
- B. Apply seal coat to surface course in accordance with Section 302-8.2, SSPWC.
- C. Add water to specified seal coat material. When air temperatures of 90 degrees F or more are encountered during application, consult manufacturer for recommendations.
- D. If pavement surface exhibits imperfections noted Placing Asphalt Pavement above, as determined by the Architect, the addition of sand aggregate to seal coat, and amounts thereof, shall be as recommended by the manufacturer.
- E. A second application shall be made after first coat has dried to the touch. When sand is added to the first seal coat, two additional coats without extra sand shall be applied.
- F. Allow seal coat to dry before permitting traffic or striping.

3.7 SLURRY SEALING

- A. Prior to slurry application, repair areas and major depressions, wide cracks filled, remove dust, dirt and other foreign material from the surface.
- B. Apply a tack coat of diluted emulsified asphalt of same type and grade specified for the slurry.
- C. Apply slurry in accordance with [ASTM D-3910], the Asphalt Institute Standards and the International Slurry Seal Association. Minimum thickness of 1/4".

3.8 PARKING BUMPERS

- A. Securely attach precast concrete parking bumpers into pavement with two 5/8 inch diameter galvanized solid rod anchors. Extend anchors 24 inches into ground. Apply adhesive to underside of concrete bumpers, as recommended by the manufacturer.

3.9 SPOT PATCHING AND REPAIRS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Scarify and recompact the upper 12 inches of subgrade to 95% of maximum density. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
 - 3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.10 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From True Elevation: Within 1/2 inch.

3.11 PROTECTION

- A. Protect asphalt paving against vehicular traffic before and for 48 hours following seal coating.

END OF SECTION

SECTION 31 40 00
SITE CONCRETE WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Cast-In-Place concrete pedestrian paving and sidewalks.
2. Curbs and gutters.
3. Concrete stairs, ramps and landings.
4. Light standard bases, fence post bases, flagpole bases, monument sign, railing footings and similar site structures.
5. Utility concrete pads.
6. Perimeter concrete curbing, mow strips, concrete drainage structures, swales.
7. Slurry Concrete.

1.2 REFERENCES

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.**
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary, 2003 Edition.**
- C. ASTM - American Society for Testing and Materials**
1. ASTM A185 - Steel Welded Wire Reinforcement, Plain, for Concrete
 2. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 3. ASTM C33 - Concrete Aggregates
 4. ASTM C94 - Ready-Mixed Concrete
 5. ASTM C150 - Portland Cement
 6. ASTM C171 - Sheet Materials for Curing Concrete
 7. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
 8. ASTM C920 - Elastomeric Joint Sealants
 9. ASTM C979 - Pigments for Integrally Colored Concrete
 10. ASTM C1107 - Packaged Dry, Hydraulic - Cement Grout (Non-Shrink)
 11. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete, Paving and Structural Construction
- D. CBC - 2013 California Building Code and Supplements**
1. CBC-11 – CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing
 2. CBC-17 – CBC Chapter 17, Structural Tests and Special Inspections
 3. CBC-19 – CBC Chapter 19[A], Concrete

- E. CACRM - California Accessibility Compliance Reference Manual, updated based on 2013 California Building Code

1.3 SUBMITTALS

- A. Placement Schedule for approval: Provide details or sketches showing location of each placement of concrete Work. Do not deviate from location of expansion joints or scorelines.
- B. Product data on joint filler, sealants, curing compounds and reinforcing.
- C. Project Record Documents
 - 1. Accurately record actual locations of embedded sleeves, utilities and components that are concealed from view.
- D. Submit Certification of experience for Color, Stain, Aggregate finisher.

1.4 REGULATORY REQUIREMENTS

- A. Pedestrian walks, plazas and paving shall comply with CBC-11B, Sections 1133B.7.1.1, and 1133B.7.2. Architect has relied on CACRM published by DSA in its interpretation of these regulations.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of all records on site.
- B. Acquire cement and aggregate from same source for all Work.
- C. Conform to Section 1905A.13, California Building Code, when placing concrete during hot weather.
- D. Conform to Section 1905A.12, California Building Code, when placing concrete during cold weather. No placement of concrete permitted below 50 degrees Fahrenheit.
- E. Mock-up
 - 1. Install minimum 5 feet by 5 feet mock-up of concrete sidewalk for each surface treatment specified.
 - 2. Install mock-up one month prior to installation.
 - 3. Locate as approved by the Architect.
 - 4. Use identical forming system, sub-grade type, reinforcing, expansion joints, score joints, finishing and edge trim as specified for installation.
 - 5. Owner approval required.
 - 6. Mock-up may not be used in final installation.
 - 7. Remove mock-up materials from site and dispose legally.

1.6 EXTENDED WARRANTY

- A. Manufacturer shall warrant prefabricated detectable warning texture products against failure in materials or workmanship for at least the specified warranty periods. Upon written notice from Owner manufacturer shall promptly, without cost, and with least practicable inconvenience to Owner correct such defects.
 - 1. Failures include, but are not limited to, significant degradation in color fastness, conformation, sound-on-cane acoustic quality, resilience, and attachment will not degrade significantly.
 - a. Significant degradation means that product loses 10 percent or more of its approved design characteristics, as determined by the authority having jurisdiction.
 - 2. Minimum Warranty Period: 5 years from date of Certified Completion.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150 - Type I - Normal or Type II - Moderate, Portland Cement type, from one manufacturing plant only. Color for exposed matrix: White cement for exposed aggregate finishes and colored concrete per Section 03 35 00.
- B. Aggregates: ASTM C33, single source for all materials. Maximum size aggregate: 1 inch.
- C. Non-Shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 4,000 psi in 24 hours and 7,500 psi in 7 days unless otherwise indicated on Drawings; of consistency suitable for application and a 30 minute working time.
- D. Threshold and landing mortar: Ardex Poly-Top, Mapei Quickcem Top 101 or equal.
- E. Crushed Aggregate Base: As specified in Section 32 12 16. Crushed rock and rock dust conforming to requirements of Section 200-1.2, SSPWC, with 3/8 inch sieve requirement waived, or Class 2 aggregate base as defined in Section 26, CSS.

2.2 ACCESSORIES

- A. Expansion Joints:
 - 1. Expansion Joint Filler - ASTM D1751: Close cell bituminous saturated fiberboard, 1/2 inch max. thick; FIBER EXPANSION JOINT manufactured by American Highway Technology, Kankakee, IL, W. R. Meadows, or approved equal.
 - 2. Joint Devices: Integral extruded polystyrene plastic; 1/2 inch max. thick, with removable top strip exposing sealant trough; JOINT CAPS.

3. Sealant: Polyurethane two-component type, self-leveling, for level surface application, UREXPAN NR-200 or DYNATRED for sloped surfaces, manufactured by Pecora Corp., Harleysville PA, or equal. Color shall be selected by Architect from manufacturer's standard list of colors.
 4. Primer: As recommended by sealant manufacturer.
 5. Joint Backing: ASTM C1330, Cylindrical, Type C, closed cell, polyethylene backer rod; oversized 30 to 50 percent larger than joint width. Green Rod by Nomaco Inc. or equal.
- B. Slip Resistant Finish: Dry shake type aluminum oxide abrasive grains, hardness No. 9 on Mohr's scale; Emery Non-slip, manufactured by Dayton Superior, Kansas City, KS, Emery Aggregate manufactured by Oregon Emery Co., Halsey OR, or equal as approved in accordance with Division 01, General Requirements for Substitutions.
- C. Detectable Warning Texture: County of San Bernardino approved products shall be used, compliance with CBC Sections 1133B.8.3 through 1133B.8.5, IRs 11B-3 and 11B-4 and the California Accessibility Reference Manual.
1. Truncated Domes: provide raised Detectable Warnings with diameter of 0.9 inch at base tapering to 0.45 inch at top, height of 0.2 inch, with center-to-center spacing of 1.67 inches and corner domes spaced at 0.896 inch from the corner edges of tile. Provide raised truncated domes in a square grid (in-line) pattern.
 - a. Truncated Dome: shall contrast visually with adjoining surfaces, light-on-dark or dark-on-light. Material used to provide contrast shall be integral part of walking surface. Warning surface shall differ from adjoining surface in resiliency or sound to cane contact.
 2. Detectable Warning Texture (Truncated Domes): Paver Tiles: 12 by 12 inches unless noted otherwise on drawings, with pre-formed fastener locations.
 - a. Pavers: Refer to Section 32 14 13

2.3 CONCRETE MIX

- A. Mix and deliver concrete in accordance with Section 1905A, California Building Code. Deliver concrete in transit mixers only. Mix concrete for 10 minutes minimum at a peripheral drum speed of approximately 200 feet per minute. Mix at jobsite minimum 3 minutes. Discharge loads in less than 1-1/2 hours or under 300 revolutions of the drum, whichever comes first, after water is first added.
1. Design Mix:
 - a. Conform to Section 1905A.3, 2013 California Building Code for Proportioning on the basis of field experience or trial mixtures method.
 - b. Conform to Section 1905A.2 for Selection of concrete proportions method. Selection of concrete proportions and ingredients for design mix by a County of San Bernardino approved Testing Laboratory and certified by a registered civil engineer licensed in California.

2. Do not exceed 0.50 water-cement ratio by weight for floor slabs and for other concrete.
3. Quantities of Materials: Weighmaster's records not required for sitework concrete.
4. Required Strength: Minimum 2,500 psi for sitework concrete.

B. Slurry Concrete:

1. Slump: Between 4 inches and 6 inches.
2. Aggregate: 40 percent sand by weight, 60 percent pea gravel, minimum 1/4 inch, maximum 5/8 inch.
3. Portland Cement: ASTM C150, 2 sack mix.

2.4 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615; 60 ksi yield grade; deformed billet steel bars, uncoated finish.
- B. Welded Wire Reinforcement: Plain type, ASTM A185; in flat sheets; uncoated finish, 6 x 6 - W4.0 x W4.0 unless otherwise note on drawings.
- C. Tie Wire: Annealed steel, minimum 16 gage size.
- D. Dowels: ASTM A615; 60 ksi yield grade, plain steel, uncoated finish.
- E. Secondary Fibrous Reinforcement:
 1. Collated, fibrillated, polypropylene fibers for secondary reinforcement of concrete slabs with length varying from 1-1/2 to 2 inches or nylon filamentized fibers of 3/4 inch length meeting requirements of ASTM C1116, Type III, by Forta, Forta Corp., or equal.

2.5 FORMS

- A. Conform to Section 1906A.1 and 1906A.2, California Building Code.
- B. Plywood Forms: APA - Medium density overlay, Group 1, Exterior, PS-1, for exposed surfaces. APA Plyform B-B, Class 1, Exterior, PS-1 for unexposed surfaces.
 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- C. Lumber: Douglas Fir species, construction grade, Surfaced Lumber, with grade stamp clearly visible for smooth and straight exposed surface.
- D. Form Release Agent; commercially formulated form-release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.6 CURING MATERIALS

- A. Polyethylene Film ASTM C171; 10 mil thick, clear, manufactured from virgin resin with no scrap or additives, manufactured by Burke-Edoco, Long Beach, CA, or equal as approved in accordance with Division 01, General Requirements for Substitutions.
- B. Water: Potable and not detrimental to concrete.
- C. Curing Compound: ASTM C309, Type 2, Class A; wax resin base, Burke Wax Emulsion White curing compound, by Burke-Edoco, Euclid Chemical Co. or equal as approved in accordance with Division 01, General Requirements for Substitutions. Curing materials and procedures for colored concrete in accordance with coloring material manufacturer's recommendations.
- D. Curing Compound: ASTM C309, Type1-D, Class B; water-based, All-Resin Curing Compound-Clear with red fugitive dye, by Burke-Edoco, Euclid Chemical Co. equal. Curing materials and procedures for colored concrete in accordance with coloring material manufacturer's recommendations.
- E. Curing Compound for Colored Concrete: ASTM C309, Type1, Class B; Water-base all resin curing compound-clear, by Burke-Edoco, Euclid Chemical Co. or equal. Curing materials and procedures for colored concrete in accordance with coloring material manufacturer's recommendations.

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, positioned securely and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is doveled to existing Work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.3 PLACING CONCRETE (GENERAL)

- A. Convey and deposit concrete in accordance with Section 1905A.9 and 1905A.10, California Building Code. Remove loose dirt from excavations.

- B. Notify Project Inspector minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and accessories are not disturbed during concrete placement.
- D. Ensure sub-base or base materials have been compacted or otherwise treated.
 - 1. Remove unsuitable soil, backfill with clean compactable soil or approve granular material to required elevations.
 - 2. Scarify exposed natural sub-base to depth of 6 inches. Bring to optimum moisture content and re-compact to 90 percent in accordance with ASTM D 1557.
 - 3. Add approved aggregated base to required elevation in 6 inch maximum lifts. Bring to optimum moisture content and compact to 90 percent in accordance with ASTM D1557.
- E. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.
- F. Place concrete continuously between predetermined expansion joints.
 - 1. Install expansion joints at vertical concrete walls at 24 feet on center unless noted otherwise on drawings.
- G. Do not interrupt successive placement; do not permit cold joints to occur. Avoid segregation of materials. Perform tamping and vibrating so as to produce a dense, smooth application free of rock pockets and voids. Do not use vibrators to move concrete horizontally.
- H. Do not allow concrete to fall free from any height which will cause materials to segregate. Maximum height of free fall permitted in any case: 5 feet.
- I. Defective Installation: Repair and clean at Contractor's expense all concrete damaged or discolored during construction. Where concrete requires repair before acceptance, the repair shall be made by removing and replacing entire section between joints and not by refinishing the damaged portion.
- J. Proper curing of concrete surfaces is the responsibility of the Contractor. Concrete failing to meet specified strength shall be removed and replaced.

3.4 ON-SITE CONCRETE SIDEWALKS, PEDESTRIAN PAVED AREAS AND RAMPS

- A. Forms, Wood: Free from warp, with smooth and straight upper edges, surfaced one side, minimum thickness 1-1/2 inches adequate to resist springing or deflection from placing concrete.
- B. Forms, Metal: Gage sufficient to provide rigidity and strength equivalent to wood.
- C. Reinforcing Steel: # 4 bars, place bars at 12 inches on center each way for sidewalks and paved areas and #4 bars for edges unless otherwise indicated on Drawings.
- D. Reinforcement: Provide welded steel wire fabric, 6 inches by 6 inches, No. 10 gage at middle of slab for sidewalks and ramps. Interrupt reinforcement at expansion joints.

- E. Concrete Placement: Dampen subgrade to retain moisture in concrete mix. Tamp and spade to consolidate concrete for entire length of pour. Strike off upper surface to specified grades.
- F. Isolation Joints: Locate at slabs abutting vertical concrete surfaces and as patterned on drawings. Install vertically, full depth of concrete with preformed joint filler recessed for plastic cap at 1/2 inch depth at top for sealant application.
1. Doweled Isolation Joints at Heavy Vehicle Driveways and Parking: At abutting building foundations; provide 1/2-inch diameter smooth steel dowels 14 inches long, one end of dowel lubricated and set in capped sleeve to allow for longitudinal movement, spaced at 24 inches on center maximum, 6 inches from edges.
 2. Monolithic Curb and Gutter: No expansion joints required between gutter and curb face.
- G. Expansion Joints: Locate maximum 24 feet centers and as patterned on drawings. Install vertically, full depth of concrete, install preformed joint filler recessed for plastic cap at 1/2 inch depth at top for sealant application.
1. Monolithic Curb and Gutter: No expansion joints required between gutter and curb face.
- H. Contraction/Crack Control Joints: At 8 feet each way at concrete paved areas, and 5 feet at sidewalks, tool joint with 1/2 inch radius, depth 1/4 the thickness of slab but not less than 1 inch deep. Refer to drawings for required design patterns.
- I. Curb Ramps: Form grooves, flush to finished surfaces, 12" wide border. Grooves at 1/4" deep, 1/4" wide and at 3/4" on centers. at 3 sides on level surface of the sidewalk. Provide patterns as indicated in drawings. Detectable Warnings at Curb Ramps per IR 11B-2 and 11B-3, 11B-4 CBC 1127B.5.7.
1. Detectable warning (Truncated Domes) required at curb ramps less than 1:15 (6.7% slope)
 2. Detectable Warnings (Truncated Domes) required at all Curb Ramps, American with Disabilities Act Standards for Accessibility Design Section 4.7.7.
 - a. Set Paver Truncated Dome products in full mortar bed per Section 32 14 13 Unit Pavers and as indicated on drawings.
 - b. Form bottom edge flush and free of abrupt changes.
- J. Finish:
1. Screed concrete to required grade, float to a smooth, flat, uniform surface. Edge all headers to 1/2 inch radius. Edge expansion joints to 1/4 inch radius. Steel trowel to hard surface.
 2. Grades less than 6 percent: shall conform to Section 1133B.7.1.1. After final troweling, apply a medium broom finish transverse to centerline or direction of traffic. Finish shall be at least as slip resistant as that described as a medium salted finish.

3. Grades exceeding 6 percent: shall conform to Section 1133B.7.1.2. After final troweling, apply a heavy broom finish transverse to centerline or direction of traffic
 4. Walkway grades in excess of 5 percent shall conform to requirements of Section 1133B.7.3, California Building Code.
 5. Concrete slabs indicated to receive paving units, DETECTABLE WARNING AND DIRECTIONAL TEXTURE: Wood float to grades required for pavers.
- K. Curing: Cure surfaces utilizing one of the following methods:
1. Spraying: Spray water over slab areas and maintain wet for 7 days, use burlap mats.
 2. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
 3. Apply liquid curing compound at rate of 200 sf per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units of any kind.
- L. Remove expansion joint plastic caps. Prime both sides of joint and apply self-leveling sealant per Section 07 92 00. Provide smooth concave surface.
- M. Detectable Warnings AT BOARDING PLATFORMS. Comply with CBC Sections 1133B.8.3, 1133B.8.4.and 1133B.8.5.
1. Set paver products in full mortar bed per Section 32 14 13 Unit Pavers and as indicated on drawings.

3.5 SLIP RESISTANT FINISH

- A. Apply slip resistant finish in accordance with manufacturer's instructions on concrete ramp surfaces with slope in excess of 6 percent and all formed concrete stairs and landings:
1. Float and trowel concrete once and allow to set until surface will support finisher's supports.
 2. Uniformly distribute grains over surface at the rate of 50 lbs. per 100 square feet.
 3. Imbed grains with a light wood float.
 4. Apply a light steel float. Do not trowel excessively. Grains shall remain visible in a uniform pattern.

3.6 LIGHT STANDARD BASES, FENCE POST BASES, FLAGPOLE BASES, RAILING FOOTINGS, MISCELLANEOUS SURFACES, UTILITY PADS, AND SIMILAR SITE STRUCTURES.

- A. Forms: Suitable material and type, size, shape, quality and strength to insure construction as designed, true to line and sufficiently rigid to resist deflection during placing of concrete. Clean forms of all dirt, mortar and foreign matter before use.

- B. Reinforcement: Place accurately and hold in position, using metal chairs, spacers, metal hangers, supporting wires and other devices of sufficient strength to resist crushing under full load. Clean reinforcing steel of mortar, oil, dirt, loose mill scale loose or thick rust and coatings.
- C. Coordinate installation of conduits, cast in place items and other inserts.
- D. Finish: Grind or sack as required as determined by the Architect to produce a smooth, straight, plumb and acceptable finish without burrs or form marks. For horizontal surfaces: provide float finish.
- E. Curing: Cure surfaces utilizing one of the following methods:
 - 1. Spraying: Spray water over slab areas and maintain wet for 7 days.
 - 2. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
 - 3. Apply liquid curing compound at rate of 200 square feet per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units or finish of any kind.
- F. Flagpole bases: refer to Section 10 75 00, Flagpoles for size of footings and cast in place items supplied by that section.

3.7 FORMED CONCRETE STAIRS AND LANDINGS

- A. Subgrade Preparation: As approved by the Geotechnical Engineer.
- B. Forms: Suitable material and type, size, shape, quality and strength to ensure construction as designed, true to line and sufficiently rigid to resist deflection during placing of concrete. Clean forms of all dirt, mortar and foreign matter before use.
- C. Reinforcement: Place accurately and hold in position, using metal chairs, spacers, metal hangers, supporting wires and other devices of sufficient strength to resist crushing under full load. Clean reinforcing steel of mortar, oil, dirt, loose mill scale, loose or thick rust and coatings.
- D. Finish: Steel trowel surfaces treated with Slip Resistant Finish sufficiently to allow particles to extend slightly above finish surface.
 - 1. Slip Resistant Finish: Apply in accordance with manufacturer's instructions on surfaces at a minimum rate of 50 lbs. per 100 square feet.
 - 2. Owner's Option in lieu of Slip Resistant Finish:
 - a. Apply Medium Broom Finish.
 - b. Apply Heavy Broom Finish.
- E. Curing: Cure surfaces utilizing one of the following methods:
 - 1. Spraying: Spray water over slab areas and maintain wet for 7 days.

2. Contractor's Option
 - a. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
 - b. Apply liquid curing compound at rate of 200 square feet per gallon, using power sprayer equipped with agitator.
- F. Install anti-slip tape at existing concrete stairs, all treads.
- 3.8 CURB AND GUTTER, PERIMETER CONCRETE CURBING, MOW STRIPS, CONCRETE DRAINAGE STRUCTURES, SWALES.
 - A. Subgrade Preparation: Subgrade material, base material and compaction requirements as approved by the Geotechnical Engineer.
 - B. Forms: Single face type required, cut to conform exactly with face batter and radius, sufficiently rigid to resist springing or deflection from concrete placement. Clean forms of all loose dirt, mortar or similar materials and apply a light coating of oil or other suitable material prior to concrete placement.
 1. Slip Forms: Contractor's option upon approval of the Architect.
 - C. Reinforcement: Refer to drawings for size and spacing. Interrupt reinforcement at expansion joints.
 - D. Concrete Placement: Dampen subgrade to retain moisture in concrete mix. Tamp and spade to consolidate concrete to entire length of pour. Strike off upper surface to specified grades. Cut drain pipes to conform to curb batter.
 - E. Expansion Joints: Locate joint filler at maximum 20 foot centers. Trim off excess filler material flush to finish surface. No sealant application required.
 - F. Control Joints: at 8 feet on center, tooled joints, 1/2 inch radius.
 - G. Finish: Apply thin layer of mortar of 1 part portland cement to 1-1/2 parts sand to exposed faces. Trowel to a smooth and even finish with a fine hair broom applied parallel with the line of the work. Round all edges to 1/2 inch radius. No Contractor identification permitted.
 - H. Curing: Cure surfaces utilizing one of the following methods:
 1. Spraying: Spray water over curb and gutter and maintain wet for 7 days.
 2. Spread polyethylene film over areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
 3. Apply liquid-curing compound at rate of 200 sf per gallon, using power sprayer equipped with agitator.

3.9 FINISH AT EXPOSED VERTICAL SURFACES

- A. Rubbed Finish: Apply the following to smooth-formed finished concrete:
1. Grout-Cleaned Finish (Sack-rubbed finish): Remove fins, rough spots, stains, and hardened mortar by carefully rubbing with a fine abrasive stone to a smooth even surface. Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 2. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- A. Sandblast Finish: Light sandblast or Medium sandblast where plywood or other smooth forms have been used, uniformly sand-blasted with sharp quartz sand under sufficient air pressure. Such surfaces shall be thoroughly washed with clear water after sandblasting.

3.10 BUILD-UP CONCRETE AT DOOR TRESHOLDS FOR ACCESSIBILITY COMPLIANCE

- A. Remove concrete areas as indicated on drawings.
- B. Install Threshold and Landing Mortar at front of doors, 72 x 60 refer to drawings inches, level area, and edges to ramp to a maximum slope of 5%.

3.11 TOLERANCES

- A. Construction tolerances shall not violate dimensions, grades, slopes required by CBC for accessibility requirements. Adjust work accordingly to comply with requirements.
- B. Comply with tolerances of ACI 117 and as follows:
1. Maximum deviation of 1/8 inch in 10 feet.
 2. Elevation: 1/4 inch (6 mm).
 3. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
 4. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/8 inch (3 mm).
 5. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).
 6. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).

7. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
9. Joint Spacing: 3 inches (75 mm).
10. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
11. Joint Width: Plus 1/8 inch (3 mm), no minus.

END OF SECTION

NOT FOR BID

SECTION 31 50 00
PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
Curb marking and red curbs.
- C. Related Sections
Section 314100: Site Concrete Work

1.2 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings, indicating location, extent, color and texture of markings.
- B. Material Samples: Submit color Samples.

1.3 PROJECT CONDITIONS

- A. Do not install
 - 1. Parking stripes, markings and accessibility symbols, as indicated.
 - 2. Fire lane/curb "No Parking" and Related Markings.
 - 3. Section 313000: Asphalt Concrete Paving
 - 4. markings when adverse weather conditions are forecasted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Paint: Water emulsion-based Dura-Strip paint as manufactured by TMT-Pathway, or equal.

PART 3 - EXECUTION

3.1 PAVEMENT MARKINGS

A. Application of Paint:

1. Prior to application of paint, allow the pavement to properly cure. Clean and prepare in accordance with paint manufacturer's written recommendations.
2. Provide mechanical equipment to install paint in a uniform, straight or curved pattern, without holidays and other defects.
3. Do not permit traffic until paint has completely cured.
4. Install 2 coats in thickness recommended by manufacturer.

B. Marking Width and Color: Unless indicated otherwise, marking width and color are as follows:

	<u>Width</u>	<u>Color</u>
1. Parking stall lines	4 inches	White
2. Traffic markings	4 inches	Yellow
3. Striping:		
a. General	4 inches	Yellow
b. Disabled	4 inches	Blue equal to Color No. 15090 per Federal Standard 595B
4. Disabled emblem	2 inches	White on blue background. Blue equal to Color No.15090 per Federal Standard 595B.

3.2 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 apply to this section
- B. Section Includes:
 - 1. Chain link fences and gates as indicated.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit plans and details indicating extent of fences, locations of gates, and details of attachment and footings. Indicate means and methods for surface preparation and finishing.

1.3 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Class 500-C-2500 concrete furnished as prescribed in Section 201-1 "Concrete, Mortar and Related Materials" of the Standard Specifications for Public Works Construction or may be provided in the following volumetric proportions:

Portland Cement	1 part
Fine Aggregate	2 parts
Coarse Aggregate (1/4 inch to 1-1/2 inches)	4 parts
Water	7-1/2 gallons, maximum per sack of cement

- B. Chain Link Fence Fabric: Conforming to ASTM A 392, Class C2 zinc coating, 2.00 ounces minimum per square foot of uncoated wire surface, hot-dipped galvanized after weaving, and top and bottom edges knuckled.
 - 1. Fabric for perimeter fencing and interior fencing shall be 9 gauge woven wire with 2 inch mesh, unless otherwise specified.

2. Fences 12 feet high or less shall be furnished with single width fabric.
 3. Fabric for fencing on top of handball court shall be 9 gauge wire minimum with 1 inch mesh.
- C. Posts, Top Rails, Brace Rails and Gate Frames: Standard weight, galvanized, welded or seamless steel pipe conforming to ASTM A 53, with a minimum yield strength of 50,000 psi. Embed posts into footing as detailed on drawings.
 - D. Schedule of Posts and Footings:
 - E. Post Caps: Malleable iron, ASTM A 47, Grade 32510, designed to fit snugly over posts with a minimum projection of 1-1/2 inches below top of posts. Post caps shall be manufactured with a curved top.
 - F. Eye Tops: Malleable iron, ASTM A 47, Grade 32510, designed to fit over line posts, and for through passage of top rail.
 - G. Expansion Sleeve Couplings for Top Rails: Steel, 6 inches long, designed to fit tightly on inside of rail, fitted with raised center.
 - H. Rail Ends for Top Rails and Brace Rails: Malleable iron, ASTM A 47, Grade 32510, with holes to receive 3/8 inch bolts for securing to rail end bands.
 - I. Tension Bands and Bands for Securing Rail Ends: Mild steel flats, at least 11 gage x one inch, tension bands in gates shall be 11 gage x 1 inch. Bolts for use with tension bands and rail end bands shall be 3/8 inch x 1-1/2 inches.
 - J. Tension Bars: Mild steel flats at least 3/16 inch x 3/4 inch.
 - K. Tension Wire for Installation at Bottom of Fabric: 6 gauge steel spring wire, conforming to requirements of AISI Steel Products Manual, Carbon Steel Wire, Section 16, merchant quality, galvanized, soft temper with Type I coating. Wavy type wire is not acceptable.
 - L. Turnbuckles for installation with Tension Wires: Eye and hook type, drop forged steel, right and left hand threads, at least 3/8 inch screw diameter with at least 4-1/2 inches of take-up.
 - M. Tie Wire: Aluminum ties 6 gauge for fastening fabric to posts, top rails and brace rails. At bottom tension wire 9 gauge galvanized hog rings shall be installed.
 - N. Finish of Metal Parts: Post caps, couplings, rail ends, tension bands, tension bars, turnbuckles, rivets, bolts, and other metal parts and fittings shall be hot-dipped galvanized after fabrication, except bolts, which may be galvanized or cadmium-plated. Galvanizing shall conform to ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, and ASTM A 47 Standard Specification for Ferritic Malleable Iron Castings.
 - O. Provide plastic vertical privacy slats, 90% privacy type in frame and gates.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fences to heights indicated on Drawings.
- B. Space fence posts at equal intervals between terminal, angle, corner, and gate posts, and not more than 10 feet apart measured from center to center of posts. In curved fence sections having a radius of 50 feet or less, space posts not more than 5 feet - 6 inches apart. Install posts so that top of eye of post caps are level with top of fabric.
- C. Install angle or corner posts at each change in direction of 15 degrees or more, at change of 5 percent or more in grade of fencing, and at the beginning and end of curved fence sections.
- D. Install terminal posts at ends of runs of fencing. Install gateposts on both sides of driveway and pedestrian gates. For double-leaf gates, net opening between gate posts shall be gate size as indicated on Drawings, plus 3-1/2 inches; for single leaf gates, net opening shall be gate size plus 2-1/2 inches.
- E. Where a fence is to be installed on a curb, construct footings with top of footing level with the lower finish grade. Align posts, set plumb and true before placing footings. Remove splattered concrete from exposed pipe surfaces while concrete is still soft. In bituminous surfaced areas, install seal coat on top of concrete footings.
- F. Install fences with top rail. Top rail shall pass through eye tops and be secured at ends with rail-end fittings and bands.
- G. Provide full length horizontal mid-rail set at mid-height of fence and rigidly secured to posts with rail end fittings and bands.
- H. Provide brace rails at angles, corners, and terminals at 1/4 and 3/4 of fence height. Provide one horizontal brace rail in panels adjacent to terminal, angle, corner, and gateposts, install at mid-height of fence and rigidly secured to posts with rail end fittings and bands.
- I. Provide a transom rail and fabric at top of pedestrian gate openings. Install transom rail 6 feet - 8 inches above high point of grade at gate opening. Ends of transom rails shall be pinned or riveted to rail end fittings with 1/4 inch mild steel rivets. Pin or rivet must go through rail and peen. Welding on rail ends is not permitted.
- J. Install bottom tension wire a minimum of 3 inches from grade for fencing, and provide a turnbuckle for each 150 feet of wire or fractional part thereof. Turnbuckles are not required in runs of 15 feet or less. Install ends of tension wires to posts in a manner to prevent slipping or loss of tension. Wrap should start from fence side of post. Turn end of wire around post tightly twisted at least 3 times around wire. At turnbuckles, wire through eye and tightly twist end at least 3 times around wire. Cut tail of bottom wire flush.

- K. Install fence fabric on outward facing side of posts, except for tennis courts. Install fence fabric with top edge projecting above top rail of fence.
- L. Install bottom of fence fabric to clear finish grades, except on bituminous surface install 3/4 inch above such surface. Locally shape and trench ground surfaces where necessary to provide uniform top and bottom alignment of fence.
- M. Tightly stretch fabric and at terminal, pull corner, angle, and gateposts, secure with tension bars extending full height of fence. Secure tension bars to posts with bolted tension bands spaced not more than 14 inches apart.
- N. Bands and Ties: Install bands and ties in accordance with following schedule:
- | | |
|---------------------------|--------------------------|
| 15 bands on 16 feet fence | 16 ties on 16 feet fence |
| 11 bands on 12 feet fence | 12 ties on 12 feet fence |
| 7 bands on 8 feet fence | 7 ties on 8 feet fence |
| 6 bands on 6 feet fence | 6 ties on 6 feet fence |
| 4 bands on 4 feet fence | 4 ties on 4 feet fence |
- O. Fasten fabric to line posts with wire ties spaced not more than 16 inches apart. Where 6 gauge aluminum ties are furnished, hook the tie at both ends. Installation of hooked ties with links is not permitted.
- P. Fasten fabric to top rails, mid-rails, brace rails, with wire ties spaced not more than 18 inches apart. Bend back ends of tie wires so as not to be a hazard. At bottom tension wire, install hog rings spaced not more than 18 inches apart. Where 2 fabrics are furnished, lap the fabrics one mesh at mid-rail and tie both fabrics with 9 gauge wire or 6 gauge aluminum ties to midrails.
- Q. Grind all field welds smooth, clean off flux and spatter, damaged galvanizing removed, burrs and projections ground off, properly prepared, then heavily coated with "Rust Bullet" as manufactured by Poliflex USA or equal product approved by Owner's Office of Environmental Health and Safety. Install coating in accordance with written recommendations of manufacturer.
- R. Fabrication of Gates:
1. Frames: Fabricate gate frames from steel pipe of size specified, with joints at corners miter cut and continuously welded to sides.
 2. Fabric: Install fence fabric to side members with tension bars and tension bands as specified, spaced not more than 14 inches apart. Tension bars shall extend full height of gate. Install fence fabric to top and bottom members and to brace rail with wire ties as specified for top rails, spaced not more than 12 inches apart.
 3. Latches: Weld gate latches and strikes to gate posts and frames. Welding shall be performed before gate frames are galvanized, or welds shall be finished as specified for field welds.
 4. Hinges: Install and adjust hinges; burr or center punch threads of gate hinge bolts to prevent removal of nuts. Install 3 hinges on each post for swing gates.
 5. Grind welds flush and smooth. Hot-dip galvanize fabricated parts after welding, or finish weld as specified for field welds.

3.2 INSTALLATION OF GATES

- A. Provide gates of the sizes indicated on Drawings. Allow clearance on gates of 1-1/2 inches at bottom and one inch at top. Construct gates installed in sloping areas to conform to the grade. Provide an opening in each gate for access to locking device or padlock. Knuckle ends of fabric cut for opening to eliminate hazards.

3.3 COMPLETION

- A. Completed fencing shall form continuous units between points indicated with required parts, accessories, and fittings provided and installed. Clean exposed metal surfaces of cement, grout and other foreign substances.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION