

Franklin Elementary School District

November 30, 2023

TK & Kinder Building Additions

Site Development - Rebid

PROJECT NUMBER: #23-01-02

ADDENDUM NO. 1

TO ALL PROSPECTIVE BIDDERS:

Please incorporate the following revisions as part of the contract documents for subject project. Any workmanship and/or materials involved shall be set forth in the original drawings and/or specifications unless otherwise directed herein.

ADDENDUM ITEM

Bidder
Questions

1. **Question:** Is there an Engineer's Estimate available?
Answer: Yes, the Engineer's Estimate is \$750,000 Base Bid and \$1,000,000 if all bid alternates are selected.
2. **Question:** The technical specifications are missing division 26 electrical & 27 telecommunications.
Answer: Refer to Item 1.1 below for all electrical specifications.
3. **Question:** Is the District planning on requesting support from Sutter County for this project.
Answer: Yes. Franklin Elementary School District has reviewed the project with Sutter County Planning staff and plans on asking Sutter County to assist with funding of all or part of the work planned within the Franklin Road Right of Way. To facilitate Sutter County's participation in the project and quantify the value of the work planned within the Franklin Road Right of Way, we have revised the bid form to include an identification of the Contractor's breakdown of the work to be performed within the Franklin Road Right of Way. The value of the work identified on the bid form as the value of the work within the right of way is to be included in the base bid value submitted.
4. **Question:** The plans and specifications call for different data cabling requirements, please confirm what data cabling standard is to be used
Answer: Provide all CAT6A cabling as described in Specification 26 71 13 Section 1.04 System Description. Disregard reference to CAT6e performance criteria in Section 2.06 A.1.d.

4. **Question:** There is a discrepancy between Specification Section 32 31 13 and plan detail 15/A0.5. Please confirm chain link fencing requirements.
Answer: Where differences occur between detail 15/A0.5 and Specification Section 32 31 13, the Specification requirement should be followed.

5. **Question:** Notes on the irrigation pages indicate that we are to replace the existing controller, but the irrigation legend shows 2 controllers are to be installed. Please clarify.
Answer: One controller is to be replaced. Description is clarified in Addendum#1.

6. **Question:** Is there a plan holders list that can be shared?
Answer: No. The District did not require registration to receive plans, but we have included the sign-in sheets for the non-mandatory site walk for this and the previous project bid.

7. **Question:** How and when will the lowest apparent bidder be identified?
Answer: The District is currently bidding the building component of this project separately with 3 modular building manufacturers. The District's selection of bid alternates will in-part depend on the district's selection of the modular building manufacturer, therefore, we do not expect a decision regarding the Site Development Bid Alternates selected and therefore the identification of the lowest apparent bidder until after 1/9/2024.

8. **Question:** Specs: "Bid Alternates Playground Fill Surface" call for Base Price to include "SpectraTurf Synthetic Turf", but Plans (page C03) call for "Versa Lush Synthetic Turf". Which one should be included in the Base Bid pricing?

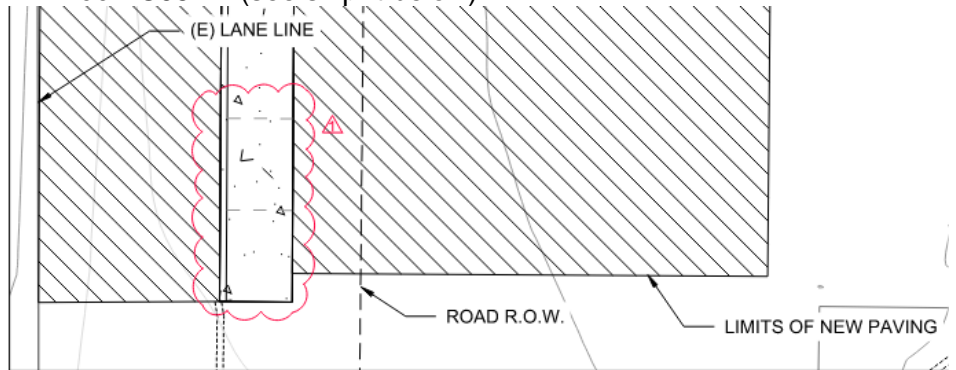
9. **Question:** Is the District planning on requesting support from Sutter County for this project.
Answer: Yes. Franklin Elementary School District has reviewed the project with Sutter County Planning staff and plans on asking Sutter County to assist with funding of all or part of the work planned within the Franklin Road Right of Way. To facilitate Sutter County's participation in the project and quantify the value of the work planned within the Franklin Road Right of Way, we have revised the bid form to include an identification of the Contractor's breakdown of the work to be performed within the Franklin Road Right of Way. The value of the work identified on the bid form as the value of the work within the right of way is to be included in the base bid value submitted.

<u>ADDENDUM ITEM</u>	<u>PAGE OR DRAWING</u>	<u>LOCATION AND DESCRIPTION OF CHANGE</u>
1.0		Sign-In Sheet - Site walk 11/16/23 Sign-in Sheet – Site walk 9/21/23
1.1	Division 26 Electrical Specs	<u>SPECIFICATIONS:</u> Refer to the Technical Specifications and ADD the following sections: 26 00 10 BASIC ELECTRICAL REQUIREMENTS 26 05 19 BUILDING WIRE AND CABLE

- 26 05 26 GROUNDING AND BONDING
- 26 05 29 ELECTRICAL HANGERS AND SUPPORTS
- 26 05 31 CONDUIT
- 26 05 33 BOXES
- 26 05 43 UNDERGROUND DUCTS AND STRUCTURES
- 26 05 53 ELECTRICAL IDENTIFICATION
- 26 27 16 CABINETS AND ENCLOSURES
- 26 28 16 OVERCURRENT PROTECTIVE DEVICES
- 26 61 13 FIRE ALARM/LIFE SAFETY SYSTEM
- 26 65 16 SECURITY ALARM MONITORING SYSTEM
- 26 71 13 TELECOMMUNICATION CABLING SYSTEMS

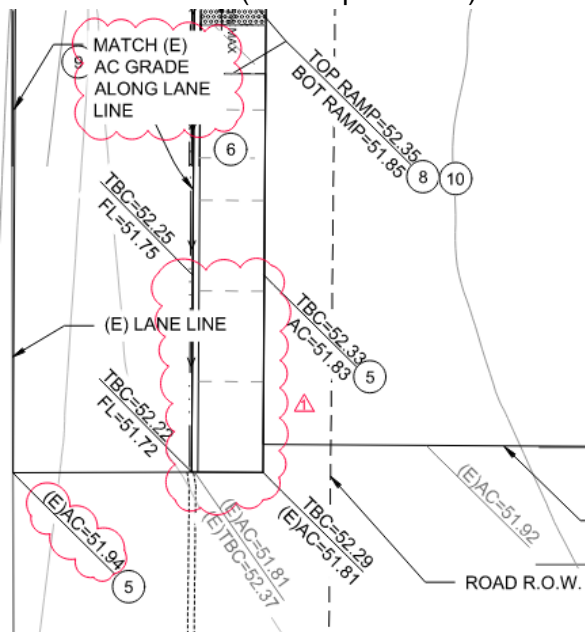
1.3 BID Form 00 41 13 **PROJECT MANUAL: REVISE** Bid Form that adds Bid Alternate #3 – AMS Modular Building Foundations (attached)

1.4 C03 **DRAWINGS:** Refer to C03 and **REVISE** the following: **“ADD001-C03-1”** (see snip-it below)



Modified limits of new paving

1.5 C04 **DRAWINGS:** Refer to C04 and **REVISE** the following: **“ADD001-C04-1”** (see snip-it below)



New grades for modified limits of new paving

- 1.6 Drawings **DRAWINGS:** Refer to the Bid Drawings and **ADD** the following sheets:
- S1.2 AMS PC A#02-118326 - Concrete Foundation Plan
 - S1.4 AMS PC A#02-118326 - Concrete Foundation Details
 - S1.5 AMS PC A#02-118326 - Concrete Foundation Plan
 - S1.6 AMS PC A#02-118326 - Foundation Anchorage Details
 - S1.7 AMS PC A#02-118326 - Concrete Optional Utility Openings in Footings
- 1.7 C03 **DRAWINGS:** Refer to C03 and **REPLACE** the drawings sheet with the following:
- “C03 Engineered Fill Plan”** (attached)

END OF ADDENDUM



Franklin Elementary School
TK & K Classroom Building Addition
322 N. Township Road, Yuba City, CA

Contractor Sign-in Sheet
Date: September 21, 2023
Time: 10:00 AM

This Pre-Bid Conference is non-mandatory.

Please print clearly

Name of person Attending	Name of firm you are representing	Email Address
John DeGrace	Kelly Moore Paints	Jdegrace@kellymoore.com
Brycen Seiler	Ginno Construction Inc.	Ian@ginnoconstruction.net

Franklin Elementary School
TK & K Classroom Building Addition
322 N. Township Road, Yuba City, CA

Contractor Sign-in Sheet
Date: September 21, 2023
Time: 10:00 AM

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Please print clearly

Name of person Attending	Name of firm you are representing	Email Address
EDGAR BARZA	UNITED BUILDING CONTRACTORS	EDGARZI@UNITEDBUILDING CONTRACTORS.COM
Armando Ramirez	Arrow Fence	Armando @ arrow fence company.com
Chris Pizzo	Abide Builders	bidso@abidebuilders.com
Luca Lathrop	BRCO Constructors	llathrop@gobrcos.com
TIM SCHODER	NORTH STAR CONST	tim @ northstarconst.com

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TK & K Classroom Building Addition
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Contractor Sign-in Sheet

Date: September 21, 2023

Time: 10:00 AM

This Pre-Bid Conference is non-mandatory.

Please print clearly

Name of person Attending	Name of firm you are representing	Email Address
Anthony Dobyns	craftmanship Paint & Siding.	c@painting885@gmail.com
Will Cannell	JL Construction JL Modular	WillC@JLCBuild.com
Scott Heyland	Norcal Excavating Inc.	scott@norcalexcavating.com
Jason Deschaine	Deschaine Enterprises Inc	J.tson@deschaineenterprises.com 530 277 9353
John Deschaine	Deschaine Enterprises Inc	d.ent@icloud.com 530 274 9975

Franklin Elementary School
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Date: September 21, 2023

Time: 10:00 AM

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Please print clearly

Name of person Attending	Name of firm you are representing	Email Address
Brandon Reitz	Hilbers Inc.	brritz@hilbersinc.com
CARMEN O'CAMPO	MEEHLEIS modular Buildings Inc MMBI	CARMENC MEEHLEIS.COM
Ken Norton	Lamar Const Co Inc	Knorton@lamarconstruction.com
Zach Milner	Zach@northstarinc.com	North Star Construction

Franklin Elementary School
TK & K Classroom Building Addition

Site Development - ReBID

322 N. Township Road, Yuba City, CA

Contractor Sign-in Sheet

Date: November 16, 2023

Time: 10:00 AM

This Pre-Bid Conference is non-mandatory.

Please print clearly.

Name of person Attending	Name of firm you are representing Telephone number	Email Address
DEBORAH WALKER	AMERICAN RIVER CONSTRUCTION, INC 530-621-1785	arcbids@sbcglobal.net
Jerry Handy	4J CON, INC 530-682-6129	jerry@4jcon.com
Brandon Rertz	Hilbers Inc. 530-441-6322	breitz@hilbersinc.com
TIM SCHODER	NORTH STAR CONSTRUCTION 530-812-7184	tim@northstarinc.com
Paul Kiz	Kiz Construction Inc 916 7157771	paulkiz@comcast.net

Franklin Elementary School
TK & K Classroom Building Addition

Site Development - ReBID

322 N. Township Road, Yuba City, CA

Contractor Sign-in Sheet

Date: November 16, 2023

Time: 10:00 AM

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Please print clearly.

Name of person Attending	Name of firm you are representing	Email Address
CHRIS STURGEON	OPERATING ENGINEERS LOCAL 5 Telephone number 916-956-0722	CSturgeon@OE3-ORG
LUCA LATHROP	BRCO Constructors (916) 253-9373	llathrop@gobrcos.com
GREG LEICHTER	ROCK CREEK CONSTRUCTION 415 471 4252	greg@rockcreekconstructioninc.com
Pavel Chernyy	Proexconstruction, Inc 916-868 2137	Bids@proexconstruction.com
Cory Stumpf	Big S Asphalt 530-682-5149	Cory@bigsasphalt.com

SECTION 260010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Table of Contents, Division 26 - Electrical:

SECTION NO.	SECTION TITLE
260010	BASIC ELECTRICAL REQUIREMENTS
260519	BUILDING WIRE AND CABLE
260526	GROUNDING AND BONDING
260529	ELECTRICAL HANGERS AND SUPPORTS
260531	CONDUIT
260533	BOXES
260543	UNDERGROUND DUCTS AND STRUCTURES
260553	ELECTRICAL IDENTIFICATION
262716	CABINETS AND ENCLOSURES
262816	OVERCURRENT PROTECTIVE DEVICES
266116	FIRE ALARM/LIFE SAFETY SYSTEM
266516	SECURITY ALARM MONITORING SYSTEM
267113	TELECOMMUNICATION CABLING SYSTEM
267613	SCHOOL COMMUNICATION SYSTEM

B. Work included: This Section includes general administrative and procedural requirements for Division 26. The following administrative and procedural requirements are included in this Section to supplement the requirements specified in Division 01.

1. Quality assurance.
2. Definition of terms.
3. Submittals.
4. Coordination.
5. Record documents.
6. Operation and maintenance manuals.
7. Rough-in.
8. Electrical installation.
9. Cutting, patching, painting and sealing.
10. Field quality control.
11. Cleaning.
12. Project closeout.

C. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete and operable installation.

1. General and supplementary conditions: Drawings and general provisions of Contract and Division 01 of the Specifications, apply to all Division 26 Sections.

2. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, etc. Refer to Division 31, Earthwork.
 3. Miscellaneous metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, cabinets, etc. Refer to Division 05, Miscellaneous Metals.
 4. Miscellaneous lumber and framing Work: Include wood grounds, nailers, blocking, fasteners and anchorage for support of electrical materials and equipment. Refer to Division 06, Rough Carpentry.
 5. Moisture protection and smoke barrier penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vaportight. Refer to Division 07, Thermal and Moisture Protection.
 6. Painting: Include surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, etc. where indicated as field painted in this Division. Refer to Division 09, Painting.
- D. Work furnished and installed under another Division requiring connections under this Division includes but is not limited to:
1. Electric motors.
 2. Package mechanical equipment: fans, fan coil units, pumps, boilers, compressors, etc.
 3. Flow switches and valve monitors for sprinkler system.
 4. Pre-wired electrified partition furniture.
 5. Temperature control panel(s). (Line voltage only)
 6. Irrigation controller(s). (Line voltage only)
 7. FM-200 control panel. (Line voltage only)
 8. Kitchen equipment and appliances.
 9. Electric signage.
 10. Electric door locks.
 11. Door hold-open/release devices.
 12. Variable frequency drive units.
 13. Motorized roll down/sliding doors and grills.
 14. Projection screens.
- E. Items furnished under another Division, but installed and connected under this Division includes but is not limited to:
1. Wall mounted control stations for motorized roll down and sliding doors.
 2. Electric fire sprinkler water flow bells.
 3. Speed control switches for ceiling exhaust fans.

1.02 QUALITY ASSURANCE

- A. Reference to Codes, Standards, Specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.
- B. When codes, standards, regulations, etc. allow Work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred authority for reducing the quality, requirements or extent of the Contract Documents. The Contract Documents address the minimum requirements for construction.
- C. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
 1. California Electric Code (CEC).

2. California Building Code (CBC).
3. California Fire Code (CFC).
4. California Mechanical Code (CMC).

D. Standards: Equipment and materials specified under this Division shall conform to the following standards where applicable:

ACI	American Concrete Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
CBM	Certified Ballast Manufacturers
ETL	Electrical Testing Laboratories
FS	Federal Specification
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IPCEA	Insulated Power Cable Engineer Association
NEMA	National Electrical Manufacturer's Association
UL	Underwriters' Laboratories

E. Independent Testing Agency qualifications:

1. Testing Agency shall be an independent testing organization that will function as an unbiased authority, professionally independent of Manufacturer, Supplier and Contractor, furnishing and installing equipment or system evaluated by Testing Agency.
2. Testing Agency shall be regularly engaged in the testing of electrical equipment, devices, installations and systems.
3. Testing Agency shall meet Federal Occupational Safety and Health Administration (OSHA) requirements for accreditation of independent testing laboratories, Title 9, Part 1907.
4. On-site technical personnel shall be currently certified by the International Electrical Testing Association in electrical power distribution system testing.
5. Testing Agency shall use technicians who are regularly employed by the firm for testing services.
6. Contractor shall submit proof of above Testing Agency qualifications with bid documentation upon request.

F. All base material shall be ASTM and/or ANSI standards.

G. All electrical apparatus furnished under this Section shall conform to NEMA standards and the NEC and bear the UL label where such label is applicable.

H. Certify that each welder performing Work has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.03 DEFINITION OF TERMS

A. The following list of terms as used in the Division 26 documents shall be defined as follows:

1. "Provide": Shall mean furnish, install and connect unless otherwise indicated.
2. "Furnish": Shall mean purchase and deliver to Project site.
3. "Install": Shall mean to physically install the items in-place.
4. "Connect": Shall mean make final electrical connections for a complete operating piece of equipment.
5. "As directed": Shall be as directed by the Owner or their authorized Representative.

6. "Utility Companies": Shall mean the company providing electrical, telephone or cable television services to the Project.

1.04 SUBMITTALS

- A. Format: Furnish submittal data neatly bound in an 8-1/2" x 11" folder or binder for each Specification Section with a table of contents listing materials by Section and paragraph number.
- B. Submittals shall consist of detailed Shop Drawings, Specifications, block wiring diagrams, "catalog cuts" and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication and material finish. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded. Furnish quantities of each submittal as noted in Division 01.
- C. Each submittal shall be labeled with the Specification Section Number and shall be accompanied by a cover letter or shall bear a stamp stating that the submittal has been thoroughly reviewed by the Contractor and is in full compliance with the requirements of the Contract Documents. Cover letters shall list in full the items and data submitted. Failure to comply with this requirement shall constitute grounds for rejection of data.
- D. The Contractor shall submit detailed Drawings of all electrical equipment rooms and closets if the proposed installation layout differs from the construction documents. Physical size of electrical equipment indicated on the Drawings shall match those of the electrical equipment that is being submitted for review, i.e.: switchboards, panelboards, transformers, control panels, etc. Minimum scale: 1/4" = 1'- 0". Revised electrical equipment layouts must be approved prior to release of order for equipment and prior to installation.
- E. As part of the equipment and fixture submittals, the Contractor shall provide anchorage calculations for floor and wall mounted electrical equipment and fixtures, distribution conduits and raceways, in conformance with the 2013 California Building Code (CBC) and ASCE 7-05. Use the Occupancy Category, Ground Accelerations, Site Class, Seismic Design Category, and Seismic Importance Factor as noted in the structural drawings. For components required for Life Safety or containing hazardous materials use $I_p=1.5$. Structural Calculations shall be prepared, stamped and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.
- F. The Manufacturer shall recommend the method of anchoring the equipment to the mounting surface and shall provide the Contractor with the assembly dimensions, weights and approximate centers of gravity.
- G. The Manufacturer shall recommend the method of anchoring the equipment to the mounting surface and shall provide the Contractor with the assembly dimensions, weights and approximate centers of gravity.
- H. All resubmittals shall include a cover letter that lists the action taken and revisions made to each Drawing and equipment data sheet in response to Submittal Review Comments. Resubmittal packages will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.
- I. Shop Drawings for the following systems must be prepared via a computer aided drafting (CAD) system for submission by the Contractor. The Engineer can provide files of the electrical Contract Documents to the Contractor.
1. Fire alarm/life safety system, Section 266116.
 2. Security alarm monitoring system, Section 266516.
- J. Independent Testing Agency report:

1. Testing Agency shall provide 3 copies of the complete testing report.
2. Test report shall include the following:
 - a. Summary of Project.
 - b. Description of equipment.
 - c. Equipment used to conduct the test.
 - 1) Type.
 - 2) Manufacturer.
 - 3) Model number.
 - 4) Serial number.
 - 5) Date of last calibration.
 - 6) Documentation of calibration leading to NIST standards.
 - d. Description of test.
 - e. Test results, as compared to Manufacturers or industry accepted standards and tolerances.
 - f. Conclusion and recommendation.
 - g. Signature of responsible test organization authority.
3. Furnish completed test report to Engineer no later than 30 days after completion of testing, unless otherwise directed.

K. Substitutions:

1. All requests for substitutions shall conform to the general requirements and procedure outlined in Division 01.
2. Where items are noted as "or equal," a product of equal design, construction and performance will be considered. Contractor must submit to the Engineer all pertinent test data, catalog cuts and product information required substantiating that the product is in fact equal to that specified. Only one substitution will be considered for each product specified.
3. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment, which in the opinion of the Engineer is equal in quality, utility and appearance, will be approved as substitutions to that specified.
4. Whenever any material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, the Contractor shall present an affidavit from the Manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, support test data to substantiate compliance shall be submitted by the Contractor at no additional cost.
5. Substitutions shall be equal, in the opinion of the Architect/Engineer, to the specified product. The burden of proof of such shall rest with the Contractor. When the Architect/Engineer in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted article or material to be equal to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work or from any provisions of the Specifications.
6. The Contractor shall be responsible for all expenses in connection with the substitution materials, processes and equipment, including the effect of the substitution on the Contractor, Subcontractor's or other Contractor's Work. No substitution of material, processes or equipment shall be permitted without written authorization of the Architect/Engineer. Any assumptions on the acceptability of a proposed substitution prior to acceptance by the Engineer are at the sole risk of the Contractor.

1.05 COORDINATION

A. Discrepancies:

1. In the event of discrepancies within the Contract Documents, the Engineer shall be so notified, within sufficient time, as delineated in Division 01, prior to the Bid Opening to allow the issuance of an Addendum.
 2. If, in the event that time does not permit notification or clarification of discrepancies prior to the Bid Opening, the following shall apply: The Drawings govern in matters of quantity and the Specifications govern in matters of quality. In the event of conflict within the Drawings involving quantities or within the Specifications involving quantities or within the Specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Contractor's Bid. No additional allowances will be made because of errors, ambiguities or omissions that reasonably should have been discovered during the preparation of the Bid.
- B. Project conditions:
1. Examination of Project site: The Contractor shall visit the Project site and thoroughly review the locale, working conditions, conflicting utilities and the conditions in which the Electrical Work will take place. Verify all existing conditions in the field. No allowances will be made subsequently for any costs that may be incurred because of any error or omission due to failure to examine the Project site and to notify the Engineer of any discrepancies between Contract Documents and actual Project site conditions.
 2. Protection: Keep conduits, junction boxes, outlet boxes and other openings closed to prevent entry of foreign matter. Cover fixtures, equipment, devices and apparatus and protect them against dirt, paint, water, chemical or mechanical damage, before and during construction period. Prior to final acceptance, restore to original condition any fixture, apparatus or equipment damaged including restoration of damaged factory applied painted finishes. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.
 3. Supervision: Contractor shall personally or through an authorized and competent representative constantly supervise the Work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.
- C. Preparation:
1. Drawings:
 - a. Layout: General layout indicated on the Drawings shall be followed except where other Work may conflict with the Drawings.
 - b. Accuracy: Drawings for the Work under this Section are essentially diagrammatic within the constraints of the symbology applied.
 2. Design-Build systems approach: The Drawings do not fully represent the entire installation for the systems indicated below. The Contractor is required to complete the design for these systems as specified herein and as indicated on the Drawings. CAD Shop Drawings shall be submitted for review prior to installation:
 - a. Security system: Drawings indicate the layout and location of control console(s) components, as well as location of all security devices, i.e. CCTV cameras, card readers, door locks and contacts, intercom stations, duress stations, personal security system receivers, etc. conduits, wire and cabling between all system components, equipment, devices, etc. are not indicated

1.06 RECORD DOCUMENTS

- A. Provide Project Record Drawings as described herein:
1. Drawings shall fully represent installed conditions including actual locations of outlets, true panelboard connections following phase balancing routines, correct conduit and wire sizing as well as routing, revised fixture schedule listing Manufacturers and products actually installed and revised panel schedules. Contractor shall record all changes in the Work during the course of construction on blue or black line prints. These prints shall be made subject of monthly review by the Owner's Representative to ascertain that they are current. If not current monthly payments may be withheld.

2. Record Drawings shall be the transfer of information on these prints to the Revit Model.
 3. Record drawing submissions shall be provided to the Engineer to review upon the completion of the following phases of Work:
 - a. Final electrical installation.
 4. Include in the record drawing submission the following shop drawing submission with all updated installation information:
 - a. Fire alarm/life safety system.
 - b. Security alarm monitoring system.
 - c. Telecommunication cabling system
 - d. School communication system.
 5. A single set of half size prints of the Record Drawings shall be submitted for review. Upon receipt of the Engineer's review comments, corrections shall be made and the Contractor shall provide the following:
 - a. Printed drawing sets and digital files as defined in Division 1.
 - b. Updated electrical Revit model with all field changes, redlines, shop drawings, and updated installation information completed by the Contractor.
- B. Panel schedules:
1. Typewritten panel schedules shall be provided for panelboards indicating the loads served and the correct branch circuit number. Schedules shall be prepared on forms matching those in the construction documents and inserted in the pocket of the inner door of each panelboard. See Section 262416: Panelboards for requirements.
 2. The contractor shall update the Revit model panel schedules at project completion.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. Prior to Project closeout furnish to the Owner, six (6) hard back 3-ring binders containing all bulletins, operation and maintenance instructions, part lists, service telephone numbers and other pertinent information as noted in each Section all equipment furnished under Division 26. Binders shall be indexed into Division Sections and labeled for easy reference. Bulletins containing more information than the equipment concerned shall be properly stripped and assembled.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 ROUGH-IN

- A. Contractor shall verify lines, levels and dimensions indicated on the Drawings and shall be responsible for the accuracy of the setting out of Work and for its strict conformance with existing conditions at the Project site.
- B. Verify final locations for rough-ins with field measurements and with the requirements for the actual equipment to be connected.
- C. Refer to equipment specification in Divisions 22 through 33 for rough-in requirements.

3.02 ELECTRICAL INSTALLATION

- A. Preparation, sequencing, handling and installation shall be in accordance with Manufacturer's written instructions and technical data particular to the product specified and/or accepted equal except as otherwise specified. Comply with the following requirements:
 1. Shop Drawings prepared by Manufacturer.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots and openings in other building components during progress of construction, to allow for electrical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting height is not detailed or dimensioned, contact the Architect for direction prior to proceeding with rough-in.
7. Install systems, materials and equipment to conform with approved submittal data, including coordination Drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are indicated only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
8. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
9. Install electrical equipment to facilitate servicing, maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
10. Coordinate electrical systems, equipment and materials installations with other building components.
11. Provide access panel or doors where devices or equipment are concealed behind finished surfaces. Furnish and install access doors per the requirements of Division 08.
12. Install systems, materials and equipment giving right-of-way priority to other systems that are required to maintain a specified slope.
13. Conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.

3.03 CUTTING, PATCHING, PAINTING AND SEALING

- A. Structural members shall in no case be drilled, bored or notched in such a manner that will impair their structural value. Cutting of holes, if required, shall be done with core drill and only with the approval of the Architect and Structural Engineer.
- B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- C. Application of joint sealers:
 1. General: Comply with joint sealer Manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 2. Installation of fire-stopping sealant: Install sealant, including forming, packing and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops and fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.04 FIELD QUALITY CONTROL

- A. General testing requirements:
 1. The purpose of testing is to ensure that all tested electrical equipment, both Contractor and Owner supplied, is operational and within industry and Manufacturer's tolerances and is installed in accordance with design Specifications.
 2. Tests and inspections shall determine suitability for energization.
 3. Perform tests in presence of the Owner's Representative and furnish test equipment, facilities and technical personnel required to perform tests.
 4. Tests shall be conducted during the construction period and at completion to determine conformity with applicable codes and with these Specifications.

- B. Tests: In addition to specific system test described elsewhere, tests shall include:
1. Equipment operations: Test motors for correct operation and rotation.
 2. Lighting control circuits: Test lighting circuits for correct operation through their control devices.
 3. Alarm and interlock systems: Produce malfunction symptoms in operating systems to test alarm and interlock systems. In addition, all specific tests described in the fire alarm/life safety system shall be performed.
 4. Circuit numbering verification: Select on a random basis various circuit breakers in the panelboards and cycle them on and off to verify compliance of the typed panel directories with actual field wiring.
 5. Voltage check:
 - a. At completion of job, check voltage at several points of utilization on the system that has been installed under this Contract. During test, energize all installed loads.
 - b. Adjust taps on transformers to give proper voltage, which is 118 to 122 volts for 120 volt nominal systems and proportionately equivalent for higher voltage systems. If proper voltage cannot be obtained, inform the Owner and the serving Utility Company.
- C. Contractor shall provide test power required when testing equipment before service energization and coordinate availability of test power with General Contractor after service energization. The Contractor shall provide any specialized test power as needed or specified herein.
- D. Testing safety and precautions:
1. Safety practices shall include the following requirements:
 - a. Applicable State and Local safety operating procedures.
 - b. OSHA.
 - c. NSC.
 - d. NFPA 70E.
 2. All tests shall be performed with apparatus de-energized and grounded except where otherwise specifically required ungrounded by test procedure.
- E. Calibration of test equipment:
1. Testing Agency shall have calibration program that assures test instruments are maintained within rated accuracy.
 2. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog, 6 month maximum; Digital, 12 months maximum.
 - b. Laboratory instruments: 12 months.
 - c. Leased specialty equipment: 12 months where accuracy is guaranteed by lessor.
 3. Dated calibration labels shall be visible on test equipment.
 4. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
 5. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.
 6. Calibration standards shall be of higher accuracy than instrument tested.
 7. Equipment used for field testing shall be more accurate than instrument being tested.
- F. Coordinate with General Contractor regarding testing schedule and availability of equipment ready for testing.
- G. Notify Owner and Engineer one week in advance of any testing.
- H. Any products which fail during the tests or are ruled unsatisfactory by the Owner's Representative shall be replaced, repaired or corrected as prescribed by the Owner's Representative at the expense of the Contractor. Tests shall be performed after repairs, replacements or corrections until satisfactory performance is demonstrated.

- I. Testing Agency shall maintain written record of tests and shall assemble and certify final test report.
- J. Include all test results in the maintenance manuals.

3.05 CLEANING

- A. Prior to energizing of electrical equipment, the Contractor shall thoroughly clean the interior of enclosures from construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.
- B. Upon completion of Project, prior to final acceptance, the Contractor shall thoroughly clean both the interior and exterior of all electrical equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt and debris.
- C. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.06 PROJECT CLOSEOUT

- A. Training: At the time of completion, a period of not less than 4 hours shall be allotted by the Contractor for instruction of building operating and maintenance personnel in the use of all systems. This 4 hours training is in addition to any instruction time called out in the Specifications for specific systems, i.e., Fire Alarm, etc. All personnel shall be instructed at one time, the Contractor making all necessary arrangements with Manufacturer's Representative. The equipment Manufacturer shall be requested to provide product literature and application guides for the users' reference. Costs, if any, for the above services shall be paid by the Contractor.
- B. Special tools: Provide one of each tool required for proper operation and maintenance of the equipment provided under this Section. All tools shall be delivered to the Owner at the Project completion.
- C. Keying: Provide two keys for each lock furnished under this Section and turn over to Owner.

END OF SECTION [26 00 10]

SECTION 26 05 19

BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Building wire.
 - 2. Cable.
 - 3. Wiring connections and terminations.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Federal Specifications (FS):
 - FS J-C-30A; Cable and Wire, Electrical (Power, Fixed Installation).
 - FS W-S-610C; Splice Conductor.
 - FS HH-I-595C; Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic.
 - 2. Underwriters Laboratories, Inc. (UL):
 - UL 4; Armored Cable.
 - UL 44; Thermoset-Insulated Wires and Cables.
 - UL 62; Flexible Cord and Fixture Wire.
 - UL 83; Thermoplastic-Insulated Wires and Cables.
 - UL 183; Manufactured Wiring Systems.
 - UL 310; Electrical Quick-Connect Terminals.
 - UL 486A & B; Wire Connectors.
 - UL 486C; Splicing Wire Connectors.
 - UL 486D; Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
 - UL 493; Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables.
 - UL 510; Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
 - UL 854; Service-Entrance Cables.
 - UL 1569; Metal-Clad Cables.
 - UL 1581; Reference Standard for Electrical Wires, Cables and Flexible Cords.
 - 3. National Electrical Manufacturer Association (NEMA):
 - NEMA WC-5; Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - NEMA WC-7; Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - 4. Institute of Electrical and Electronic Engineers (IEEE):
 - IEEE 82; Test Procedure for Impulse Voltage Tests on Insulated Conductors.

1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
3. Submit Manufacturer's installation instructions.
4. Final test results.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.
- C. Independent Testing Agency qualifications: Refer to Section 260010: Basic Electrical Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 1. Building wire:
 - a. Cerrowire
 - b. General Cable
 - c. Southwire Company
 - d. Stabiloy (aluminum only)
 - e. United Wire and Cable
 2. Metal-Clad Armored Cable:
 - a. AFC Cable Systems
 - b. AFC Cable Systems – MC Luminary Cable (0-10V)
 - c. Southwire Company
 3. Flexible Cords and Cables:
 - a. Carol Cable Company
 - b. Cerrowire
 - c. PWC Corp
 4. Wiring connectors and terminations:
 - a. 3M Company.
 - b. Ideal.
 - c. Blackburn-Holub.
 - d. Burndy.
 - e. Thomas & Betts Corp.
 - f. Beau Barrier.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 BUILDING WIRE

- A. Conductor material:
 1. Provide annealed copper for all wire, conductor and cable, unless otherwise indicated.
 2. Copper wire AWG #8 and larger shall be stranded, unless otherwise indicated.
 3. Copper wire AWG #10 and smaller may be solid or stranded as best suited for the installation.

- B. Insulation material:
 - 1. All insulated wire, conductor and cable shall be 600 volt rated unless otherwise noted on the Drawings.
 - 2. Thermoplastic-insulated building wire: NEMA WC 5.
 - 3. Rubber-insulated building wire: NEMA WC 3.
 - 4. Copper feeders and branch circuits larger than #6 AWG: Type THW, XHHW or dual rated THHN/THWN.
 - 5. Copper feeders and branch circuits #6 AWG and smaller: Type TW, THW, XHHW or dual rated THHN/THWN.
- 6. Feeders and branch circuits for direct-current (DC) in wet locations: Type XHHW-2
 - 7. Service Entrance: Type RHW or THWN.
 - 8. Control Circuits: Type THW or dual rated THHN/THWN.
 - 9. Identify system conductors as to voltage and phase connections by means of color-impregnated insulation.

2.03 WIRING CONNECTIONS AND TERMINATIONS

- A. Bolted pressure connectors: Provide wide range-taking connectors with cast bronze compression bolts, designed for parallel taps, tees, crosses or end-to-end connections.
- B. Electrical spring wire connectors:
 - 1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-section steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.
 - 2. Self-striping pigtail and tap U-contact connectors shall not be used.
- C. Push-in wire connectors:
 - 1. Multi-port push-in wire connectors for a maximum of 8-wires, as required for specific application. Connectors are manufactured to accommodate a wide range of sizes with either solid or stranded conductors, up to a maximum wire size of #10 AWG. Low insertion force required for ease of installation.
 - 2. Housing shall be 105 degrees C and transparent for visual connection verification.
 - 3. 600 volt maximum rating with copper contacts.
 - 4. UL Listed to 486C and UL 467 Listed for grounding and bonding applications.
- D. Compression type terminating lugs:
 - 1. Provide tin-plated copper high-compression type lugs for installation with hand or hydraulically operated circumference-crimping tools and dies as stipulated by the lug Manufacturer or as indicated on Drawings. Notch or single point type crimping is NOT acceptable.
 - 2. Two hole, long barrel lugs shall be provided for size (4/0) and larger wire where terminated to bus bars. Use minimum of three crimps per lug, on sizes where possible.
- E. Splicing and insulating tape: Provide black, ultraviolet proof, self-extinguishing, 7 mil thick vinyl general purpose electrical tape with a dielectric strength of 10,000 volts suitable for temperatures from minus 18 degrees C to 105 degrees C. Federal Spec. HH-I-595, Scotch 33+ or equal minimum.
- F. Insulating putty:
 - 1. Provide pads or rolls of non-corrosive, self-fusing, one-eighth inch thick rubber putty with PVC backing sheet. Scotch vinyl mastic pads and roll or equal.
 - 2. Use putty suitable for temperatures from minus 17.8 degrees C to 37.8 degrees C with a dielectric strength of 570-volts/mil minimum.
- G. Insulating resin:

1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. Scotchcast 4 or equal for wet or underground vaults, boxes, etc. splices or terminations.
 2. Use resin with a set up time of approximately 30 minutes at 21.1 degrees C and with thermal and dielectric properties equal to the insulating properties of the cables immersed in the resin.
- H. Terminal strips:
1. Provide box type terminal strips in the required quantity plus 25% spare. Install in continuous rows in terminal cabinets.
 2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.
 3. Identify all terminals with numbering sequence being used for a particular system.
- I. Crimp type connectors:
1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support
 2. Fasten crimp type connectors or terminals using a crimping tool recommended by the connector Manufacturer.
 3. Provide insulated overlap splices with tinned seamless electrolytic copper barrel with funnel wire entry and insulation support.
 4. Provide insulated butt splices with tinned seamless electrolytic copper barrel with center stop, funnel wire entry and insulation support.
- J. Cable ties: Provide harnessing and point-to-point wire bundling with nylon cable ties. All cable ties shall be installed using tool supplied by Manufacturer of ties.
- K. Wire lubricating compound:
1. UL listed for the wire insulation and conduit type and shall not harden or become adhesive.
 2. Shall not be used on wire for isolated type electrical power systems.
- L. Bolt termination hardware:
1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE grade 5; or silicon bronze alloy ASTM B-9954 Type B.
 2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
 3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, conforming to ANSI B27.2. SAE or narrow series shall not be used.
 4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
 5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
 - a. 1/4" bolt - 125 amps
 - b. 5/16" bolt - 175 amps
 - c. 3/8" bolt - 225 amps
 - d. 1/2" bolt - 300 amps
 - e. 5/8" bolt - 375 amps
 - f. 3/4" bolt - 450 amps

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of wire and cable installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 APPLICATION

- A. All wire, conductor and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient condition.
- B. Feeders and branch circuits in wet locations shall be rated 75 degree C.
- C. Feeders and branch circuits in dry locations shall be rated 90 degree C.
- D. Minimum conductor size:
 - 1. Provide minimum AWG #12 for all power and lighting branch circuits.
 - 2. Provide minimum AWG #14 for all line voltage signal and control wiring unless otherwise indicated.
- E. Color coding:
 - 1. For 120/208 volt, 3 phase, 4 wire systems:
 - a. Phase A - Black
 - b. Phase B - Red
 - c. Phase C - Blue
 - d. Neutral - White
 - e. Ground - Green

3.03 WIRING METHODS

- A. Install wires and cables in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Install all single conductors in raceway system, unless otherwise noted.
- C. Parallel circuit conductors and terminations shall be equal in length and identical in all ways.
- D. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- E. 20 amp power and lighting branch circuit containing no more than four (4) current carrying conductors (phases and neutrals). Use #10 AWG conductor for 120/208 volt circuits located outside a 75 foot radius of panel source and for 277 volt branch circuits located outside a 200 foot radius of panel source, unless otherwise noted.
- F. 20 amp power and lighting branch circuits containing no more than eight (8) current carrying conductors (phases and neutrals). Use #10 AWG conductors for 120/208 volt circuits located outside a 65 foot radius of panel source and for 277/480 volt circuits located outside a 150 foot radius of panel source.
- G. Provide #10 AWG pig tails on all 20A and 30A wiring devices served by #8 AWG conductors and larger.
- H. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes or handholes. Group and bundle with tie wrap each neutral with it's associated phase conductor where more than one neutral is present in a conduit.
- I. Install cable supports for all vertical feeders in accordance with the NEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.

- J. Neatly form, train and tie the cables in individual circuits. For panelboards, cabinets, wireways, switches and equipment assemblies.
- K. Seal cable or wire, entering a building from underground or exiting walk-in cold box or freezer, between the wire or cable and conduit, where it exits the conduit, with a non-hardening approved compound, i.e. duct seal or equal.
- L. Provide UL-listed factory-fabricated, solderless metal connectors of size, ampacity rating, material, type and class for applications and for services indicated. Use connectors with temperature ratings equal to or greater than the wires that are being terminated.
- M. Stranded wire shall be terminated using fitting, lugs or devices listed for the application. However, in no case shall stranded wire be terminated solely by wrapping it around a screw or bolt.
- N. Flexible cords and cables supplied, as part of a pre-manufacturer fixture or unit assembly shall be installed according to Manufacturers published installation instructions.

3.04 WIRING INSTALLATION IN RACEWAYS

- A. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical Work likely to injure conductors has been completed. Pull all conductors into a raceway at the same time. Exercise care in pulling conductors so that insulation is not damaged. Use UL listed, non-petroleum base and insulating type pulling compound as needed.
- B. Completely mandrel all underground or concrete encased conduits prior to installing conductors.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors of size smaller than AWG #1.
- E. Wire pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use rope made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. Pull in together multiple conductors or cables in a single conduit.
- F. Install and test all cables in accordance with Manufacturer's instructions and warranty.

3.05 WIRE SPLICES, JOINTS AND TERMINATION

- A. Join and terminate wire, conductors and cables in accordance with UL 486A, C, NEC and Manufacturer's instructions.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- D. Splices and terminations shall be made mechanically and electrically secure.
- E. Where it's determined that unsatisfactory splice or terminations have been installed, remove the devices and install approved devices at no addition cost.

- F. Terminate wires in Terminal Cabinets, relay and contactor panels, etc. using terminal strip connectors.
- G. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere in the panel or cabinet.
- H. Install cable ties and maintain harnessing.
- I. Encapsulate splices in exterior outlets, pullboxes and junction boxes using specified insulating resin kits. Make all splices watertight for exterior equipment and equipment in pump rooms.
- J. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as the feed conductor. Form conductor prior to cutting and provide at least six (6) inches of tail and neatly packed in box after splice is made up.
- K. Branch circuits (#10 AWG and smaller):
 - 1. Connectors: Solderless, screw-on, reusable spring pressure cable type, 600 volt, 105-degree C. with integral insulation, approved for copper conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped wires.
 - 3. The number, size and combination of conductors as listed on the Manufacturers packaging shall be strictly complied with.
- L. Feeder circuits: (#6 to 750 MCM)
 - 1. Join or tap conductors from #6 AWG to 750 MCM using bolted pressure connectors or insulate mechanical compression (hi-press) taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of the joint.
 - 2. Terminate conductors from size #6 AWG to 750 MCM copper using bolted pressure or mechanical compression lugs in accordance with Manufacturer recommendation or as specified elsewhere.
 - 3. Field installed compression connectors for cable sizes 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.
 - 4. Insulate splices and joints with materials approved for the particular use, location, voltage and temperature. Insulate with not less than that of the conductor level that is being joined.
- M. Termination hardware assemblies:
 - 1. AL/CU lugs connected to aluminum plated or copper buss, shall be secured using a steel bolt, flat washer (two per bolt), Belleville washer and nut.
 - 2. Copper lugs connected to copper bus, shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer and nut.
 - 3. The crown of Belleville washers shall be under the nut.
 - 4. Bolt assemblies shall be torque to Manufacturer recommendation. Where manufacture recommendation are not obtainable, the following values shall be used:
 - a. 1/4" - 20 bolt at 80-inch pounds torque.
 - b. 5/16" - 18 bolt at 180-inch pounds torque.
 - c. 3/8" - 16 bolt at 20-foot pounds torque.
 - d. 1/2" - 13 bolt at 40-foot pounds torque.
 - e. 5/8" - 11 bolt at 55-foot pounds torque.
 - f. 3/4" - 10 bolt at 158-foot pounds torque.

3.06 IDENTIFICATION

- A. Refer to Section 260553: Electrical Identification for additional requirements.

- B. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.
- C. Color code conductors size #8 and larger using specified phase color markers and identification tags.
- D. Provide all terminal strips with each individual terminal identified using specified vinyl markers.
- E. In manholes, pullboxes and handholes, provide tags of the embossed brass type and also show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.07 FIELD QUALITY CONTROL

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing required herein. Independent Testing Agency shall meet the requirements as outlined in Section 260010: Basic Electrical Requirements.
- B. Prefunctional testing:
 - 1. Visual and mechanical inspection:
 - a. Compare cable data with Contract Documents.
 - b. Inspect exposed sections of wires and cables for physical damage and proper connections.
 - c. Verify tightness of accessible bolted connections with calibrated torque wrench in accordance with Manufacturer's published data.
 - d. Inspect compression applied connectors for correct cable match and indentation.
 - e. Verify visible cable bend meet or exceed ICEA and Manufacturer's minimum allowable bending radius.
 - f. If cables are terminated through window type current transformers, make an inspection to verify neutral and ground conductors are correctly placed for operation of protective devices.
 - g. Ensure wire and cable identification has been installed as specified herein.
 - 2. Electrical testing:
 - a. Contractor shall perform feeder and branch circuit insulation test after installation and prior to connection to utilization devices such as fixtures, motors or appliances. Testing shall be as follows:
 - 1) 100% of all feeders 100 amp rated and above.
 - 2) 50% of all feeders smaller than 100 amps.
 - 3) 10% of all branch circuits at each individual panelboard.
 - b. Perform insulation-resistance test using megohm meter with applied potential of 1000V DC for a continuous duration of 60 seconds. Test conductors phase-to-phase and phase-to-ground. Conductors shall test free from short-circuit and ground faults.
 - c. Perform continuity test of all feeder and branch circuits to ensure correct cable connections. Test all neutrals for improper grounds.
 - d. Contractor shall furnish instruments, materials and labor for these tests.
 - 3. Test values: Investigate resistance values less than 50 megohms.
 - 4. Furnish test results in typewritten report form for review and inclusion in the operation and maintenance manuals.

END OF SECTION [26 05 19]

SECTION 260526

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Power system grounding.
 - 2. Telecommunication system grounding.
 - 3. Electrical equipment and raceway grounding and bonding.
 - 4. Safety ground grid and/or mat.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 05: Building Steel.
 - 2. Division 22: Cold Water Piping.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Underwriters Laboratories, Inc. (UL):
UL 467; Grounding and Bonding Equipment.
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
IEEE No. 142; Recommended Practice for Grounding of industrial and Commercial Power Systems.
IEEE No. 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.03 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment as described herein and indicated on Drawings.
- B. Ground each separately derived system neutral as described herein and indicated on Drawings.
- C. Provide telecommunications system grounding conductor as described herein and indicate on Drawings.
- D. Provide a safety ground grid and/or mat beneath all electrical switchgear operating at 1000 volts and above, and at emergency generator. Grid/mat shall be poured in the concrete floor slab and constructed as specified herein.
- E. Except as otherwise indicated, the complete electrical installation including the neutral conductor, metallic conduits and raceways, cable trays, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically indicated or specified.
- F. Resistance:
 - 1. Resistance from the main switchboard ground bus through the ground electrode to earth shall not exceed 5 OHMS unless otherwise noted.

2. Resistance from the farthest panelboard, switchboard, etc. ground bus through the ground electrode to earth shall not exceed 20 OHMS

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 3. Submit Manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 1. Ground Rods:
 - a. Weaver.
 - b. Erico "Cadweld" Products, Inc.
 2. Ground Wells:
 - a. Christy Concrete Products, Inc.
 - b. Forni Corp.
 3. Ground Bushings, Connectors, Jumpers and Bus:
 - a. O-Z/Gedney.
 - b. Thomas & Betts Corp.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GROUND CONDUCTORS

- A. Refer to Specification Section 260519: Building Wire and Cable for conductor specifications.
- B. General purpose insulated:
 1. UL approved and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green.
 2. Where continuous color-coded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with NEC/CEC.
- C. Bare conductors in direct contact with earth or encased in concrete: #2/0 AWG copper minimum, U.O.N.
- D. Bonding pigtails: Insulated copper conductor, identified green, sized per code and provide with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

2.03 DRIVEN (GROUND) RODS

- A. Copper clad steel, minimum 3/4-inch diameter by 8 feet long, unless otherwise noted.

2.04 GROUND WELL BOXES FOR GROUND RODS

- A. Precast concrete box nominal 9" throat diameter x 14" deep with light duty concrete cover for non-traffic areas or steel plate for traffic areas. Cover shall be embossed or engraved with "GROUND ROD".

2.05 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.06 CONNECTIONS TO PIPE

- A. For cable to pipe: UL and NEC/CEC approved bolted connection.

2.07 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPLICES

- A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
 1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
 2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections.

2.08 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

- A. Where required by Code, indicated on the Drawing, and specified herein.

2.09 BUILDING GROUND BUS REQUIREMENTS

- A. Building power system reference ground bus:
 1. The reference ground bus is furnished as part of the main panel for the building, along with neutral disconnect and bus, and is in addition to the main building power system ground bus outlined above. The building grounding electrode shall make a direct connection to the building referenced ground bus in the main switchboard.
 2. Provide a #2/0 AWG copper ground conductor connection between the building reference ground bus in switchboard and the main building ground bus wall mounted in main electrical room.
- B. Telecommunication system ground bus requirements:
 1. Telecommunication system ground bus: Provide one 12" wide x 4" high x 1/4" thick copper bus bar as a minimum. Mount in IDF cabinet.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of grounding system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 INSTALLATION

- A. Grounding electrodes:
1. Metal underground water pipe: Cold water metal piping system: Where the underground cold water service line is metal, indirect contact with the earth for 10 feet or more, the Contractor shall install a grounding electrode conductor from the main incoming cold water line ahead of the meter and extend to the main building reference ground bus in the main electrical room. The electrode shall be sized per NEC/CEC Article 250. Electrode connection should be accessible.
 2. Concrete encased grounding electrode (UFER ground): Provide a #2/0 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings which are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. The electrode shall extend through a horizontal length of 30 feet minimum and shall be encased in not less than 2 or more than 5 inches of concrete separating it from surrounding soils. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to the main building reference ground bus.
 3. Supplementary grounding electrode (ground ring, grid and driven rods): Provide, as indicated on the Drawings, driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod with structural steel and adjacent rods with minimum #4 AWG bare copper conductor. Ground rod shall not be less than 10 foot from any other electrode of another electrical system or from adjacent ground rod(s).
- B. Grounding electrode conductor: Provide grounding electrode conductor as indicated on the Drawings or sized per NEC/CEC Article 250, whichever is greater.
- C. Power system grounding:
1. Provide, unless otherwise indicated, a main building power system ground bus mounted on the wall in the main electrical room. Connect the following items using NEC/CEC sized copper grounding conductors to lugs on the main building ground bus:
 - a. Grounding conductor from building reference ground bus in main service switchboard.
 - b. Bonding conductor to metallic cold water piping system.
 - c. Bonding conductor to building structural steel.
 - d. Separately derived system grounding conductors in same room.
 2. At the building power system reference ground bus in the main service switchboard, connect the grounding electrode conductor from concrete encased UFER ground or other grounding electrode systems as indicated on the Drawing or herein.
- D. Separately derived electrical system grounding:
1. Ground each separately derived system per requirements in NEC/CEC Article 250 as a minimum, unless greater requirements are required elsewhere in the Contract Documents.
 2. Transformers: Provide a dual rated four or six-barrel grounding lug with a 5/8"-11 threaded hole. Drill enclosure with 11/16" bit and attach lug to enclosure utilizing a torque bolt and a dragon tooth transition washer or equal. Connect the following when present:
 - a. Grounding electrode conductor from supplemental ground rods.
 - b. Building steel.
 - c. Cold water pipe.
 - d. Primary feeder ground.
 - e. Secondary feeder ground.
 - f. Main bond jumper.
 - g. Isolated ground conductor.
- E. Equipment bonding/grounding:

1. Provide a NEC/CEC sized insulated copper ground conductor in all 120VAC through 600 VAC feeder and branch circuit distribution conduits and cables.
 2. Provide a separate grounding bus at panelboards, and switchboards. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35 volts above ground.
 3. Conduit terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
 4. Provide bonding jumpers across expansion and deflection couplings in conduit runs, pipe connections to water meters, dielectric couplings in metallic cold water piping system.
 5. Provide internal ground wire in flexible conduit connected at each end via grounding bushing.
 6. Provide external ground wire wrapped around flexible conduit and terminate to connectors designed for the purpose.
- F. Telecommunication system grounding:
1. In addition to grounding noted on the Drawings for the power systems, provide a telecommunication system ground system consisting of the following:
 - a. Provide a main telecommunication system ground bus bar mounted at the IDF Cabinet.
 - b. From the main telecommunication system ground bus provide one #1/0 THHN in 1-1/4" conduit to the driven ground rod at building exterior, or bond to building steel.

3.03 FIELD QUALITY CONTROL

- A. Independent Testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing required herein.
- B. Prefunctional testing:
1. Provide Testing Agency with Contract Documents for their review prior to the commencement of ground testing.
 2. Visual and mechanical inspection:
 - a. The Testing Agency shall inspect the grounding electrode and connections prior to concrete encasement, burial or concealment.
 - b. Check tightness and welds of all ground conductor terminations.
 - c. Verify installation complies with the intent of the Contract Documents
 3. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required complying with resistance limits specified under this Section of the Specification.
 4. A typewritten record of measured resistance values shall be submitted for review and included with the operation and maintenance manual furnished to the Owner at the time of Project closeout and before certificate of final payment is issued.

END OF SECTION [26 05 26]

SECTION 260529

ELECTRICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Conduit supports.
 - 2. Equipment supports.
 - 3. Fastening hardware.

- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 03: Cast-in-place concrete. Concrete equipment pads.
 - 2. Division 05: Miscellaneous metals. Hangers for electrical equipment.
 - 3. Division 09: Ceiling suspension systems. Slack fixture support wires.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Underwriters Laboratories, Inc. (UL):
UL 2239; Hardware for the Supports of Conduit, Tubing and Cable.

1.03 SYSTEM DESCRIPTION

- A. Provide devices specified in this Section and related Sections for support of electrical equipment furnished and installed under Division 26.

- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein.
 - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 3. Submit Manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
1. Concrete fasteners:
 - a. Hilti Kwik Bolt TZ
 - b. Phillips "Red-Head".
 - c. Remington.
 - d. Ramset.
 2. Concrete inserts and construction channel:
 - a. Unistrut Corp.
 - b. GS Metals "Globe Strut."
 - c. Thomas & Betts "Kindorf" Corp.
 3. Conduit straps:
 - a. O-Z/Gedney.
 - b. Erico "Caddy" Fastening Products.
 - c. Thomas & Betts "Kindorf" Corp.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 CONCRETE FASTENERS

- A. Provide expansion-shield type concrete anchors.
- B. Provide powder driven concrete fasteners with washers. Obtain approval by Architect and Structural Engineer prior to use.

2.03 CONCRETE INSERTS

- A. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of $\frac{1}{4}$ inch to $\frac{1}{2}$ inch diameter thread for rod support.

2.04 THREADED ROD

- A. Provide steel threaded rod, sized for the load unless otherwise noted on the Drawings or in the Specifications.

2.05 CONSTRUCTION CHANNEL

- A. Provide 1-1/2 inch by 1-1/2 inch, 12 gauge galvanized steel channel with $\frac{17}{32}$ -inch diameter bolt holes and 1-1/2 inch on center in the base of the channel.

2.06 CONDUIT STRAPS

- A. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
1. Use malleable strap with spacers for exterior and wet locations.
 2. Use steel strap without spacers for interior locations.
- B. Steel channel conduit strap for support from construction channel.
- C. Steel conduit hanger for pendant support with threaded rod
- D. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of supporting device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 PREPARATION

- A. Coordinate size, shape and location of concrete pads with Division 03, Cast-in-place concrete.
- B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where indicated on the Contract Documents, install freestanding electrical equipment on concrete pads.

3.03 INSTALLATION

- A. Furnish and install supporting devices as noted throughout Division 26.
- B. Electrical device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using precast inserts, expansion anchors, preset inserts or beam clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.
- E. Use expansion anchors or preset inserts in solid masonry walls.
- F. Use self-drilling anchors, expansion anchor or preset inserts on concrete surfaces.
- G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.
- H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit or acoustical ceiling suspension wires.
- I. Do not drill structural steel members unless first approved in writing by the Architect or Structural Engineer.
- J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- K. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.
- L. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.04 ERECTION OF METAL SUPPORTS

- A. Cut, fit and place miscellaneous metal fabrications accurately in location, alignment and elevation to support and anchor electrical materials and equipment.

- B. Field Welding: Comply with AWS "Structural Welding Code."

3.05 WOOD SUPPORTS

- A. Cut, fit and place wood grounds, nailers, blocking and anchorage accurately in location, alignment and elevation to support and anchor electrical materials and equipment.

3.06 ANCHORAGE

- A. All floor mounted, free standing electrical equipment such as transformers, etc. shall be securely fastened to the floor structure.
- B. Anchorage of electrical equipment shall comply with the seismic requirements as outlined in Section 260010: Basic Electrical Requirements.

END OF SECTION [26 05 29]

SECTION 260531

CONDUIT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Rigid steel conduit and fittings.
 - 2. PVC insulated rigid steel conduit and fittings.
 - 3. Intermediate metal conduit and fittings.
 - 4. Electrical metallic tubing and fittings.
 - 5. Flexible metallic conduit and fittings.
 - 6. Liquidtight flexible metallic conduit and fittings.
 - 7. Miscellaneous conduit fittings and products.

- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 01: Cutting and patching.
 - 2. Division 07: Sheet metal flashing and trim.
 - 3. Division 09: Painting. Exposed conduit and other devices.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Federal Specifications (FS):
 - FS WW-C-563; Electrical Metallic Tubing.
 - FS WW-C-566; Specification for Flexible Metal Conduit.
 - FS WW-C-581; Specification for Galvanized Rigid Conduit.
 - FS W-C-1094A; Conduit and Conduit Fittings Plastic, Rigid.
 - 2. American National Standards Institute, Inc. (ANSI):
 - ANSI C80.1; Rigid Steel Conduit, Zinc-Coated.
 - ANSI C80.3; Electrical Metallic Tubing, Zinc Coated.
 - 3. Underwriters Laboratories, Inc. (UL):
 - UL 1; Flexible Metal Conduit.
 - UL 6; Rigid Metal Conduit.
 - UL 360; Liquid-Tight Flexible Steel Conduit.
 - UL 514B; Conduit, Tubing and Cable Fittings.
 - UL 635; Insulating Bushings.
 - UL 797; Electrical Metallic Tubing - Steel.
 - UL 1242; Intermediate Metal Conduit - Steel.
 - 4. National Electrical Manufacturer Association (NEMA):
 - NEMA RN1; PVC Externally coated Galvanized Rigid Steel Conduit.

1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Submit Manufacturer's installation instruction. Provide written instructions for raceway products requiring glues, special tools or specific installation techniques.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted and approved.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 1. Metal conduit:
 - a. Allied Tube and Conduit Co.
 - b. Triangle PWC, Inc.
 - c. Western Tube and Conduit Corp.
 - d. Spring City Electrical Manufacturing Co.
 - e. Occidental Coating Co. (OCAL).
 - f. Alflex Corp.
 - g. American Flexible Metal Conduit Co.
 - h. Anaconda.
 2. Fittings:
 - a. Appleton Electric Co.
 - b. OZ/Gedney.
 - c. Thomas & Betts Corp.
 - d. Spring City Electrical Manufacturing Co.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GALVANIZED RIGID STEEL CONDUIT (GRS)

- A. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.
- B. Standard threaded couplings, locknuts, bushings and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.
- C. Three piece couplings: Electroplated, cast malleable iron.
- D. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.
- E. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
- F. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.
- G. All fittings and connectors shall be threaded.

2.03 PVC INSULATED GALVANIZED RIGID STEEL CONDUIT (PVC GRS)

- A. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 20 or 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
- B. Fittings: Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Conduit: Hot dip galvanized steel meeting the requirements of NEC Article 345 and conforming to ANSI C80.6 and UL 1242.
- B. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

2.05 ELECTRICAL METALLIC TUBING (EMT)

- A. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 Specifications and shall meet UL requirements.
- B. Set screw type couplings: Electroplated, steel or cast malleable iron, UL listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
- C. Set screw type connectors: Electroplated steel or cast malleable iron UL listed concrete tight with male hub and insulated plastic throat, 150 degree C temperature rated. Setscrew shall be same as for couplings.
- D. Raintight couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.
- E. Raintight connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

2.06 FLEXIBLE METALLIC CONDUIT (FMC)

- A. Conduit: Shall be fabricated in continuous lengths from galvanized steel strip, spirally wound and formed to provide an interlocking design and conforming to UL 1.
- B. Fittings: Connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.

2.07 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

- A. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
- B. Fittings: Connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into

the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.08 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

- A. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.
- B. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.
- C. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.
- D. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion or contraction in any direction and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514. Manufacturer shall be OZ/Gedney Type DX, Steel City Type EDF or equal.
- E. Fire rated penetration seals:
 - 1. UL building materials directory classified.
 - 2. Conduit penetrations in fire rated separation shall be sealed with a UL classified fill, void or cavity material.
 - 3. The fire rated sealant material shall be the product best suited for each type of penetration and may be a caulk, putty, composite sheet or wrap/strip.
- F. Standard products not herein specified:
 - 1. Provide listing of standard electrical conduit hardware and fittings not herein specified for approval prior to use or installation, i.e. locknuts, bushings, etc.
 - 2. Listing shall include Manufacturers name, part numbers and a written description of the item indicating type of material and construction.
 - 3. Miscellaneous components shall be equal in quality, material and construction to similar items herein specified.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of conduit system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 APPLICATION

- A. Galvanized rigid steel conduit (GRS) shall be used in the following applications:
 - 1. For feeders and branch circuits located indoors, concealed or exposed above suspended ceilings, in damp/wet locations, in crawl spaces, in attics, chases, furred spaces, equipment rooms, loading docks or in hazardous locations in accordance with NEC and local Codes.

2. For feeders and branch circuits concealed in concrete floors and walls when not in contact with earth.
- B. PVC insulated galvanized rigid steel conduit shall be used in the following applications:
 1. Use 40-mil coating for feeders and branch circuits in damp or wet locations.
 2. Use 20 or 40 mil for feeders and branch circuits concealed in concrete walls or slabs in contact with earth.
 3. Use 20 or 40-mil for runs beneath floor slabs on grade.
 4. Use 40-mil for all below grade penetrations through floor slabs on grade or exterior walls.
 - C. Intermediate metal conduit (IMC): Shall be used for the same application as galvanized rigid steel conduit as specified herein.
 - D. Electrical metallic tubing (EMT): Shall be used exposed or concealed for interior electrical feeders 4" and smaller, interior power and lighting branch circuits and low tension distribution system where run above suspended ceilings, in concrete slabs and walls not in contact with earth; in stud walls, furred spaces and crawl spaces. EMT shall not be installed exposed below 6 feet above the finish floor except within electrical, communication or signal rooms or closets.
 - E. Flexible metallic conduit (FMC): Shall be used only in dry locations for connections from an adjacent outlet box or conduit to all motors, transformers, vibrating equipment or machinery, controllers, solenoid valves, float and flow switches or similar devices and to lighting fixtures installed in suspended ceilings, minimum sizes shall be 3/8" for lighting fixtures and control wiring and 1/2" for motor and transformer connections. U.O.N.
 - F. Liquidtight flexible metallic conduit (LFMC): Shall be used in wet or damp locations for connections from adjacent outlet box or conduit to all motors, transformers, vibrating equipment or machinery, controllers, solenoid valves, float and flow switches or similar devices. These areas are typically food preparation and dishwashing areas, sump wells, loading docks, pump rooms, exterior areas, etc. Minimum sizes shall be 1/2".

3.03 PREPARATION

- A. Locations of conduit runs shall be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas and shall not unnecessarily cross other conduits or pipe, nor prevent removal of ceiling tiles or panels, nor block access to mechanical or electrical equipment.
- B. Where practical, install conduits in groups in parallel vertical or horizontal runs and at elevations that avoid unnecessary offsets.
- C. All conduits shall be run parallel or at right angles to the centerlines of columns and beams, whether routed exposed, concealed above suspended ceiling or in concrete slabs.
- D. Conduits shall not be placed closer than 12 inches to a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
- E. Exposed conduit installation shall not encroach into the ceiling height headroom of walkways or doorways. Where possible, install horizontal raceway runs above water and below steam piping.
- F. The largest trade size conduits in concrete floor and wall slabs shall not exceed 1/3 the floor or wall thickness and conduits shall be spaced a minimum of three conduit diameters apart unless otherwise noted on the Drawings. All conduits shall be installed in the center of concrete slabs or wall and shall not be placed between reinforcing steel and the bottom of floor slabs.

- G. In long runs of conduit, provide sufficient pull boxes inside buildings to facilitate pulling wires and cables, with spacing not to exceed 150 feet. Support pull boxes from structure independent of conduit supports. These pull boxes are not indicated on the Drawings.
- H. Provide all reasonably inferred standard conduits fitting and products required to complete conduit installation to meet the intended application whether noted, indicated or specified in the Contract Documents or not.
- I. Connect recessed lighting fixtures to conduit runs with maximum six feet of flexible metal conduit.

3.04 INSTALLATION

- A. Install conduit in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Minimum Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 1/2" for interior applications and 3/4" for exterior and underground applications.
- C. All conduit sizes indicated on the Drawings are sized for copper conductors with THHN/THWN insulation. If conductor type or size is changed the Contractor shall be responsible for resizing conduits upward to meet Code.
- D. In general, all conduit work shall be concealed where possible. Exceptions shall be electrical, communication and mechanical rooms, exposed ceiling areas, and parking garages.
- E. Conduit connections to motors and surface cabinets shall be concealed, with the exception of electrical, communication and mechanical rooms, or unless exposed Work is clearly called for on the Drawings.
- F. Install conduits in complete runs before pulling in cables or wires.
- G. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.
- H. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.
- I. In making joints in rigid steel conduit, ream conduit smooth after cutting and threading. Coat all field-threaded joints with UL approved conductive type compound to ensure low resistance ground continuity through conduit and to prevent seizing and corrosion.
- J. Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.
- K. In all empty conduits or ducts, install a "True Tape" conduit measuring tape line to provide overall conduit length for determining length of cables/conductors for future use.
- L. Conduit systems shall be mechanically and electrically continuous throughout. Install code size, insulated, copper, green-grounding conductors in all conduit runs for branch circuits and feeders. This conductor is not indicated on the Drawings. Refer to Section 260526: Grounding and Bonding.
- M. Metallic conduit shall not be in contact with other dissimilar metal pipes (i.e. plumbing).
- N. Make bends with standard conduit bending hand tool or machines. The use of any item not specifically designed for the bending of electrical conduit is strictly prohibited.

- O. A run of conduit between terminations at wire pulling points shall not contain more than the equivalent of four quarter bends (360 degrees, total).
- P. Emergency power raceway system: Install entirely independent of other raceway systems, except where specifically allowed by NEC Article 517.

3.05 PENETRATIONS

- A. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, wall, etc. Penetrations are acceptable only when the following occurs:
 - 1. Where indicated on the Structural Drawings.
 - 2. As approved by the Structural Engineer prior to construction and after submittal of Drawing showing location, size and position of each penetration.
- B. Cutting or holes:
 - 1. Cut holes through concrete, masonry block or brick floors and floors of structure with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
 - 2. Provide sleeves or “can outs” for cast-in-place concrete floors and walls. Following conduit installation, seal all penetrations using non-iron bearing, chloride free, non-shrinking, dry-pack grouting compounds; or fire rated penetration-sealing materials.
 - 3. Cut holes for conduit penetrations through non-concrete and non-masonry walls, partitions or floors with a hole saw. The hole shall be only as large as required to accommodate the size of the conduit.
 - 4. Provide single piece escutcheon plates around all exposed conduit penetrations in public places.
- C. Sealing:
 - 1. Non-rated penetrations: Pack opening around conduits with non-flammable insulating material and seal with gypsum wallboard taping compound.
 - 2. Fire stop: Where conduits, wireways and other electrical raceways pass through fire rated partitions, walls, smoke partitions or floor; install a UL classified fire stop material to provide an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.
- D. Waterproofing: At floor, exterior wall and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Division 07: Sealants and Caulking.
 - 1. Install specified watertight conduit entrance seals at all below grade wall and floor penetrations. Conduits penetrating exterior building walls and building floor slab shall be PVC coated rigid galvanized steel.
 - 2. For roof penetrations furnish and install roof flashing, counter flashing and pitch-pockets as specified under Roofing and Sheet Metal Sections of the Specifications.
 - 3. Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane.
 - 4. Conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration on the exterior side a minimum of two times the conduit diameters.

3.06 CONCEALED IN CONCRETE

- A. Install conduits approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the conduits.
- B. Installation of conduit in structural concrete that is less than three inches thick is prohibited. Topping slabs, maintenance pads and curbs are exempted.

- C. Tie conduits to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Run conduit larger than 1-inch trade size, parallel with or at right angles to the main reinforcement; where at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab.
- D. Where nonmetallic conduit or tubing is used, raceways must be converted to PVC coated rigid steel conduit before rising above floor.
- E. Make couplings and connections watertight.
- F. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

3.07 TERMINATIONS AND JOINTS

- A. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
- B. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.
- C. Conduits shall be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
- D. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
- E. Stub-up connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver operated threaded flush plugs with floor.
- F. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating in switchgear, cabinets or gutters inside the building. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.
- G. Raceway seal: Inject into wire filled raceways, a pre-formulated rigid 2 lbs. density polyurethane foam which expands a minimum 35 times it's original bulk. Foam shall have the physical properties of water vapor transmission of 1.2 to 3.0 perms; water absorption less than 2% by volume, fungus and bacterial resistant. Foam shall permanent seal against water, moisture, insects and rodents. Install raceway sealing foam at the following points:
 - 1. Where conduits pass from warm locations to cold locations to prevent passage of water vapor (such as refrigerated spaces, constant temperature rooms, air-conditioned spaces, etc.).
 - 2. Where conduits enter buildings from below grade.
- H. Install expansion couplings where any conduit crosses a building separation or expansion joint as follows:

1. Conduits three inches and larger, shall be rigidly secured to the building structure on opposite sides of a building expansion joint and provided with expansion or deflection couplings. Install the couplings in accordance with the Manufacturer's recommendations.
 2. Conduits smaller than three inches shall be rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground-bonding jumper installed. For concrete embedded conduit, use expansion and deflection couplings as specified above for three inches and larger conduits.
- I. Use short length (maximum of 6ft) of the appropriate FMC or LFMC conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters or noise transmission. Provide liquidtight flexible metal conduit for installation in exterior locations, moisture or humidity-laden atmosphere, corrosive atmosphere, water hose or spray wash-down operations and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with FMC or LFMC conduit.

3.08 SUPPORTS

- A. Provide supports for raceways as specified in Section 260529: Electrical Hangers and Supports.
- B. All raceways systems shall be secured to building structures using specified fasteners, clamps and hangers spaced according to the NEC.
- C. Support single runs of conduit using one-hole pipe straps. Where run horizontally on walls in damp or wet locations, install "clamp backs" to space conduit off the surface.
- D. Multiple conduit runs shall be supported using "trapeze" hangers fabricated from specified construction channel, mounted to 3/8-inch diameter, threaded steel rods secured to building structures. Fasten conduit to construction channel with standard one-hole pipe clamps or the equivalent. Provide lateral seismic bracing for hangers.
- E. Individual 1/2" and 3/4" conduits installed above suspended ceilings may be attached to the ceiling's hanger wire using spring steel support clips provided that not more than two conduits are attached to any single support wire.
- F. Support exposed vertical conduit runs at each floor level, independent of cabinets or switches to which they run, by means of acceptable supports.
- G. Fasteners and supports in solid masonry and concrete:
 1. Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 2. After concrete installation:
 - a. Steel expansion anchors not less than 1/4 inch bolt size and not less than 1-1/8 inch embedment.
 - b. Power set fasteners not less than 1/4 inch diameter with depth of penetration not less than three inches.
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- H. Hollow masonry: Toggle bolts are permitted. Bolts supported only by masonry block are not acceptable.
- I. Metal structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

END OF SECTION [26 05 31]

SECTION 260533

BOXES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Wall and ceiling outlet boxes.
 - 2. Pull and junction boxes.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 08: Access doors. Wall and ceiling access doors.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
 - 1. American National Standards Institute/National Electrical Manufacturer Association:
 - ANSI/NEMA OS-1; Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
 - ANSI/NEMA OS-2; Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
 - NEMA 250; Enclosures for Electrical Equipment (1000 volts maximum).
 - 2. Underwriters Laboratories (UL):
 - UL 50; Enclosures for Electrical Equipment.
 - UL 514A; Metallic Outlet Boxes.
 - UL 1773; Termination Boxes.

1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 3. Submit Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 - a. Outlet boxes:
 - b. Bowers
 - c. Hubbel
 - 2. Weatherproof Outlet Boxes and Box Extension Adapters:
 - a. Bell
 - b. Red Dot
 - c. Carlon
 - 3. Floor boxes:
 - a. Legrand.
 - b. Hubbell Inc.
 - c. Steel City
 - 4. Junction and Pullboxes:
 - a. Circle AW Products.
 - b. Hoffman Engineering Co.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 OUTLET BOXES

- A. Standard outlet box:
 - 1. Provide galvanized, one-piece die formed or drawn steel, knockout type box of size and configuration best suited to the application indicated on the Drawings.
 - 2. 4-inch square by 1-1/2 inch deep shall be minimum box size.
 - 3. ANSI/NEMA OS 1.
- B. Concrete box:
 - 1. Provide galvanized steel, 4-inch octagon rings with mounting lugs, backplate and adapter ring as required.
 - 2. Select height as necessary to position knockouts above concrete reinforcing steel.
 - 3. ANSI/NEMA OS 1.
- C. Tile box:
 - 1. Provide outlet boxes for installation in tile or concrete block walls.
 - 2. Standard outlet boxes with raised, square corners and device covers are acceptable.
 - 3. ANSI/NEMA OS 1.
- D. Cast metal outlet body:
 - 1. Provide four inch round, galvanized cast iron alloy with threaded hubs and mounting lugs as required.
 - 2. Provide boxes with cast cover plates of the same material as the box and neoprene cover gaskets.
- E. Conduit outlet body: Provide Cadmium plated cast iron alloy, oblong conduit outlet bodies with threaded conduit hubs and neoprene gasket, cast iron covers.

2.03 PULL AND JUNCTION BOXES

- A. Sheet metal pull and junction box:
 - 1. Provide standard outlet or concrete ring boxes wherever possible; otherwise use minimum 16 gauge galvanized sheet metal, NEMA 1 boxes, sized to Code requirements with covers secured by cadmium plated machine screws located 6 inches on centers.
 - 2. ANSI/NEMA OS 1.

- B. Cast metal pull and junction box: Provide standard cast malleable iron outlet or device boxes wherever possible; otherwise use cadmium plated, cast malleable iron boxes with bolt-on, interchangeable conduit hub plates with neoprene gaskets.
- C. Flush mounted pullboxes and junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

2.04 FLOOR BOXES

- A. Refer to Section 262726: Wiring Devices for floor mounted service boxes.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of box installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 PREPARATION

- A. Install all outlet boxes flush with building walls, ceilings and floors except where boxes are installed in mechanical and electrical rooms, in cabinetry, above accessible ceilings or where exposed Work is called for on the Drawings.
- B. Locate pullboxes and junction boxes in concealed locations above removable ceilings or exposed in electrical rooms, utility rooms or storage areas.
- C. Install outlet boxes at the locations and elevations indicated on the Drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
- D. Locate switch outlet boxes on the latch side of doorways unless otherwise indicated.
- E. Locate outlet boxes above hung ceilings having concealed suspension systems, adjacent to openings for removable recessed lighting fixtures.
- F. Do not install outlet boxes back-to-back, separate boxes by at least 6". In fire rated walls separate boxes by at least 24" and wall stud.
- G. Adjust position of outlet boxes in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for boxes.

3.03 INSTALLATION

- A. Install boxes in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Locate electrical boxes as indicated on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
- C. Install junction or pullboxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not indicated on the Drawings.

- D. Install raised covers (plaster rings) on all outlet boxes in stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
- E. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
- F. Provide cast metal boxes with gasketed cast metal cover plates where boxes are exposed in damp or wet locations.
- G. Provide precast concrete boxes in exterior planting areas, walkways, roads etc.
- H. Provide an access panel in permanent ceiling or wall where boxes are installed and will be inaccessible.
- I. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.
- J. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height to agree with required location for equipment served.
- K. Use conduit outlet bodies to facilitate pulling of conductors or to make changes in conduit direction only. Do not make splices in conduit outlet bodies.
- L. Add additional sheet rock as necessary to maintain original fire rating of walls where boxes are installed.
- M. Install galvanized steel coverplates on boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.

3.04 SUPPORTS

- A. Provide boxes installed in metal stud walls with brackets designed for attaching directly to the studs or mount boxes on specified box supports.
- B. Mount boxes, installed in suspended ceilings of gypsum board or lath and plaster construction, to 16 gauge metal channel bars attached to main ceiling runners.
- C. Support boxes independently of conduit system.
- D. Support boxes, installed in suspended ceilings supporting acoustical tiles or panels, directly from the structure above wherever pendant mounted lighting fixtures are to be installed from the box.
- E. Support boxes, mounted above suspended acoustical tile ceilings, directly from the structure above.

END OF SECTION [26 05 33]

SECTION 260543

UNDERGROUND DUCTS AND STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Underground conduits and ducts.
 - 2. Handhole and pullboxes.
 - 3. Excavation, trenching and backfill.

- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 31 - Earthwork: General requirements for Excavation and Backfill and related items for ducts, manholes, pullboxes and handholes.
 - 2. Division 03 - Cast-in-place concrete: Protective envelope for ducts.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Federal Specifications (FS):
FS W-C-1094A; Conduit and Conduit Fittings Plastic, Rigid.
 - 2. American Concrete Institute (ACI):
ACI 318; Building Code Requirements for Structural Concrete
 - 3. American National Standards Institute, Inc. (ANSI):
ANSI C80.1; Rigid Steel Conduit, Zinc-Coated.
 - 4. American Society for Testing And Materials (ASTM):
ASTM C31; Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39; Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C172; Standard Practice for Sampling Freshly Mixed Concrete
ASTM C192; Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231; Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C478; Specification for Precast Reinforced Concrete Manhole Sections
ASTM C805; Test Method for Rebound Number of Hardened Concrete
ASTM C857; Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C858; Specification for Underground Precast Concrete Utility Structures
ASTM C877; Specification for External Sealing Bands for Concrete Pipe, Manholes and Precast Box Sections
ASTM C891; Practice for Installation of Underground Precast Concrete Utility Structures
ASTM C990; Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1037; Practice for Inspection of Underground Precast Concrete Utility Structures
ASTM C1064; Standard Test Method for Temperature of Freshly Mixed Concrete

- ASTM C1231; Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinder
- ASTM C1611; Standard Test Method for Slump Flow of Self-Consolidating Concrete
- 5. Underwriters Laboratories, Inc. (UL):
 - UL 6; Rigid Metal Conduit.
 - UL 651; Schedule 40 and 80 Rigid PVC Conduit.
 - UL 651A; Type EB and A Rigid PVC Conduit and HDPE Conduit.
- 6. National Electrical Manufacturer Association (NEMA):
 - NEMA RN1; PVC Externally-coated Galvanized Rigid Steel Conduit.
 - NEMA TC 2; Electrical Plastic Tubing and Conduit.
 - NEMA TC 3; PVC Fittings for use with Rigid PVC Conduit.
 - NEMA TC6; PVC Plastic Utilities Duct (EB and BD Type).

1.03 DEFINITIONS

- A. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground embedded in earth.
- B. Duct bank: Two or more conduits or other raceway installed underground in same trench.
- C. Handhole: An underground junction box in a duct or duct bank.

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 3. Shop Drawings showing details and design calculations for precast handholes, including reinforced steel. Stamp Drawings with seal of registered professional Structural Engineer.
 - 4. Submit Manufacturer's installation instructions.
 - 5. Complete bill of material listing all components.
 - 6. Certificate for concrete and steel used in underground precast concrete utility structures, according to ASTM C858.
 - 7. Inspection report for factory inspections, according to ASTM C1037.
 - 8. Coordination Drawings showing duct profiles and coordination with other utilities and underground structures. Include plans and section drawn to accurate scale.

1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted and approved.
- C. Precast concrete vaults shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete units similar to that indicated in the project specifications or drawings for at least 10 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 - 1. Underground precast concrete utility structures:
 - a. Oldcastle Enclosure Solutions.
 - b. Jensen Precast.
 - 2. Conduits, ducts and fittings:
 - a. Prime Conduit.
 - b. JM Eagle.
 - c. Cantex.
 - d. Occidental Coating Company (OCAL).
- B. Substitution: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 CONDUIT AND DUCT

- A. Refer to 260531: Conduit.
- B. PVC insulated galvanized rigid steel conduit (PVC GRS):
 - 1. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 20 or 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
 - 2. Fittings: Conduit couplings and connectors shall be steel or malleable iron as required with factory PVC coating and insulated jacket equivalent to that of the coated material.
- C. Rigid non-metallic conduit (PVC):
 - 1. Conduit:
 - a. Rigid polyvinylchloride, schedule 40 or 80 conforming to NEMA TC2 and UL 651. UL listed for exposed and direct-burial applications and for 90 degrees C conductor insulation. Conduit shall include an integral bell fitting at one end.
 - b. Rigid polyvinylchloride, type EB or DB conforming to NEMA TC 6 and UL 651. UL listed for concrete encased burial and direct burial applications and for 90 degree C conductor insulation. Conduit shall include an integral bell fitting at one end.
 - 2. Fittings: Couplings, adaptors, transition fittings, bell ends, etc., shall be molded PVC, slip on and solvent weld type. Schedule 40 or 80 conforming to NEMA TC 3 and type EB or DB conforming to NEMA TC 9.
 - 3. Factory elbows: Minimum radius bends shall be 36 inches.
- D. Duct supports: Rigid PVC spacers selected to provide minimum duct spacing and concrete cover depths, while supporting ducts during concrete pour.
- E. Duct sealing compound: Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 degree F, withstands temperature of 300 degrees F without slump and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, cable sheaths and jackets, etc.

2.03 PULLBOXES AND HANDHOLES

- A. Construction: High densities precast reinforced concrete box, extension, base and cover. Furnish box with end and side knockouts and non-settling shoulders. Cover shall have hold-down bolts and two lifting eyes.
- B. Size: As indicated on the Drawings.

- C. Cover markings: Covers shall read "ELECTRICAL" or "SIGNAL" as appropriate.
- D. Rated covers: Use cast iron lid with H20 traffic rating when subject to vehicular traffic.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of duct and manhole installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 EARTHWORK

- A. Excavation and backfill: Conform to Division 31, Earthwork.
- B. Excavation for underground electrical structures: Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation or services, other construction and for inspection.
 - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system for damage and dry-out. Maintain moist conditions for root system and over exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
 - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- C. Trenching: Excavate trenches for electrical installation as follows:
 - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearances on both sides of raceways and equipment.
 - 2. Excavate trenches to depth indicated or required.
 - 3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
 - 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.
- D. Backfilling and filling: Place soil materials in layers to required sub-grade elevations for each area classification, using materials and methods specified in Division 31: Earthwork.
 - 1. Under building slabs, use drainage fill materials.

3.03 CONDUIT AND DUCT INSTALLATION

- A. Install duct lines in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Application:
 - 1. Direct burial ducts: Schedule 40, minimum 24-inches below finished grade.
 - 2. Below building slab-on-grade: Schedule 40, minimum 4-inches below bottom of slab except that bends and penetrates through floor slab shall be PVC coated galvanized rigid steel.
 - 3. Penetrations of building and equipment slabs: PVC insulated rigid steel.
- C. Slope duct to drain towards handholes and away from building and equipment entrances. Pitch not less than 4-inches per 100-feet. Curved sections in duct lines shall consist of long sweep

bends with a minimum radius of 25-feet in the horizontal and vertical directions. The use of manufactured bends is limited to building entrances and equipment stub-ups.

- D. Underground conduit stub-ups to inside of building and exterior equipment shall be PVC insulated rigid steel.
- E. Make joints in ducts and fittings watertight according to Manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- F. Terminate duct lines at handholes with end bells spaced 10-inches on center for 5-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10-feet from the end bell without reducing duct line slope and without forming trap in the line.
- G. Separation between direct buried duct lines shall be 3-inches minimum for like systems and 12 inches minimum between power and signal ducts.
- H. For direct burial installations install continuous warning strip of heavy gage plastic imprinted "electrical ducts below", approximately 12-inch wide at 12-inches above ducts.
- I. Mandrel all ducts upon completion of installation and prior to pulling cables.

3.04 HANDHOLE AND PULL BOX INSTALLATION

- A. Install handholes in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Handholes shall be installed flush with finished grade or surface. Install on a level 6-inch bed of well-tamped gravel or crushed stone.
- C. Orientation of handholes shall be coordinated in advance with Landscape Architect and arranged to minimize connecting duct bends and deflections.

3.05 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and structures.
 - 1. Duct integrity: Rod ducts with a mandrel 1/4-inch smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove the obstructions and retest.

3.06 CLEANING

- A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2-inch greater than internal diameter of duct.
- B. Clean internal surfaces of handholes. Remove foreign material.

END OF SECTION [26 05 43]

SECTION 260553

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Electrical equipment nameplates.
 - 2. Panelboard directories.
 - 3. Wire and cable identification.
 - 4. Buried electrical line warnings.
 - 5. Junction box identification.
 - 6. Inscribed device coverplates.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 09: Painting.

1.02 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein.
 - 2. Schedules for nameplates to be furnished.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 - 1. Conduit and wire markers:
 - a. Thomas & Betts Corp.
 - b. Brady.
 - c. Griffolyn.
 - 2. Inscription Tape:
 - a. Kroy.
 - b. Merlin.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 NAMEPLATES

- A. Type NP: Engraved, plastic laminated labels, Signs and Instruction Plates. Engrave stock melamine plastic laminate 1/16-inch minimum thickness for signs up to 20 square inches or 8 inches in length; 1/8 inch thick for larger sizes. Engraved nameplates shall have white letters and be punched for mechanical fasteners.
- B. Color and letter height as specified in Part 3: Execution.

2.03 LEGEND PLATES

- A. Type LP: Die-stamped metal legend plate with mounting hole and positioning key for panel mounted operator devices, i.e. motor control pilot devices, hand-off-auto switches, reset buttons, etc.
- B. Stamped characters to be paint filled.

2.04 BRASS TAGS

- A. Type BT: Metal tags with die-stamped legend, punched for fastener.
- B. Dimensions: 2" diameter 19 gauge.

2.05 PANELBOARD DIRECTORIES (400 AMP OR LESS)

- A. Directories: A 6" x 8" minimum size circuit directory frame and card with clear plastic covering shall be provided inside the inner panel door.
- B. Circuit numbering: Starting at the top, odd numbered circuits in sequence down the left hand side and even numbered circuits down the right hand side. Multi-section panelboards shall have continuous consecutive circuit numbers, i.e. Section 1 (circuit numbers 1-42), Section 2 (circuit numbers 43-84), Section 3 (circuit numbers 85-126).

2.06 WIRE AND TERMINAL MARKERS

- A. Provide self-adhering, pre-printed, machine printable or write-on, self-laminating vinyl wrap around strips. Blank markers shall be inscribed using the printer or pen recommended by Manufacturer for this purpose.

2.07 CONDUCTOR PHASE MARKERS

- A. Colored vinyl plastic electrical tape, 3/4" wide, for identification of phase conductors. Scotch 35 Brand Tape or equal.

2.08 UNDERGROUND CONDUIT MARKER

- A. 6-inch wide, yellow polyethylene tape, with continuous black imprinting reading "Caution - Buried Electric Line Below".

2.09 INSCRIBED DEVICE COVERPLATES

- A. Coverplate material shall be as specified in Section 262726: Wiring Devices.
- B. Methods of inscription: (Unless otherwise noted)
 - 1. Type-on-tape:
 - a. Imprinted or thermal transfer characters onto tape lettering system.
 - b. Tape trimmer.
 - c. Matte finish spray-on clear coating.
 - 2. Engraving:
 - a. 1/8" high letters.
 - b. Paint filled letters finished in black.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of identification device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 NAMEPLATES

- A. Installation:
 - 1. Degrease and clean surfaces to receive nameplates.
 - 2. Install nameplates parallel to equipment lines.
 - 3. Secure nameplates to equipment fronts using machine screws.
- B. Provide type 'NP' color coded nameplates that present, as applicable, the following information:
 - 1. Equipment or device designation:
 - 2. Amperage, KVA or horsepower rating, where applicable.
 - 3. Voltage or signal system name.
 - 4. Source of power or control.
- C. Nameplates for power system distribution equipment and devices are to be black.
- D. Nameplates for signal systems equipment and devices are to be black except as follows:
 - 1. Fire alarm and life safety - Red.
- E. Minimum letter height shall be as follows:
 - 1. For Switchboards, panelboards, etc.: ½ inch letters to identify equipment designation. Use ¼ inch letters to identify voltage, phase, wires, etc.
 - 2. For individual circuit breakers, switches and motor starters in Switchboards, Distribution panelboards, use 3/8-inch letters to identify equipment designation. Use 1/8-inch letters to identify all other.
 - 3. For individual mounted circuit breakers, disconnect switches, enclosed switches and motor starters use 3/8-inch letters to identify equipment designation. Use 1/8" letters to identify all other.
 - 4. For transformers use 1/2 inch letters to identify equipment designation. Use ¼ inch letters to identify primary and secondary voltages, etc.
 - 5. For equipment cabinets, terminal cabinets, control panels and other cabinet enclosed apparatus use 3/8-inch letters to identify equipment designation.

3.03 LEGEND PLATES

- A. Provide panel-mounted operators devices such as pilot lights, reset buttons, "HAND-OFF-AUTO" switches, etc.

3.04 BRASS TAGS

- A. Provide type BT tags for individual ground conductors to exposed ground bus indicating connection i.e. "UFER", "Cold water bond", etc.
- B. Provide tags for all feeder cables in underground vaults and pull boxes.
- C. Provide tags for empty conduits in underground vault, pull boxes and stubs.

3.05 PANELBOARD DIRECTORIES (400 AMP OR LESS)

- A. Provide typewritten directories arranged in numerical order denoting loads served by room number or area for each circuit.
- B. Verify room numbers or area designation with Project Manager.

- C. Mount panelboard directories in a minimum 6" x 8" metal frame under clear plastic cover inside every panelboard.

3.06 WIRE AND CABLE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboards, pull boxes, outlet and junction boxes and at load connection. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment Manufacturer's Shop Drawings for control wiring.
- B. Provide colored phase markers for conductors as noted in Section 260519: Building Wire and Cable. Apply colored, pressure sensitive plastic tape in half-lapped turns for a distance of 3 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Do not cover cable identification markings by taping.

3.07 UNDERGROUND CONDUIT MARKERS

- A. During trench backfilling, for exterior underground power, signal and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

3.08 JUNCTION BOX IDENTIFICATION

- A. The cover of junction, pull and connection boxes for both power and signal systems, located above suspended ceilings and below ceilings in non-public areas, shall be clearly marked with a permanent ink felt pen. Identify the circuit(s) (panel designation and circuit numbers) contained in each box, unless otherwise noted or specified.

3.09 INSCRIBED DEVICE COVERPLATE

- A. General:
 - 1. Lettering type: Helvetica, 12 point or 1/8" high.
 - 2. Color of characters shall be black.
 - 3. Locate the top of the inscription 1/2" below the top edge of the coverplate.
 - 4. Inscription shall be centered and square with coverplate.
- B. Application:
 - 1. Provide inscribed coverplates for devices as outlined below:
 - a. Outlets in surface raceways.
 - b. Network Lighting Control Switches and Dimmers
 - c. Special purpose switches, i.e. projection screens, shades, exhaust fans, etc.
 - 2. Type-on-tape inscriptions shall be provided for the following devices:
 - a. Receptacles.
 - b. Outlets in surface raceways.
 - c. Telecommunication outlets.
 - 3. Type-on-tape installation:
 - a. Tape shall be trimmed to the height of the letters.
 - b. Trim tape length to 1/4 inch back from each edge of coverplate.
 - c. Contractor hands shall be clean or covered with surgical type glove prior to application of tape. Tape installations with visible fingerprints or smudges will not be acceptable.

END OF SECTION [26 05 53]

SECTION 262716

CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Hinged cover enclosures.
 - 2. Cabinets.
 - 3. Terminal blocks and accessories.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. National Electrical Manufacturer's Association (NEMA):
 - NEMA 250; Enclosures for Electrical Equipment.
 - NEMA ICS 1; Industrial Control and Systems.
 - NEMA ICS 4; Terminal Blocks and Industrial use.
 - NEMA ICS 6; Enclosures for Industrial Controls and Systems.
 - 2. Underwriters Laboratories (UL):
 - UL 50; Enclosures for Electrical Equipment.
 - UL 65; Standards for Wired Cabinets.
 - UL 1059; Terminal Blocks.
 - UL 1773; Termination Boxes.

1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Describe Project construction, material, finish and any specific features of each component.
 - 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 4. Submit Manufacturer's installation instructions.
 - 5. Shop Drawings: Indicating wiring diagrams and equipment arrangement within cabinets.
 - 6. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 - 1. Hoffman Engineering Co.
 - 2. Circle AW Products.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 CABINETS AND ENCLOSURES

- A. Construction: Shall be code gauge galvanized steel with standard concentric knockouts for conduit terminations. Size shall be as indicated on Drawings. Cabinet shall be NEMA 250 Type 1.
- B. Finish: Manufacturer's standard gray baked enamel finish.
- C. Covers: Continuous hinged steel door, lockable and keyed to match panelboard locks.
- D. Mounting:
 - 1. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.
 - 2. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.

2.03 BACKBOARDS

- A. Furnish cabinet with 3/4-inch fire retardant plywood mounting backboard on interior unless otherwise indicated on Drawings.

2.04 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal blocks: NEMA ICS 4; UL listed.
- B. Power terminals: Unit construction type, closed-back with tubular pressure screw connections, rated 600 volts.
- C. Signal and control terminals: See terminal strips in Section 260519: Building Wire and Cable.
- D. Identification: Identify terminal strips with permanent numbers.
- E. Wiring diagram: Provide wiring diagram in protective pocket on inside front cover of cabinet. Diagram shall indicate control wiring, connections and layout of components within enclosure.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of cabinets and enclosures installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 INSTALLATION

- A. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.
- B. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with that referenced in Section 260010: Basic Electrical Requirement.
- C. "Train" interior wiring, bundle and clamp using specified plastic wire wraps.
- D. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.
- E. Terminate conduit in cabinet with lock nut and grounding bushing.
- F. Terminate wiring on terminal blocks and identify each with heat shrink tags.

3.03 CLEANING

- A. Touch-up paint any marks, blemishes or other finish damage suffered during installation.
- B. Vacuum clean cabinet on completion of installation.

END OF SECTION [26 27 16]

SECTION 262816

OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Fuses.
 - 2. Molded case circuit breakers.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Federal Specification (FS):
FS W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service.
 - 2. Underwriters Laboratories, Inc. (UL):
UL 489; Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
 - 3. National Electrical Manufacturer Association (NEMA):
NEMA AB 1; Molded Case Circuit Breakers.
 - 4. Pacific Gas & Electric (PG&E) – Section G2 – Protection and Control Requirements for Generation Entities - Power Generation Interconnection Handbook:
Paragraph G2.14; Emergency Generator Requirements
Table G2-5; Section G2 – Protection and Control Requirements for Generation Entities document.

1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Describe product operation, equipment and dimensions and indicate features of each component.
 - 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 4. Provide factory certification of trip characteristics for each type and rating of circuit breaker.
 - 5. Provide current let-through and melting time information for each type and rating of fuses.
 - 6. Submit Manufacturer's installation instructions.
 - 7. Complete bill of material listing all components.
 - 8. Warranty.

1.04 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:

1. A detailed explanation of the operation of the system.
2. Instructions for routine maintenance.
3. Parts list and part numbers.
4. Telephone numbers for authorized parts and service distributors.
5. Final testing reports.

1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Overcurrent Protective Device components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.07 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 1. Fuses:
 - a. Bussmann Division, Cooper Industries.
 - b. Gould Shawmut Co.
 2. Circuit breakers:
 - a. Square D.
 - b. General Electric.
 - c. Eaton Electrical/Cutler-Hammer.
 - d. Siemens/I-T-E.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 FUSES

- A. General: All power fuses shall be time-delay, high interrupting (300 K AIC), current limiting type, unless otherwise noted on the Drawings. All fuses shall be the product of a single Manufacturer

and shall be selectively coordinated when applied in 2:1 ratios. Types of fuses shall be as follows:

1. Motor branch circuit fuses (0-600 amperes): UL Class J dual element, time delay type fuse. Motor branch circuit fuses shall be sized for Type 2 coordination for the motor controller and back-up motor overload protection and shall be coordinated with motor starter overload relay heaters. See Section 262900: Motor Controls.
- B. Control and instrument fuses shall be suitable for installing in blocks or fuseholders. Exact type and rating shall be as recommended by the Manufacturer of the equipment being protected.

2.03 MOLDED CASE CIRCUIT BREAKERS

- A. Branch and feeder circuit breakers shall be molded case, bolt on and trip indicating.
- B. Where stationary molded case circuit breakers are indicated on the Drawings to be current limiting type, they shall be current limiting as defined by UL 489 and shall not employ any fusible elements.
- C. Circuit breakers shall have interrupting capacity not less than that indicated on the Drawings or if not indicated, not less than 14,000 RMS symmetrical amps for 480 volt systems and 10,000 RMS symmetrical amps for 208 volt systems.
- D. Covers shall be sealed on non-interchangeable breakers and trip unit covers shall be sealed on interchangeable trip breakers to prevent tampering. Circuit breaker ratings shall be clearly visible after installation or engraved nameplates shall be provided stating the rating. All ferrous parts shall be plated to minimize corrosion.
- E. Circuit breakers shall be toggle, quick-make and quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against overcurrent conditions in the circuit. Trip position of the breakers shall be clearly indicated by operating handles moving to a center position.
- F. Multipole breakers shall have a single handle to open and close all contacts simultaneously in both manual operation and under automatic tripping. Interpole barriers shall be provided inside the breaker to prevent any phase-to-phase flashover. Each pole of the breaker shall have means for Arc extinguishing.
- G. All terminals shall be rated for aluminum or copper wire.
- H. Circuit breakers with trip ratings 100 amp and smaller shall be ambient temperature compensated, thermal magnetic type unless otherwise noted. Breakers shall be of full size, 1" per pole type. Panels with more than one branch breaker larger than 100 amps shall be installed in distribution type panels.
- I. Circuit breakers with trip ratings 101 amps through 400 amps shall have solid state electronic trips with true RMS reading through the 13th harmonic with 1% accuracy, interchangeable trip via front accessible current plug, adjustable instantaneous and short time be rated as indicated on Drawings at the voltage indicated.
- J. Circuit breakers with trip ratings 401 amps through 1200 amps shall have electronic trips with the following characteristics:
1. Electronic true RMS sensing trip, adjustable via current plug.
 2. Adjustable long time setting and delay.
 3. Adjustable short time pick-up and delay.
 4. Adjustable instantaneous pick-up.
 5. Mechanical targets on overload, ground fault and short circuit.

- K. Accessories: Provide accessories as noted on the Drawings, i.e. shunt-trip, auxiliary contacts, undervoltage trip, alarm switch, etc.
- L. Spaces in the boards shall be able to accept any combination of 1, 2 or 3 pole circuit breakers as indicated. Provide all necessary bus, device supports and mounting hardware sized for frame, not trip rating.
- M. Series rated breakers are not acceptable unless specifically noted on the Drawings.
- N. Refer to the Drawings for breakers requiring ground fault protection. See Section 262413: Switchboards for requirements of ground fault protection system.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of overcurrent protective device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 INSTALLATION

- A. Install overcurrent protective devices in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment Manufacturers published torque-tightening values for equipment connectors. Where Manufacturers torque requirements are not indicated tighten connectors and terminals to comply with tightening torque specified in UL Standard 486A.
- C. Install overcurrent protective devices and accessories in accordance with Manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. All devices shall be installed in accordance with applicable NEC and NEMA standards for installation.
- D. Circuit breakers serving "Fire Alarm Control Panel(s)" shall be red in color.

3.03 FIELD QUALITY CONTROL

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:
 - 1. Assure overcurrent protective device installation conforms to specified requirements and operates within specified tolerances.
 - 2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
 - 3. Prepare final test report including results, observations, failures, adjustments and remedies.
 - 4. Verify ratings and settings and make final adjustments.
- B. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- C. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.

- D. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.
- E. Prefunctional testing:
 - 1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
 - 2. Visual and mechanical inspection:
 - a. Inspect for physical damage, defects alignment and fit.
 - b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
 - c. Compare nameplate information and connections to Contract Documents.
 - d. Check tightness of all control and power connections.
 - e. Check that all covers, barriers and doors are secure.
 - 3. Electrical tests:
 - a. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.
 - b. Determine that circuit breaker will trip under overcurrent condition, with tripping time in conformance with NEMA AB 1 requirements.
 - c. Test all circuit breakers with frame size 225 amps and larger and 10 percent of all circuit breakers with frame sizes less than 225 amps in each panelboard, distribution board, switchboard, etc. unless otherwise noted.
- F. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- G. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.04 ADJUSTING

- A. Adjust circuit breaker trip settings based on recommendations of Section 260060: Power System Study.
- B. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.
- C. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

3.05 CLEANING

- A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean overcurrent protective devices per Manufacturer's approved methods and materials. Remove paint splatters and other spots, dirt and debris.

3.06 TRAINING

- A. Factory authorized service representative shall conduct a 4 hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION [26 28 16]

SECTION 266113

FIRE ALARM/LIFE SAFETY SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
1. Fire alarm control panel(s) 'FACP'
 2. Fire alarm annunciators
 3. Fire alarm terminal cabinets 'FATC'
 4. Initiating devices
 5. Notification appliances
 6. Auxiliary equipment control and supervision
 7. Voice communication system
 8. Record Drawings
 9. Pretesting and final testing

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
1. American National Standards Institute, Inc. (ANSI):
ANSI C62.41; Guide for Surge Voltage in Low-Voltage AC Power Circuits
ANSI/ASME A17.1; Safety Code for Elevators and Escalators
 2. National Fire Protection Association (NFPA):
NFPA 13; Standards for the Installation of Fire Sprinkler Systems
NFPA 72; National Fire Alarm Code
NFPA 90A; Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 101; Life Safety Code
 3. Underwriters Laboratories, Inc. (UL):
UL 38; Manually Activated Signaling Boxes
UL 268; Smoke Detectors for Fire Protective Signaling Systems
UL 268A; Smoke Detectors for Duct Applications
UL 464; Audible Signal Appliances
UL 497B; Protectors for Data Communications and Fire Alarm Circuits
UL 521; Heat Detectors for Fire Protective Signaling Systems
UL 864; Control Units for Fire-Protective Signaling Systems
UL 1424; Cables for Power-Limited Fire-Alarm Circuits
UL 1480; Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
UL 1481; Power Supplies for Fire-Protective Signaling Systems
UL 1638 Visual Signaling Appliances Standard
UL 1971 Signal Devices for the Hearing Impaired
 4. Factory Mutual System (FM):
FM P7825 Approval Guide

1.03 DEFINITIONS

- A. Addressable device: A fire alarm system initiating, control or monitoring device module component on a signaling line circuit (SLC) with discrete digital identification that can have its status individually identified or that is used to individually control other functions, using site-specific programming at the fire alarm control panel.

- B. Alarm signal: A signal indicating an emergency that requires immediate action, such as a signal indicative of fire.
- C. Circuits and pathways:
 - 1. Class B: Performance that does not include a redundant pathway and will not be capable of operation past a single open or ground fault condition but does include monitoring and annunciation of a trouble signal when either condition occurs. Any conditions that affect the intended operation of the path are annunciated as a trouble signal.
- D. Initiating device: A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box or supervisory switch.
- E. Initiating device circuit: A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated.
- F. Notification appliances: A fire alarm system component such as a bell, horn, speaker, light or text display that provides audible, tactile or visible outputs or any combination thereof.
- G. Notification appliance circuit: A circuit or path directly connected to a notification appliance(s).
- H. Signaling line circuit: A circuit or path between any combination of circuit interfaces, control units or transmitters over which multiple system input signals or output signals or both, are carried.
- I. Trouble signal: A signal initiated by the fire alarm system or device indicative of a fault in a monitoring circuit or component.

1.04 SYSTEM DESCRIPTION

- A. The fire alarm system is an existing Notifier NFS2-3030 with an external Notifier NFC 50/100 Voice Evacuation Panel located in the Administration Building.
- B. Provide system with the following circuit and pathway performance:
 - 1. Signaling line circuits (SLCs): Class B
 - 2. Notification appliance circuits (NACs): Class B
 - 3. Additionally, all notification and communication circuits for partial evacuation systems (EVACS) shall comply with the survivability requirements of NFPA 72, Chapter 12, Level 2 and Level 3.
- C. Standby power: The standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for twenty-four (24) hours and capable of operating the system for fifteen (15) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.
- D. Voltage drop:
 - 1. Under all operating conditions, the voltage on the NAC must be sufficient to operate all the notification appliances so that they deliver the proper signal intensity. The worst-case operating condition shall be calculated from when the control unit primary power supply has failed, and the battery capacity is at its lowest point. An end of useful battery life starting value of 20.4 Volts shall be used at the starting voltage unless the manufacturer's instructions indicate that a higher or lower value should be used. The current draw of an appliance at the minimum listed operating voltage (16 Volts) should be used.
 - 2. The point-to-point Ohm's Law voltage drop calculations of all alarm system circuits shall not exceed.
- E. Spare capacity: The system shall be engineered to accommodate 20% spare capacity on each individual loop, and 20% spare on system power supplies.

1.05 SEQUENCE OF OPERATION

- A. For system description of output controls and monitoring, based on input signals, refer to Sequence of Operation Matrix on the Drawings.
- B. General alarm operation: Upon alarm activation of any area smoke detector, duct smoke detector, heat detector, manual pull station, sprinkler waterflow, etc., the following functions shall automatically occur:
1. The internal audible device shall sound at the control panel and annunciator.
 2. The LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location and time/date.
 3. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
 4. The following notification signals and actions shall occur simultaneously:
 - a. Speakers shall sound throughout the building.
 - b. Activate visual strobes throughout the building.
 5. Transmit signal to the central station with point identification.
 6. Activate automatic smoke control sequences.
 7. All self-closing fire/smoke doors held open shall be released.
 8. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
- C. Trouble operation: Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:
1. The internal audible device shall sound at the control panel and annunciator.
 2. The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
 3. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
 4. Transmit signal to the central station with point identification.
- D. Monitor activation: Upon activation of any device connected to a monitor circuit (fire pump, emergency generator status, etc.), the following functions shall automatically occur:
1. The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
 2. Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.

1.06 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 2. Describe system operation, equipment and dimensions and indicate features of each component.
 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 4. Shop Drawings. A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:
 - a. All drawings and diagrams shall include the contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewer's initials.
 - b. Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.

- c. A riser diagram that individually depicts all control panels, annunciators, addressable devices and notification appliances. Field addressable devices and notification appliances may be grouped together by specific type per loop or circuit.
 - d. Complete 1/8" = 1'-0 scale floor plan drawing locating all system devices and elevation of all equipment. Floor plans shall indicate accurate locations for all control and peripheral devices as well as raceway size and routing, junction boxes, and conductor size, and quantity in each raceway. All notification appliances shall be provided with a candela rating and circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.
 - e. Control panel wiring and interconnection schematics. The drawing(s) shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data-gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure.
 - f. Complete calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws.
 - g. System (Load & Battery) calculations shall be provided for each system power supply, each notification appliance circuit and each auxiliary control circuit that draws power from any system power supply.
 - h. Additionally, Drawings shall include:
 - 1) Symbols legend.
 - 2) Equipment list showing quantity, make, model and CSFM listing number for each device.
 - 3) Wire and cable schedule.
 - 4) Scope of Work with overall system description.
 - 5) Sequence of operation matrix with system inputs signals and output functions.
 - 6) Code summary and Building type.
 - 7) Assignment of Class and/or Style designation for device circuits.
 - 8) Elevation indicating mounting heights for manual pull stations, audible and visual devices and combination audible/visual devices.
 - 9) Rated penetration details.
 - 10) Typical wiring diagram details of field devices.
 - 11) Detector mounting details at HVAC ducts.
 - 12) Voltage drop calculations for system wiring circuits.
 5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
 6. Submit Manufacturer's installation instructions.
 7. Complete bill of materials listing all components.
 8. Installer's NICET 3 Certification
 9. Letter or Certificate from the fire alarm manufacturer stating that the fire alarm contractor is an authorized Strategic Partner of the specified product.
 10. Warranty.
- B. Contractor shall submit approved Shop Drawings for review by State Local Fire Marshal prior to the purchase and installation of equipment. Provide quantities of Drawing sets as required by jurisdiction. Drawings shall be wet stamped and signed by a registered professional Engineer.

- C. Record Drawings:
 - 1. Furnish Record Drawings as described in Section 260010: Basic Electrical Requirements, utilizing Shop-Drawing submissions with updated field conditions. These Drawings shall include but not be limited to the following:
 - a. Plot plans and building floor plans, showing point-to-point wiring location of and conduit routing to all devices.
 - b. Block Diagram/Riser Diagram showing the FACP, system components and all conduit and wire type/sizes between each.
 - 2. Drawings shall be incorporated into the Record Drawing submission.
 - 3. Final acceptance will not be made until the Engineer has approved the Record Drawings.

1.07 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
 - 1. A detailed explanation of the operation of the system.
 - 2. Instructions for routine maintenance.
 - 3. Pictorial parts list and part numbers.
 - 4. Schematic Drawings of wiring system, including all initiation and annunciation devices, control panel, annunciators, etc.
 - 5. Telephone numbers for the authorized parts and service distributors.
 - 6. Final testing reports.

1.08 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.
- C. All work in this Section shall be performed (furnished, installed, connected, programmed and tested) by a qualified fire alarm contractor. The fire alarm contractor shall provide the following documentation to show compliance with the contractor's qualifications.
 - 1. Contractor's License: A copy of the contractor's valid State License. The contractor must be licensed in the State where the project is located and have been in business in that State for a minimum of 5 years.
 - 2. Proof of Experience: Proof that the fire alarm contractor has successfully installed similar fire alarm systems on a previous project of comparable size and complexity. Provide a statement summarizing any pending litigation involving an officer or principal of/or the company, the nature of the litigation and what effect the litigation may carry as it relates to this work in the worst-case scenario. Non-disclosure of this item, if later discovered, may result, at the Owner's discretion, in termination of this contract with the contractor bearing all associated costs.
 - 3. Insurance Certificates: Copy of fire alarm contractor's current liability insurance and state industrial insurance certificates in conformance with the contract document.
 - 4. Service Capability: The fire alarm contractor shall have in-house Engineering, installation and service personnel with a maintenance office within 50 miles of the project location.
 - 5. Authorization Letters: Letters from the fire alarm equipment manufacturer stating that the fire alarm contractor is a Factory Authorized Distributor and is trained and certified for the equipment proposed on this project and is licensed to purchase and install the software required to provide the specified functions.
 - 6. Certifications:
 - a. Provide a copy of the National Institute for Certification in Technologies (NICET) Technician Level 3 Certificate for the employee actively involved in this project.
 - b. Documentation that the fire alarm contractor has on staff personnel factory-trained and certified for the equipment proposed for this project.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Fire alarm system components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to the Manufacturer at no cost to Owner.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.10 WARRANTY

- A. Units and components offered under this Section shall be covered by a **1** year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.
- B. The warranty package shall include, but not be limited to the following:
 - 1. Emergency maintenance service.
 - 2. Service by factory trained service representative of system Manufacturer.
 - 3. Replacement of any defective components.

1.11 MAINTENANCE

- A. Extra Material:
 - 1. Provide the following fire alarm system components as extra materials, matching the products installed and packaged for storing.
 - a. Detectors: Furnish a quantity equal to 10 percent for each type of the number installed.
 - b. Speaker/strobes, strobe's: Furnish a quantity equal to 10 percent of the number installed.
 - c. Speakers: Furnish a quantity equal to 10 percent of the number installed.
- B. Maintenance Service:
 - 1. For a period of one year following acceptance the equipment Supplier shall have a person(s) familiar with this Project attend four quarterly meetings with the Owner's Representative to review system performance, operation and any system problems. That person shall provide a written summary of the items discussed in each meeting and a schedule of when the system problems will be corrected. The report is due within 7 working days after each meeting.
 - 2. During the eleventh month following system acceptance, on a weekend day, the equipment Supplier shall perform a complete test of the system, in a manner similar to the acceptance test. A written report shall be submitted to the Owner certifying that each initiating device has been tested. A copy of these test forms shall be submitted to the Engineer for review and acceptance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Notifier

- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 CONTROL PANEL 'FACP'

- A. Notifier, Existing, located in Administration Building.

2.03 FIRE ALARM AUDIO NOTIFICATION SYSTEM

- A. Notifier NFC-50/100, Existing, located in Administration Building.

2.04 BACK-UP POWER SUPPLY (BATTERIES)

- A. Provide a back-up power source for all system components including but not limited to, amplifiers, digital message units and microphone circuits. Power source shall consist of but not be limited to all necessary conduit, batteries, wire, outlets, transformers, panels and connections to each piece of equipment as required.
- B. Back-up power shall be required such that loss of utility power shall not cause the system operator to be required to restart the system or any part thereof upon return of power. The back-up power supply shall be NFPA approved for life safety applications and shall provide a 4-hour backup of the maximum load possible on the system as required by NFPA 72.
- C. During power failure the amplifiers shall be automatically shut off to minimize drain on batteries but will turn on automatically during alarm or manual activation.
- D. Provide an automatic dual rate (high rate and float charge) battery charger capable of recharging batteries to 80% capacity in 8 hours. The charger output shall be supervised and fused.
- E. If the system loses AC power, a system trouble shall occur.
- F. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting the normal microprocessor scan and minimize resultant nuisance troubles and/or alarms.

2.05 INTELLIGENT ADDRESSABLE DETECTORS

- A. General:
1. Each detector device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Devices shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
 2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.
 3. The intelligent detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms.

Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.

4. Each detector shall be capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Maximum total analog loop response time for detectors changing state shall be 0.75 seconds. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data.
 5. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity.
 6. Each detector shall have a separate means of displaying communication and alarm status. A green/red LED shall flash to confirm communication with the analog loop controller and display alarm status.
 7. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.
 8. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.
 9. Each device microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.
- B. Photoelectric smoke detector:
1. Provide intelligent analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings.
 2. Each unit shall have a field-replaceable smoke chamber.
 3. The photo detector shall be rated for ceiling installation at a minimum of 30 ft centers and be suitable for wall mount applications.
 4. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft high and 3 ft wide with air velocities up to 5,000 ft/minute.
 5. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photoelectric detector shall be suitable for operation in the following environment:
 - a. Temperature: 32°F to 120°F (0°C to 49°C)
 - b. Humidity: 0-93% RH, non-condensing
 - c. Installation attitude: no limit
- C. Fixed temperature/rate-of-rise heat detector:
1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors with low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 2. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data.
 3. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute.

4. The heat detector shall be rated for ceiling installation at a minimum of 50 ft centers and be suitable for wall mount applications.
- D. Standard detector bases:
1. Provide standard detector mounting bases suitable for mounting on a standard 4" octagon or square box. The base shall contain no electronics and support all intelligent detector types.
 2. Removal of the respective detector shall not affect communications with other detectors.
 3. Terminal connections shall be made on the room side of the base.

2.06 INTELLIGENT ADDRESSABLE MODULES

- A. General:
1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Devices shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
 2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location.
 3. The module shall be suitable for operation in the following environment:
 - a. Temperature: 32°F to 120°F (0°C to 49°C)
 - b. Humidity: 0-93% RH, non condensing
- B. Single input module:
1. Provide intelligent signal input modules for monitoring of PIV's, tamper switches, flow switches, fan & damper status, generator status, fire pump status, preaction system alarm or trouble or any other sets of dry contacts required to be monitored.
 2. The single input module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation.
 3. The module shall be suitable for mounting on a standard 4" square box with 1-gang ring.
 4. The single input module shall support the following circuit types:
 - a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 - b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
 - c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 - d. Normally-Open Active Latching (Supervisory, Tamper Switches)
- C. Dual input module:
1. Provide intelligent dual input modules for monitoring of sets of PIV's, tamper switches, flow switches, fan & damper status, generator status, fire pump status, preaction system alarm or trouble or any other sets of dry contacts required to be monitored.
 2. The dual input module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation.
 3. The module shall be suitable for mounting on a standard 4" square box with 1-gang ring.
- D. Signal module:
1. Provide intelligent single input signal modules for activation of booster power supplies, audible/visual circuits, speaker circuits.
 2. The single input signal module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
 3. The module shall be suitable for mounting on a standard 4" square box with 2-gang ring.
 4. The single input signal module shall support audible/visible signal power selector (polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 watts of audio)

- E. Synchronized signal module:
1. Provide intelligent single input signal modules for activation of booster power supplies and/or audible/visual circuits that require synchronization.
 2. The single input signal module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
 3. The module shall be suitable for mounting on a standard 4" square box with 2-gang ring.
 4. The single input signal module shall support audible/visible signal power selector (polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 watts of audio)
 5. Provides UL1971 auto-sync output for synchronizing multiple notification appliance circuits

2.07 NOTIFICATION APPLIANCES

- A. Speakers:
1. Speakers shall be a low profile design, finished in red with white lettering and shall not protrude more than 1" off the finished wall surface. In-out screw terminals shall be provided for wiring.
 2. Speakers shall be provided with a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), and 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL 464.
 3. Wattage setting shall be visible with the cover installed.
 4. The moisture-repellent, fire-retardant speakers shall be selectable for 25-volt circuits or 70-volt circuits.
 5. Speakers shall be suitable for wall mounting and shall mount in a standard 4" square x 2 1/8" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
 6. Speakers shall also be suitable for ceiling mounting and shall mount in a standard 4" square x 2 1/8" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
 7. Where surface mounted speakers are installed a skirt enclosure or manufacturer's color-matched surface mount box, shall be installed to conceal the electrical box to which the strobe lights are mounted. The correct surface box shall be used to ensure the skirt fits properly and is flush with the wall or ceiling.
- B. Strobe lights:
1. Strobes shall be a low profile design, finished in red with white lettering and shall not protrude more than 1" off the finished wall surface. In-out screw terminals shall be provided for wiring.
 2. Strobes shall provide synchronized flash outputs at maximum pulse duration of 0.2 seconds. The light output shall be an even pattern with no hot spots. Strobes appliances shall be comprised of a Xenon flashtube with a clear lens and be entirely solid state.
 3. The strobe shall have selectable 15, 30, 75 or 110 cd settings for wall or standard ceiling height mounting.
 4. The strobe shall have selectable 95, 115, 150 or 177 cd settings for high ceilings.
 5. It shall be possible to change the strobe setting without removing the device from the wall or ceiling.
 6. Strobes shall be suitable for wall mounting and shall mount in a standard 4" square x 1 1/2" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
 7. Strobes shall also be suitable for ceiling mounting and shall mount in a standard 4" square x 1 1/2" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
 8. Where surface mounted strobe lights are installed a skirt enclosure or manufacturer's color-matched surface mount box, shall be installed to conceal the electrical box to which the strobe lights are mounted. The correct surface box shall be used to ensure the skirt fits properly and is flush with the wall or ceiling.

- C. Combination speaker/strobe lights:
1. Speaker/strobes shall be a low profile design, finished in **red** with **white** lettering and shall not protrude more than 1" off the finished wall surface. In-out screw terminals shall be provided for wiring.
 2. Speakers shall be provided with a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), and 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL 464.
 3. Wattage setting shall be visible with the cover installed.
 4. The moisture-repellent, fire-retardant speakers shall be selectable for 25-volt circuits or 70-volt circuits.
 5. Strobes shall provide synchronized flash outputs. The light output shall be an even "Full Light" pattern with no hot spots. Strobes appliances shall be comprised of a Xenon flashtube with a clear lens and be entirely solid state.
 6. It shall be possible to flash the strobe at a temporal flash rate to match the speaker.
 7. The strobe shall have selectable 15, 30, 75 or 110 cd settings for wall or standard ceiling height mounting.
 8. The strobe shall have selectable 95, 115, 150 or 177 cd settings for high ceilings.
 9. It shall be possible to change the strobe setting without removing the device from the wall or ceiling.
 10. Speaker/strobes shall be suitable for wall mounting and shall mount in a standard 4" square x 1 1/2" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
 11. Speaker/strobes shall also be suitable for ceiling mounting and shall mount in a standard 4" square x 1 1/2" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
 12. Where surface mounted speaker/strobe lights are installed a skirt enclosure or manufacturer's color-matched surface mount box, shall be installed to conceal the electrical box to which the strobe lights are mounted. The correct surface box shall be used to ensure the skirt fits properly and is flush with the wall or ceiling.
- D. Weatherproof speakers and strobes and/or combination appliances:
1. Appliances shall be a semi-flush design, finished in red with white lettering. In-out screw terminals shall be provided for wiring.
 2. Speakers shall be weatherproof re-entrant type with field selectable taps for 1/8W to 8W operation for either 25V or 70V. Speakers shall incorporate a sealed back construction for extra protection and improved audibility.
 3. Speakers shall provide a 94dBA sound output over a frequency range of 400-4000 Hz when measured in reverberation room per UL-1480.
 4. Strobes shall provide synchronized flash outputs at maximum pulse duration of 0.2 seconds. The light output shall be an even pattern with no hot spots. Strobes appliances shall be comprised of a Xenon flashtube with a clear lens and be entirely solid state.
 5. The strobe shall have a 75 cd setting for wall or standard ceiling height mounting.
 6. Strobe shall operate over an extended temperature range of -31°F to 150°F. All inputs shall be polarized for compatibility with standard reverse polarity supervision of circuit wiring.
 7. Appliance backbox shall be weatherproof and vandal resistant.
- E. Remote booster power supplies:
1. The unit shall be self-contained with 24Vdc power supply and batteries housed in its own locked enclosure. The keys provided shall be identical to the keys provided for all other fire alarm equipment provided.
 2. The power supply shall be available in both 10 Amp or 6.5 Amp models and 120Vac.
 3. On board LED indicators for each NAC, battery supervision, ground fault and AC power.
 4. The power supply shall provide four (4) independent 3Amp NACs. Each circuit can be configurable as an auxiliary output.
 5. Configurable for any one of three signaling rates: 120SPM; 3-3-3 temporal; or, continuous.

6. Two independent and configurable inputs switch selectable to allow correlation of the two (2) inputs and the four (4) outputs.
7. NACs shall be configurable for either four Class B or two Class A circuits.
8. The unit shall be compatible with SIGA-CC1S for synchronization of multiple power supplies without inter-connect wiring.
9. Brackets shall be provided inside the enclosure to allow mounting the signaling modules. All signaling modules shall be listed to be located inside the booster power supply enclosure.
10. A selectable dip switch shall enable built in synchronization for horns and strobes which may be used to synchronize downstream devices, as well as other boosters and their connected devices.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. The contractor shall thoroughly examine Project site conditions for acceptance of fire alarm system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence installation until all conditions are made satisfactory.

3.02 INSTALLATION

- A. General:
 1. Install fire alarm system in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
 2. The 120volt, 2-wire, 60 cycles AC two-20A circuit supply required to power the system shall be connected as indicated on the Drawings. Connect to red colored circuit breaker(s) in panelboard. Identify circuit as "Fire Alarm Circuit Control."
- B. Conductors:
 1. Refer to Section 260519: Building Wire and Cable.
 2. All circuits shall be rated power limited in accordance with CEC Article 760.
 3. All system conductors shall be of the type(s) specified herein.
 - a. All initiating circuits, signaling line circuit, AC power conductors, shield drain conductors and grounding conductors, shall be solid copper, stranded or bunch tinned (bonded) stranded copper.
 - b. All wiring shall be color-coded throughout.
 - c. Signaling line circuits: Shall be 18 AWG minimum multi-conductor jacketed twisted cable or as per manufacturer's requirements.
 - d. Initiating device circuits: 24Vdc circuits shall be 18 AWG minimum or per manufacturer's requirements.
 - e. Notification appliance circuits:
 - 1) Speaker: Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.
 - f. 120Vac circuits:
 - 1) Minimum 10 AWG for panel power circuits.
 - 2) Minimum 12 AWG for all other circuits.
 - 3) Each circuit shall have its own dedicated neutral conductor.
- C. Conduit raceway:
 1. All system components listed to UL864 Control Units for Fire Protective Signaling Systems may be installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.
 2. All system conduits shall be EMT, 3/4 -inch minimum, except for flexible metallic conduit used for whips to devices only, maximum length 6 feet, 1/2-inch diameter, minimum.

3. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.
 4. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or by fire damage, and so as not to interfere with other building systems, facilities or equipment, and to facilitate service and minimize maintenance.
 5. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service and maintenance.
 6. All junction box covers shall be painted red.
- D. Equipment:
1. All devices and appliances shall be mounted to flush mounted boxes where areas are finished. Exceptions being above suspended ceiling, exposed ceiling areas, or equipment rooms to facilitate connections to other equipment.
 2. All audio/visual devices shall be mounted at a minimum of 80 inches and no more than 96 inches above the finished floor, as measured on strobe center. Devices shall be mounted no less than 6 inches from the ceiling.
 3. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.
 4. No area smoke or heat detector shall be mounted within 12 inches of any wall.
 5. All fire alarm devices shall be accessible for periodic maintenance.
 6. End-of-line resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.
 7. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.
 8. Power-limited/non-power-limited CEC wiring standards shall be observed.

3.03 FIELD QUALITY CONTROL

- A. Refer to Specification Section 260800: Electrical Commissioning.
- B. Manufacturer's field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, pretesting and adjustment of the fire alarm system.
- C. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:
 1. Assure fire alarm system installation conforms to specified requirements and operates within specified tolerances.
 2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
 3. Prepare final test report including results, observations, failures, adjustments and remedies.
 4. Apply label on fire alarm system control panel upon satisfactory completion of tests and results.
 5. Verify settings and make final adjustments.
- D. Engineer witnessed testing: Allow a period of 8 hours for Engineer review and final check.
- E. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.

- F. Prefunctional testing:
1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
 2. Visual and mechanical inspection:
 - a. Inspect for physical damage, defects alignment and fit.
 - b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
 - c. Compare nameplate information and connections to Contract Documents.
 - d. Check tightness of all control and power connections.
 - e. Check that all covers, barriers and doors are secure.
 3. Electrical tests:
 - a. The system shall be completely tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the FACP. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering or shielding shall be completely corrected during pretesting and prior to any final acceptance tests.
 - b. Testing shall include each and every device in the system. Coordinate with other trades as necessary for testing.
 - 1) Smoke detectors , in-duct smoke detectors and duct mounted smoke detectors: Test with actual or approved artificial smoke. Verify that reset does not occur when devices are cleared of smoke. Verify supervisory circuit function.
 - 2) Audible/visual notification: Activate by means of an alarm-initiating device that audible and visual devices are clearly audible and/or visual throughout.
 - 3) Central station notification: Verify that one set of conductors in the terminal cabinet becomes a short circuit on any "trouble" condition and that the other set becomes a short circuit on any "alarm" condition. Verify that the conductor groups are labeled properly.
 - c. Test report:
 - 1) Provide a complete report listing every device, the date it was tested, the results and the date retested (if failure occurred during the previous test). The test report shall indicate that every device tested successfully.
 - 2) Submit two typed copies of the test report in a neatly bound folder for review and approval. Failure to comply with this will result in a delay of final testing and acceptance.
- G. Functional performance testing:
1. Refer to Specification Section 260800: Electrical Commissioning for requirements of system wide functional performance testing.
 2. After the approval of the test report, provide a schedule of final testing to be done in the presence of the Owner's Representative. The schedule must be received by the Engineer a minimum of 2 weeks prior to the Final Test Date and must list the dates and time slots in which the various systems can be tested.
 3. Coordination of the Final Test dates with all parties (General Contractor, Mechanical Contractor, Elevator Contractor, Engineer, Owner and others) shall be the sole responsibility of the Contractor. If a party is required to be present during any phase of testing to activate a device, ensure that the party or a qualified representative of the party is present throughout that phase of the testing.
- H. In the event that the system fails to function properly during the testing, as a result of inadequate pretesting or preparation, the Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate.
- I. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

- J. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.04 TRAINING

- A. Refer to Specification Section 260800: Electrical Commissioning.
- B. Factory authorized service representative shall conduct a 8 hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.
- C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION [26 61 13]

SECTION 26 6516

SECURITY ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Power supply
 - 2. Passive infrared detector "PIR."
 - 3. Door position contact switches.
 - 4. Digital keypad arming/disarming stations.
 - 5. Remote terminal cabinets.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 08: Door Hardware.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. Underwriters Laboratories, Inc. (UL):
 - UL 13; Power-Limited Circuit Cables.
 - UL 294; Access Control System Units.
 - UL 603; Power Supplies for Use with Burglar-Alarm Systems.
 - UL 639; Intrusion-Detection Units.
 - UL 1076: Proprietary Burglar Alarm Units and Systems.
 - 2. Electronics Industries Alliance (EIA):
 - EIA: Testing standards.

1.03 SYSTEM DESCRIPTION

- A. General requirements:
 - 1. Provide new components tied into the existing security alarm monitoring system as described herein.
 - 2. The system shall comprise all necessary supervision, processing, display and printout circuitry and/or devices.
 - 3. The system shall comprise redundant circuitry to ensure that no single independent failure of any component or component group shall cause consequential failure of the system.
- B. System overview:
 - 1. Passive infrared detectors shall be installed in all interior spaces indicated on the Drawings.
 - 2. Flush mounted magnetic contact switches will be provided on all exterior doors to monitor and annunciate "open," "closed," "forced," and "held" positions.
 - 3. Both passive infrared detectors and door position switches shall transmit an alarm condition when the buildings are "armed" and system is violated.
 - 4. Keypads shall be installed at each common building to provide individual zone control of a building. Keypads shall allow access to programmed zones via a 1 to 5 digit access code. They shall be capable of "disarming" or "arming" functions. A delay feature shall

be built into the system to provide personnel sufficient time to disarm system upon entering a building prior to activation of an alarm sequence.

5. The monitoring and control panel shall include a programmable microprocessor and related circuitry capable of interpreting signals from the detection circuits and initiating appropriate alarms.
6. Activation of an intrusion alarm sensor shall cause a signal to be transmitted to a Central Station via telephone lines. A built-in dialer unit shall initiate signal transmission. In addition to alarm reporting, system shall report trouble, low battery and shunted zone indications.

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 2. Describe system operation, equipment and dimensions and indicate features of each component.
 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 4. Shop Drawings:
 - a. Plot plans and building floor plans, showing location of and conduit routing to all devices.
 - b. Point-to-point wiring diagram in block or riser formats showing all components, conduit and wire types and sizes with cable legend.
 - c. Include elevations of control panel and remote terminal cabinet(s).
 5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
 6. Submit Manufacturer's installation instructions.
 7. Complete bill of materials listing all components.
 8. Warranty.

1.05 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
 1. A detailed explanation of the operation of the system.
 2. Instructions for routine maintenance.
 3. Pictorial parts list and part numbers.
 4. Schematic Drawings of wiring system, including all devices, control panel, terminal cabinets, etc.
 5. Telephone numbers for the authorized parts and service distributors.
 6. Final testing reports.

1.06 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Security monitoring and control system components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof

material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.

- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.08 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 - 1. Existing system.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 MAIN CONTROLLER/COMMUNICATOR PANEL

- A. Control Panel: Existing, located in the administration building.

2.03 PASSIVE INFRARED DETECTOR "PIR"

- A. Wall mounted wide-angle infrared detector with dual element pyro-electric sensor and directional pulse count.
- B. Tamper switch shall protect against removal of front cover or unit from wall and shall alarm upon loss of power.

2.04 DIGITAL KEYPAD

- A. Wall mounted keypad to interface with controller to remotely "arm" and "disarm" designated alarm zones of the security monitoring system.

2.05 DOOR POSITION CONTACT SWITCH

- A. Concealed, flush mounting, magnetic contact switch, with self-locking housing, six-inch wire leads and single-pole/double-throw contacts. Sentrol Model #1706 series.

2.06 TERMINAL CABINETS

- A. Provide 18" X 18" X 6" deep hinged door lockable terminal cabinet in NEMA 1 enclosure. All conduits for security system shall terminate in these boxes. Provide engraved nameplate on each box marked "Security System Wiring".

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of the security system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 COORDINATION

- A. Coordinate all installation requirements for door contacts with other trades prior to ordering of doors and frames.
- B. Install contacts, boxes, conduits and connections to doors and frames for complete operating installation. All connections shall be concealed.

3.03 INSTALLATION REQUIREMENTS

- A. Alarm circuits shall be terminated on screw terminals. Terminal blocks shall be Allen-Bradley with 600 volt screw terminals for #22 to #10 conductors, mounted to type M22 channel or approved equal. Submittal shall show internal elevation of terminal cabinets with equipment laid out.
- B. All cables shall be run through fanning strip to terminals on terminal blocks.
- C. All cables entering terminal cabinet shall be identified with Brady or E-Z code wire markers. Upon completion of installation, six (6) copies of one-line "as-built" wiring diagram shall be furnished to the Owner.
- D. Each cable run on wiring diagram shall be identified with exact wire marker code (numerical or alphabetical) as appears in terminal cabinets.
- E. Station locations shall be identified by architectural room numbers and in all ways one-line wiring diagram shall relate as closely as possible to architectural Drawings.
- F. No splices shall occur in underground pullboxes. System wiring shall be continuous, without splices, from terminal cabinet to terminal cabinet and control panel to devices. All interior junction boxes shall be accessible and locations shall be recorded or "As-Built" Drawings.
- G. Door contacts shall be located 6" from hinge side of door and both the switch and magnet shall be epoxy in place.
- H. After all equipment is installed and operational, Contractor shall set angle settings, sensitivity settings, etc., of each detector to ensure optimum performance and minimal false alarms. Mask out areas, of each detector, to remove sources of false alarms (windows, heaters, air diffusers, etc.), from detection zones.

3.04 WIRING

- A. Wiring from devices in building to terminal block at the same building shall be West Penn #241 or approved equal.
- B. Wiring from each building terminal block to the control panel shall be West Penn #244 or approved equal.
- C. Wiring from each keypad to the control panel shall be West Penn #244 or approved equal.
- D. Low voltage AC Power wiring shall not run close to or parallel to fluorescent lighting fixtures. If necessary run conduit perpendicular to the lighting conduit with as much separation as possible.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, pretesting and adjustment of the security system.
- B. Pretesting objectives shall be to:
 - 1. Assure security system installation conforms to specified requirements and operates within specified tolerances.
 - 2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
 - 3. Prepare final test report including results, observations, failures, adjustments and remedies.
 - 4. Apply label on security system control panel upon satisfactory completion of tests and results.
 - 5. Verify settings and make final adjustments.
- C. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- D. Prefunctional testing:
 - 1. Visual and mechanical inspection:
 - a. Inspect for physical damage, defects alignment and fit.
 - b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
 - c. Compare nameplate information and connections to Contract Documents.
 - d. Check tightness of all control and power connections.
 - e. Check that all covers, barriers and doors are secure.
 - 2. Electrical tests:
 - a. The system shall be completely tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the controller. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering or shielding shall be completely corrected during pretesting and prior to any final acceptance tests.
 - b. Testing shall include each and every device in the system. Coordinate with other trades as necessary for testing.
 - 1) Door contact switches: Verify alarm signal received and annunciated at control panel.
 - 2) PIR detection devices: Adjust device sensitivity as required for coverage and location. Verify alarm signal received and annunciated at control panel.
 - 3) Keypads: Ensure that keypads function properly to "arm" and "disarm" the system.
 - 4) Remote station monitoring: Verify that the alarm condition is transmitted via telephone lines to remote monitoring station from auto-dialer/modem device within the control panel.
 - c. Test report:
 - 1) Provide a complete report listing every device, the date it was tested, the results and the date retested (if failure occurred during the previous test). The test report shall indicate that every device tested successfully.
 - 2) Submit two typed copies of the test report in a neatly bound folder for review and approval. Failure to comply with this will result in a delay of final testing and acceptance.

- E. In the event that the system fails to function properly during the testing, as a result of inadequate pretesting or preparation, the Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate.
- F. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- G. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.06 TRAINING

- A. Factory authorized service representative shall conduct a 4 hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION [26 6516]

SECTION 26 7113

TELECOMMUNICATION CABLING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
1. Equipment rooms.
 2. Equipment bonding.
 3. Backbone fiber optic cabling.
 4. Backbone twisted pair cabling.
 5. Horizontal twisted pair cabling.
 6. Telecommunication testing.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
1. Federal Communications Commission (FCC) Regulations:
FCC Part 15; Radio Frequency Devices & Radiation Limits.
FCC Part 68; Connection of Terminal Equipment to the Telephone Network.
 2. Electronics Industries Alliance (EIA):
EIA; Testing Standards.
American National Standards Institute, Inc. (ANSI) / Telecommunications Industry Association (TIA) / Electronics Industries Alliance (EIA):
ANSI/TIA/EIA-568-B; Commercial Building Telecommunications Cabling Standards, including the following:
 - Part 1: General Requirements.
 - Part 2: Balanced Twisted-Pair Cabling Components.
 - TIA SP 3-4426 (12/28/06 or latest version): Transmission Performance Specifications for 4-Pair 100 Ohm Augmented Category 6 Cable (to be published as TIA-568-C.2-10).
 - Part 3: Optical Fiber Cabling Components Standard.ANSI/TIA/EIA-569-A; Commercial Building Standard for Telecommunications Pathways and Spaces, including the following:
 - TIA/EIA-569-A-1: Perimeter Pathway Addendum.
 - TIA/EIA-569-A-2: Furniture Pathway Fill Addendum.ANSI/TIA/EIA-598-B; Optical Fiber Cable Color Coding.
ANSI/TIA/EIA-606-A; Administration Standard for Commercial Telecommunications Infrastructure.
ANSI/J-STD-607-A; Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
ANSI/TIA/EIA-758; Customer-Owner Outside Plant Telecommunications Cabling Standard (TIA/EIA-758-1: Addendum No. 1).
TIA TSB-155; Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBase-T.
 3. Building Industry Consulting Service International, Inc. (BICSI):
BICSI (TDMM); Telecommunication Distribution Methods Manual.
BICSI; Customer-Owner Outside Plant Design Manual.
BICSI (NDRM); Network Design Reference Manual.
 4. Insulated Cable Engineers Association (ICEA):
ICEA S-80-576-2002; Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems.

ICEA S-83-596-1994; Fiber Optic Premises Distribution Cable.
ICEA S-87-640-1999; Fiber Optic Outside Plant Communications Cable.
ICEA S-90-661-2002; Category 3, 5 & 5e Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems.

ICEA S-104-696-2001; Standard for Indoor-Outdoor Optical Cable.

5. Underwriters Laboratories, Inc. (UL):
UL 444; Communication Cables.
UL 497; Protectors for Paired-Conductor Communication Circuits.
UL 1651; Optical Fiber Cable.
UL 1690; Data-Processing Cable.
UL 1963; Communications-Circuit Accessories.
UL 2024A; Optical Fiber Cable Routing Assemblies.

1.03 DEFINITIONS

- A. Adapter: Shall mean a connecting device joining two fiber connectors, either like or unlike.
- B. Cabling: A system comprised of cables, wires, cords, and connecting hardware.
- C. Channel: End-to-end transmission path, i.e. the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
- D. Connect: To install required patch cords, equipment cords, cross-connect wires, etc. to complete an electrical or optical circuit.
- E. Cord: Shall mean length of cordage having connectors at each end. The term "cord" is synonymous with the term "jumper" and "lead."
- F. Identifier: A unique code assigned to an element of the telecommunication infrastructure that links it to its corresponding record.
- G. Passive link segment: Shall mean the cable, connectors, couplings, and splices between two fiber optic termination units.
- H. Permanent link: Test configuration for a horizontal cabling link excluding test cords, connections at the ends of the test cords, patch cords, equipment cords, line cords, etc. The "permanent" portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in equipment rooms, and the connectors at outlets.
- I. Abbreviations:
1. BEP: Building Entrance Protection, for termination of OSP twisted pair cabling.
 2. CAT: Category, used when identifying the performance characteristics of twisted pair cabling.
 3. CMP: Communication Media Plenum, rating applied to ISP twisted pair cable.
 4. CMR: Communication Media Riser, rating applied to ISP twisted pair cable.
 5. IDF: Intermediate Distribution Facilities, telecommunication equipment rooms housing network equipment and containing termination fields for backbone cabling from MDF and horizontal cabling from outlet devices.
 6. ISP: Inside Plant, cable installation within building.
 7. MDF: Main Distribution Facilities, telecommunication equipment room housing possible service entrance facilities for interbuilding backbone cabling, network equipment, house voice system equipment headend, backbone cabling distribution headend, termination fields for backbone and horizontal cabling.
 8. MM: Multimode, fiber cable.

9. MPOE: Minimum Point of Entry, for serving telecommunications utility terminations. House's service provider's termination field(s) and interfaces between utility's facilities and premises facilities.
10. NAM: Network Access Module, workstations.
11. OFN: Optical Fiber Non-conductive, general purpose indoor non-plenum rated.
12. OFNP: Optical Fiber Non-conductive Plenum, plenum rated cable.
13. OFNR: Optical Fiber Non-conductive Riser, non-plenum rated riser cable.
14. OSP: Outside Plant, cable installation outside of building.
15. PIC: Plastic Insulated Conductors.
16. PVC: Polyvinyl Chloride.
17. SM: Singlemode, fiber cable.
18. UTP: Unshielded Twisted Pair, copper cable type.

1.04 SYSTEM DESCRIPTION

- A. Provide a complete telecommunication cabling system installation as specified herein, as shown on the Drawings, and meeting all requirements of the Twin Rivers Unified School District Information and Educational Technology Low Voltage Standards, Section 16700, dated January 2020 (available upon request). In general, system shall include, but not be limited to, the following:
 1. OSP backbone fiber optic cabling:
 - a. Backbone fiber optic cable shall route underground between each buildings main distribution facility (MDF), in a star topology, and shall consist of one 12-strand singlemode, OSP, fiber optic cable(s).
 - b. OSP backbone fiber optic cables shall terminate on rack in existing MDF room for cable interface with ISP backbone fiber optic cables. Terminate cables on backside of rack mounted 24-port patch panels at each IDF.
 - c. Existing rack(s) at MDF room for fiber termination with 96-port patch panels as required and patch cord management placed above and below each patch panel.
 - d. OSP backbone fiber optic patch panel field shall interface with ISP backbone fiber optic patch panel field at MDF via fiber patch cords between modular connectors on front side of patch panels.
 - e. Fiber optic cable connector standard shall be Type LC. Connectors shall be duplex type.
 2. OSP backbone twisted pair cabling:
 - a. Backbone twisted pair cable shall route underground between each buildings main distribution facility (MDF), in a star topology, and shall consist of one multi-conductor 25-pair, Category 3, UTP, OSP, filled copper cable.
 - b. Terminate backbone twisted pair cables on Category 3, wall-mounted, 110 style, BEP blocks at each MDF. BEP shall include a splice chamber.
 3. Horizontal twisted pair cabling:
 - a. Horizontal twisted pair cables shall route between MDF or IDF's and workstation outlets, and shall consists of two Category 6A, 4-pair, UTP, plenum rated copper cables.
 - b. Horizontal twisted pair cables shall terminate on back of rack mounted, Category 6A, 48-port, 19" wide patch panels with modular 8-pin connector front for interface with Owner furnished routers/switches or voice patch panel field via Category 6A patch cords. Patch panels shall have 110 type terminations at rear for horizontal cable terminations.
 - c. Wire management shall be provided above and below, 2 RU, for each 48-port patch panel.
 - d. Copper jack standard is Category 6A, RJ-45 connectors at patch panels and workstation outlets.
 4. Patch cords:
 - a. Patch cords shall match the physical and performance criteria of the specified horizontal twisted pair cable and be terminated at each end with 8-position modular plugs.

- b. Patch cords shall be furnished in varying lengths as required.
 - c. For every terminated cable installed, provide a patch cord for the IDF room, and a patch cord for the workstation.
- B. Workstation outlets:
- 1. Standard telecommunication outlets shall consist of the following, unless otherwise noted on the Drawings:
 - a. Three horizontal twisted pair cable(s) per outlet (two patched for data, one patched for voice)
 - b. Single-gang coverplate with 4-ports.
 - c. Two RJ-45 connector jacks for twisted pair terminations.
 - 2. Telecommunication outlets denoted for Wireless Access Points shall consist of the following, unless otherwise noted on the Drawings:
 - a. Two horizontal twisted pair cable(s) per outlet.
 - b. Single-gang coverplate with 4-ports.
 - c. Two RJ-45 connector jacks for twisted pair terminations.
 - 3. Wall mounted telephone outlets shall consist of the following, unless otherwise noted on the Drawings:
 - a. One horizontal twisted pair cable per outlet.
 - b. Single-gang metal coverplate with 1-port and two support studs.
 - c. One RJ-45 connector jack for twisted pair terminations.
- C. Required System Colors
- 1. Cable Jacket:
 - a. Blue -- Wireless Access Points
 - b. Yellow -- Data
 - c. Red - Critical Connections (UpLink/DownLink Connections)
 - d. White - Phone VOIP/Digital/
 - e. Blue - HVAC/ Alarms, ect...
 - f. Blue - Security Cameras / AccessControl
 - 2. Wall Plates:
 - a. All wall plates - White
 - 3. Patch Cords:
 - a. Blue -- Wireless Access Points
 - b. Yellow - Data
 - c. Red - Critical Connections
 - d. White - Phone VOIP/Digital/ HVAC/ ect...
 - e. Green - Security Cameras / AccessControl
 - 4. Jack Colors (Rack and Workstation)
 - a. Blue -- Wireless Access Points
 - b. Yellow -- Data
 - c. Red - Critical Connections
 - d. White - Phone VOIP/Digital/ HVAC/ ect...
 - e. Green - Security Cameras / AccessControl
- D. Refer to Drawings for complete documentation of above requirements and all additional requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
- 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Describe system operation, equipment, dimensions and indicate features of each component.

3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 4. Shop Drawings prepare in AutoCAD Release 2012 or later, to include the following:
 - a. Building floor plans showing location of all outlets, raceways, cable trays, conduits and cable routing to each device at same scale as construction documents.
 - b. Riser diagram(s) indicating all major components of system with required cable interties and backbone cable identification labels.
 - c. Provide 1/4" scale plans of equipment layout in MPOE, MDF and IDF rooms.
 - d. Provide wall elevations of MPOE, MDF and IDF rooms at 1/2" scale.
 - e. Provide equipment rack elevations at 1" scale.
 - f. Use identical symbols as those used in construction documents.
 - g. Text shall be a minimum of 3/32" high when plotted at full scale.
 - h. Screen all background information.
 5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
 6. Complete bill of materials listing all components.
 7. Warranty.
- B. Installer's qualifications: Furnish satisfactory proof of required experience specified herein for system installer.
- C. Record Drawings:
1. Furnish Record Drawings as described in Section 260010: Basic Electrical Requirements, utilizing Shop-Drawing submissions with updated field conditions. These Drawings shall include but not be limited to the following:
 - a. Plot plans and building floor plans, showing point-to-point wiring location of all devices.
 - b. Block Diagram/Riser Diagram showing the system components and all conduit and wire type/sizes between each.
 2. Drawings shall be incorporated into the Record Drawing submission.
 3. Final acceptance will not be made until the Engineer has approved the Record Drawings.

1.06 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
1. A detailed explanation of the operation of the system.
 2. Pictorial parts list and part numbers.
 3. Schematic wiring diagrams.
 4. Telephone numbers for the authorized parts and service distributor.
 5. Final testing reports.

1.07 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this section may be used on the Project unless otherwise submitted.
- C. Manufacturer qualifications: Manufacturer must have a minimum 5 continuous years of experience in design and manufacturing of the materials and equipment specified herein.
- D. Installer's qualifications:
1. Installer must have a minimum 5 continuous years of experience in satisfactory completion for Projects similar in scope and cost. Provide backup information on 5 such Projects.

2. Installer shall possess a current, active and valid C7 or C10 California State Contractors License.
3. The installer shall be the Manufacturer's certified reseller/installer of the telecommunication equipment provided. Provide evidence of this certification.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Telecommunication system components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipping shall be replaced and returned to Manufacturer at no cost to Owner.
- B. Storage: Store in clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal components damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.09 WARRANTY

- A. The warranty shall commence from the date of final written acceptance by the Owner.
- B. All conditions for obtaining the manufacturer's Performance Warranty shall be the sole responsibility of the contractor.
- C. Upon successful completion of the installation and subsequent inspection, the Owner's Project Manager shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
- D. Contractor shall warrant the installation and that all approved cabling components meet or exceed the requirements of TIA/EIA-568A, TIA/EIA-568A-A5, and ISO/IEC 11801.
- E. The contractor shall maintain a competent service organization and shall, if requested, submit a service maintenance agreement to the owner after the end of the guarantee period.
- F. A typewritten notice shall be posted at the equipment rack that shall indicate the firm, address and telephone number to call when service is necessary. The notice shall be mounted in a neatly finished metal frame with a clear plastic window and securely attached to the inside of the door.
- G. Extended Product Warranty and Application Assurance:
 1. The 25 Year Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA/EIA 568A and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of TIA/EIA TSB 155 and ISO/IEC IS 11801 for cabling links/channels, that the installation will exceed the loss and bandwidth requirements of TIA/EIA TSB 155 and ISO/IEC IS 11801 for fiber links/channels, for a twenty (20) year period. The warranty shall apply to all passive SCS components. The 20 Year Extended Product Warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for a twenty (20) year period.
- H. Contractor will provide a minimum of a fifteen (15) year written warranty from the manufacturer(s) for both UTP basic link and fiber optic cable systems. This may require the contractor to certify their installers to the manufacturer's guidelines before the project begins.

- I. The permanent link cabling system shall be warranted for a period of at least 25 years.
 - 1. The 25 Year Application Assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future, up to 10,000 Mbps parallel transmission schemes, by recognized standards or user forums that use the TIA/EIA-568A or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a twenty (20) year period.
- J. The contractor will provide a two (2) year written warranty covering workmanship and materials in compliance with Twin Rivers Unified School District specifications. All repairs shall be made at no cost to Twin Rivers Unified School District during the warranty period.
- K. Contractor will provide to the Twin Rivers Unified School District warranty information covering parts and materials used by the contractor.
- L. Upon hookup of system and system start-up by Twin Rivers Unified School District, if system troubles should indicate problems with the cables or terminations, it shall be the responsibility of the cable installation contractor to repair any such problems free of charge to the Twin Rivers Unified School District. The contractor shall start this repair work within 48-hours from the initial notification by Twin Rivers Unified School District.
- M. One-Year Maintenance Service shall be provided as follows:
 - 1. Emergency Response: Contractor must respond by utilizing remote diagnostics capabilities (as applicable) within thirty minutes of notification. If necessary, Contractor must dispatch at least one certified technician for arrival on-site within two hours of notification.
 - 2. Non-Emergency Response: Contractor shall respond by utilizing remote diagnostics capabilities and or cause dispatch of at least one certified technician for arrival on-site within one business day of notification.
 - 3. Definition of "Emergency": For maintenance purposes, "emergency" shall be defined as one or more of the following conditions:
 - a. Defects of any riser pairs and/or components involving at least ten percent (10%) of any riser cable's capacity.
 - b. Defects of station cable pairs and/or components involving at least ten percent (10%) of any department or group of analog and/or data stations.
 - c. Defects significantly impairing any single attendant console.
 - d. Defects of any fiber optic cable and/or components involving at least ten percent (10%) of any departments or groups fiber-based systems and/or stations.
 - e. Any pre-defined failure as submitted by Owner and agreed to by Contractor.
 - 4. Contractor shall provide extra service upon request on a 24 hour-a-day, 365 day-a-Year basis. Pricing for such service shall be described in the "Cable Book" Documentation.

1.10 MAINTENANCE

- A. Maintenance services:
 - 1. Distributor of the major system components shall maintain a replacement parts department and provide testing equipment when needed. A complete parts department shall be located close enough to supply replacement parts within a 4 hour period.
 - 2. Service must be rendered within 4 hours of system failure notification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Equipment cabinets:
 - a. Hoffman "Access Plus"
 2. Cable Management:
 - a. Chatsworth Product Inc. "CPI."
 - b. Cooper/B-Line.
 - c. Panduit.
 3. Bonding strap:
 - a. Chatsworth Product Inc. "CPI."
 - b. Cooper/B-Line.
 - c. Thomas & Betts.
 4. Bonding connectors and lugs:
 - a. Panduit.
 - b. Thomas & Betts.
 - c. O-Z/Gedney.
 5. Backbone fiber optic cable:
 - a. SYSTIMAX Inc.
 - b. Corning Cable Systems.
 - c. Berk-Tek.
 - d. Superior Essex
 6. Backbone fiber optic terminations:
 - a. SYSTIMAX Inc.
 - b. Corning Cable Systems.
 - c. Leviton Corp
 - d. Ortronics.
 - e. Panduit
 7. Backbone twisted pair cable:
 - a. SYSTIMAX Inc.
 - b. Superior Essex.
 - c. General Cable.
 - d. Berktek
 8. Building Entrance Protectors:
 - a. SYSTIMAX Inc.
 - b. Porta Systems (OSP).
 - c. Circa (OSP).
 9. Horizontal twisted pair and modular patch cord cable:
 - a. SYSTIMAX Inc.
 - b. Leviton
 - c. Ortronics
 - d. Panduit
 10. Horizontal twisted pair and modular patch cord terminations:
 - a. SYSTIMAX Inc.
 - b. Leviton
 - c. Ortronics.
 - d. Panduit.
 11. Innerduct and duct plugs:
 - a. TVC Communications.
 - b. Tyco "Allied Electrical Group."
 - c. MaxCell
 12. Test equipment:
 - a. Corning Cable Systems
 - b. Fluke Networks.
 - c. Agilent Technologies WireScope 350 Test Set.
 - d. Laser Precision.
 - e. Tektronix.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 EQUIPMENT ROOMS

- A. Wall Mount Equipment Cabinet
 - 1. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment, securable for installation in a joint use telecommunication/electrical room.
 - 2. Material: 14ga steel with black powder coat finish.
 - 3. Construction: 3-section wall mounted cabinet with stationary rear section with conduit knock-outs top and bottom, center swing section with venting slots and 2-pair of 19" rack mount rails, and front door with plexi-glass. Cabinet shall be independently lockable at front door and rear section. Hinges at rear section and front door shall be continuous.
 - 4. Accessories: Provide with 14-position power strip with surge protector, double sided cable organizer, dual fan kit and fan filters.
 - 5. Dimensions shall be nominal 72"H x 24"W x 24"D, minimum 39 RMU.
- B. PDU power strip
 - 1. Provide two PDU power strips per rack. PDUs shall be rated at 20amps, 120volt, 1-phase, 2-wire plus ground.
 - 2. PDU shall contain twenty-four NEMA 5-20R receptacles all per wired.
 - 3. Overall length of power strip shall be 5'-3".
- C. Vertical management sections:
 - 1. Application: Suitable for cable routing (back) and cord slack storage (front) vertically within a rack bay, from bottom of rack to the top.
 - 2. Configuration: The vertical management sections shall be double-sided having covered cable guides on the front and flip-retainers on the rear.
 - 3. Size and capacity: 8'-0" high by 10" wide, having at least 7" deep cable storage capacity in back and 7" deep cord storage capacity in front.
 - 4. Mounting: The vertical management sections shall have matching bolt holes for attachment to equipment rack.
 - 5. Finish: Black, guide and cover.
- D. Horizontal cable support bar:
 - 1. Application: Suitable to horizontally support cables at termination points on back of patch panels.
 - 2. Finish: Shall match the rack.
- E. Horizontal management panels:
 - 1. Application: Suitable to horizontally support cord management within rack bay on front of patch panels.
 - 2. Configuration: The horizontal management panels shall be single-sided.
 - 3. Size: 2U high by 19" mounting width.
 - 4. Finish: Black, guide and cover.
- F. Plywood backboards
 - 1. Plywood backboards shall be placed on all walls of the telecommunications equipment room to 8'-4"AFF. Bottom of plywood shall be 6"AFF. The plywood will support wall mounted equipment, termination blocks, cable runways, etc.
 - 2. Plywood backboards shall be A-C grade, 3/4" thick by 8' high by 4' wide, void free and sanded one side.
 - 3. Paint plywood with 2 coats of fire-retardant paint on both sides and edges. Color to match painted interior.
- G. Label plates for equipment racks:
 - 1. Label plates shall be suitable to affix onto top angle of equipment rack.
 - 2. Label plate shall be "engraved-able" stock melamine plastic laminate substrate.
 - 3. Size: 1/2" high by 6" long by 1/16" thick.

4. Lettering shall be white, engraved, 1/8" high.

2.03 EQUIPMENT BONDING

- A. General:
 1. The telecommunication system grounding backbone is covered under Section 260526: Grounding and Bonding and shown on the drawings in Riser Diagram format. It includes grounding bus bars, grounding riser conductors, connections to main service ground system, ground lugs and clamps, etc.
 2. The work outlined in this Section covers the bonding of all telecommunication equipment and apparatus in the equipment rooms to the telecommunication system grounding backbone.
- B. Bonding conductor:
 1. Refer to Section 260519: Building Wire and Cable.
 2. Conductor: #6 AWG (or larger), copper, stranded.
 3. Insulation: THHN/THWN, green in color.
- C. Cable runway bonding straps:
 1. Refer to Section 260526: Grounding and Bonding.
 2. Conductor: Flexible braided copper strap with factory installed termination connectors.
- D. Connectors and lugs:
 1. Conductor to conductor connector: C-type copper compression tap, heavy-wall, for tapping into unbroken continuous conductors as a splice, wire joint, "T" tap, or making parallel wire connections. Connector can be used with stranded or solid conductors.
 2. Conductor to busbar, racks, cabinets, or other equipment/component connector: Two-hole, copper, compression type lugs for #6 AWG conductors.
 3. Conductor to cable runway connector: Cable tray ground clamp, Extruded aluminum/tin-plated, mechanical type connector with set screws for tightening both tray and bonding conductor.

2.04 BACKBONE FIBER OPTIC CABLING

- A. OSP backbone fiber optic cable:
 1. Application:
 - a. Suitable for outdoors, in underground PVC conduit installations where protection against water and moisture entry is required.
 - b. Optical transmission performance is not significantly affected by environmental fluctuations, installation or aging.
 - c. Materials do not evolve hydrogen in quantities that will increase light attenuation.
 2. Multimode OM4, 50/125µm fiber strands shall meet or exceed the following physical criteria:
 - a. Core diameter: 50µm, ±2.5µm.
 - b. Cladding diameter: 125µm, ±1.0µm.
 - c. Core/cladding offset: ≤1.5µm.
 - d. Coating diameter: 254µm, ±7.0µm.
 - e. Coating/cladding concentricity: 6.0µm.
 - f. Minimum tensile strength: 100,000psi.
 3. Multimode OM4, 50/125µm fiber strands shall meet or exceed the following performance criteria:
 - a. Fiber Type: 850-nm 10G Laser Optimized 50 micron (OM4)
 - b. Attenuation: 3.0dB/km at 850nm and 1.0dB/km at 1300nm wavelengths, maximum.
 - c. Overfilled bandwidth: 3,500MHz•km at 850nm and 500MHz•km at 1300nm wavelengths, minimum.
 - d. Laser bandwidth: 4,700MHz•km at 850nm and 500MHz•km at 1300nm wavelengths, minimum.

4. Singlemode fiber strands shall meet or exceed the following physical criteria:
 - a. Core diameter: 8.3 μ m.
 - b. Cladding diameter: 125 μ m, \pm 0.7 μ m.
 - c. Core/cladding offset: \leq 0.5 μ m.
 - d. Coating diameter: 254 μ m, \pm 7.0 μ m.
 - e. Coating/cladding concentricity: 12.0 μ m.
 - f. Minimum tensile strength: 100,000psi.
 5. Singlemode fiber strands shall meet or exceed the following performance criteria:
 - a. Attenuation: 0.45dB/km at 1310nm and 0.25dB/km at 1550nm wavelengths, maximum.
 - b. Mode field diameter: 8.4 μ m \pm 0.6 μ m at 1310nm and 8.9 μ m \pm 0.6 μ m at 1550nm.
 - c. Cutoff wavelength: \leq 1260nm.
 - d. Dispersion: 8.0ps/nm•km at 1310nm and 2.6-6.0ps/nm•km at 1530-1565nm.
 6. Buffering:
 - a. Fibers shall be loosely buffered, either in a core tube or in multiple tubes around central member.
 - b. Buffering tube(s) shall be filled with compound to protect against moisture penetration. Filling compound shall be non-hygroscopic and non-nutritive to fungus ("FLEXGEL," or equivalent). The compound shall be easily removed with conventional nontoxic solvents.
 - c. Fibers and buffer tube(s) shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995 (also reference ANSI/ICEA S-83-596-1994 and EIA-230).
 7. Cable and sheath:
 - a. Central member: Dielectric rod (glass-reinforced plastic, GRP).
 - b. Fillers (where required to maintain circularity): Plastic rods matched to buffer tube diameter.
 - c. Water blocking tape: Applied longitudinally over the central member/buffer tube(s)/filler core.
 - d. Strength element: The cable shall have an internal strength element such as aramid yarn.
 - e. Rip cord: Nylon or similar (to aid splitting the outer jacket).
 - f. Outer jacket: The cable shall have a seamless outer jacket, high or medium density polyethylene or equal, applied to and completely covering the internal components (central member, buffer tube(s), fillers, strength element, etc.). The outer jacket shall contain UV inhibitors for stable performance in direct sunlight. The outer jacket shall be non-hygroscopic and non-nutritive to fungus.
 - g. Printing: The jacket shall be printed/permanently marked with the manufacturer, sequential length (feet), fiber type, month and year or quarter and year of manufacture.
 8. Tensile strength: The cable shall have a 600 lb minimum rated load.
 9. Operating temperature range: -40° to 158°F.
- B. Backbone fiber optic terminations:
1. Fiber optic patch panels:
 - a. Patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cables and fiber strands. Shall also contain facilities to store fiber slack and provide patch cord management.
 - b. Patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting and cross-connecting fiber optic cabling. Panel shall possess a minimum fire resistant rating of UL94V-1 and shall conform to existing OSHA Health and Safety Laws.
 - c. Patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.
 - d. Panels shall be 2U and/or 4U high, 19" rack mountable, accepting up to 8 and/or 12 adapter panels with 12-ports in each panel. Panels shall contain rear fiber entry slots, wire retainers and fiber storage drums. Furnish with slide out rails for front

- access and jumper troughs for cable management. Panels shall be suitable for multimode or singlemode fiber cable terminations.
- e. Panels shall be provided with LC couplings for termination of fiber cables with matching connectors.
 - f. Provide patch panel and port quantities as required for cable terminations.
2. Fiber optic connectors:
- a. Multimode:
 - 1) Materials:
 - a) Ferrule ceramic with pre-radiused finish/face.
 - b) Connector housing: Plastic.
 - 2) Connector shall have an integral strain relief feature, including a bend limiting rear boot.
 - 3) Connector shall be installable via either epoxy or anaerobic method.
 - 4) Connector type shall be LC
 - b. Singlemode:
 - 1) Materials:
 - a) Ferrule ceramic (zirconia or alumina) with pre-radiused finish/face.
 - b) Connector housing: Plastic.
 - 2) Connector shall meet or exceed Ultra PC performance.
 - 3) Connector shall have an integral strain relief feature, including a bend limiting rear boot.
 - 4) Connector shall be installable via either epoxy or anaerobic method.
 - 5) Connector type shall be LC.
- C. Fiber optic patch cords:
1. Suitable for indoor installations within equipment rooms.
 2. Cords shall be factory-assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via connectors as required. Splices are not permitted anywhere.
 3. Cordage:
 - a. Conductors: 2 optical conductors/strands, matching physical and optical performance parameters of the multimode and singlemode cable plant specified above.
 - b. Construction: "Mini Zipcord" type with strength member (aramid yarn) and jacket of PVC.
 - c. Flame rating: NEC OFN rated or higher, and UL Listed as such.
 4. Connectors:
 - a. Multimode patch cords shall be terminated with either duplex LC connectors at both ends or with duplex LC connectors at one end for connection with the cable plant and via connector type as required for connection to equipment at other end.
 - b. Singlemode patch cords shall be terminated with either duplex LC Ultra PC connectors at both ends or with duplex LC Ultra PC connectors at one end for connection with the cable plant and via connector type as required for connection to equipment at other end.
- D. Labels:
1. Label type shall be a durable plastic tag, suitable for indoor and/or outdoor use, and shall contain UV inhibitors. The tag shall attach to the cable via a separate steel or plastic tie wrap.
 2. Labels shall have a self-laminating feature.
 3. Printable area shall be 3.5" x 2", minimum.
 4. Color shall be yellow with black legend text.
- E. Innerduct:

1. Suitable for outdoor installations within underground duct banks to create multiple “cells” within a single conduit for fiber optic cables installed during the same phase of construction or for future installations of cables.
 2. Innerduct shall be manufactured from internally processed polyester and nylon resins, factory lubricated. Materials shall be halogen-free.
 3. Innerduct shall be flexible engineered fabric sub-ducting, stitched into multi-cell a design. Cells shall come equipped with pulling tape/rope and shall be color-coded via printing and/or stitching.
- F. Duct plugs:
1. Suitable for installation within exterior conduits at terminations within inground vaults/pullboxes and where entering buildings from underground at equipment rooms. Duct plugs shall provide a watertight (up to 20 psi) seal around innerducts and cables.
 2. Duct plugs shall be sized per conduit trade/actual size, per innerduct trade/actual size, and per cable outside diameter, as required per instance.
 3. Duct plugs shall be re-enterable and re-usable.
- G. Miscellaneous:
1. Fiber slack storage reel.
 2. Velcro cable ties:
 - a. Width: 0.75”.
 - b. Color: Same color as the cable to which it is being applied.

2.05 BACKBONE TWISTED PAIR CABLING

- A. ISP backbone twisted pair cable:
1. Application:
 - a. Suitable for indoor installations, between floors exposed in equipment rooms as vertical risers, or above suspended ceilings and below raised floors exposed in cable trays, hangers or on deck. If space is used as an air plenum, cable shall either be plenum rated or installed in EMT conduit.
 - b. Each cable run shall be continuous single cable, homogenous in nature, without splices.
 - c. Twisted pair PIC type cable, air core, with an “ALVYN” sheath, compatible with Bell System type “ARMM.”
 - d. Multipair cable shall be non-plenum rated.
 2. Conductors:
 - a. Annealed solid copper, 24 AWG.
 - b. Fully insulated conductors consisting of an inner layer of expanded polyolefin and covered with an outer layer (skin) of solid PVC.
 - c. Conductors shall be twisted into pairs. Twisted pairs shall be stranded into 25-pair bundles and into larger units of 25-pair increments, to make up the specified pair count, as well as super units (if required by pair count).
 - d. Twisted pairs and units shall be color-coded to industry standards, ANSI/ICEA Publication S-80-576 and EIA-230.
 3. Core and sheath:
 - a. Cable core (twisted pairs) shall have a tape applied longitudinally, wrapped around its entirety. Tape material shall be non-hydroscopic polypropylene film or equivalent.
 - b. Sheath type shall be “ALVYN” consisting of an inner shield and an outer jacket:
 - 1) Shield: 0.008” aluminum corrugated tape applied longitudinally with an overlap.
 - 2) Jacket: Flame-retardant PVC, adhesively bonded to shield.
 4. Cable shall be NEC rated as CMR cable and UL listed as such.
 5. Electrical performance of the twisted pairs and overall cable shall comply with TIA/EIA-568-B Part 2 requirements for Category 3 UTP cabling, minimum.
- B. OSP backbone twisted pair cable:

1. Application:
 - a. Suitable for outdoors, in underground PVC conduit installations where protection against water and moisture entry is required.
 - b. Each cable run shall be continuous single cable, homogenous in nature, without splices.
 - c. Twisted pair PIC type cable, filled core, with an "ASP" sheath, compatible with Bell System type "ANMW" or Rural Utilities Service type "PE89."
 2. Conductors:
 - a. Annealed solid copper, 24 AWG.
 - b. Fully insulated conductors consisting of an inner layer of expanded polyolefin and covered with an outer layer (skin) of solid polyolefin.
 - c. Conductors shall be twisted into pairs. Twisted pairs shall be stranded into 25-pair bundles and into larger units of 25-pair increments, to make up the specified pair count, as well as supper units (if required by pair count).
 - d. Twisted pairs and units shall be color-coded to industry standards, ANSI/ICEA Publication S-80-576 and EIA-230.
 3. Core and sheath:
 - a. Cable core (twisted pairs) shall have a tape applied longitudinally, wrapped around its entirety. Tape material shall be non-hydrosopic polypropylene film or equivalent.
 - b. Cable core and sheath shall be flooded with filling compound "FLEXGEL," or equal, to protect against moisture penetration.
 - c. Sheath type shall be "ASP" consisting of a two layer inner shield and an outer jacket:
 - 1) Shield:
 - a) 0.008" corrugated aluminum tape applied longitudinally over the core wrap.
 - b) 0.006" corrugated steel tape applied longitudinally over the aluminum tape with an overlap.
 - 2) Jacket: Black, linear low density polyethylene, bonded to shield.
- C. Backbone twisted pair terminations:
1. Inside plant:
 - a. Suitable for installation within equipment rooms for termination of twisted pair backbone cables, either wall or rack mounted, vertically oriented in wall mount column configuration.
 - b. 110 block type. Provide kits as required for 100, 300 or 900-pair, 5-pair based.
 - c. Insulated displacement connector blocks consisting of oxygen free mechanical fastening system, arranged in a flame-retardant molded plastic, and fastened to a mounting bracket.
 - d. Tower mounting construction with legless 110 blocks mounted to steel riser trough.
 - e. Termination apparatus accompanied by the quantity of management panels for routing of both horizontal and vertical cords or cross-connect wires. Horizontal wiring management between block sections and crossconnect trough at bottom.
 - f. Blocks shall meet Category 3 and conform to REA PE-87.
 - g. Include both standard blocks and pre-wired blocks as noted on drawings. Pre-wired terminal blocks shall be wired to an RJ-21C (50 Pin) connector either on block or on end of pigtail stub cable.
 2. Outside plant:
 - a. Termination of outside plant cables with building entrance protection "BEP":
 - 1) BEP terminals:
 - a) Suitable for indoor installations, within equipment rooms (such as MPOE). BEP terminals shall provide termination of outside plant twisted pair backbone cables, shall protect premise equipment against induced voltages and stray currents, and shall accept 5-pin protector modules.
 - b) BEP terminals shall be designed for wall mounted configurations and shall have the capacity to accept 50 to 100-pair incoming and/or outgoing cable pairs.

- c) 710-type input splice modules.
 - d) 110-type output punch down blocks.
 - 2) BEP modules:
 - a) Standard 5-pin type BEP, suitable for installation into BEP terminals.
 - b) Gas tube overvoltage device with DC breakdown voltage of 230-350V.
 - c) Heat coil sneak current device with 1 amp of sneak current and response time less than 15 seconds.
- D. Labels:
- 1. Labels type shall be durable plastic (PE or equal) tags, suitable for indoor and/or outdoor use, and shall contain UV inhibitors. The tags shall attach to the cable via an integrated tie or via a separate steel or plastic tie wrap.
 - 2. Printable area shall be 1.50" by 2.62", minimum.
 - 3. Tags shall be gray. Tie wraps for indoor locations shall be white. Tie wraps for outdoor locations shall be black.

2.06 HORIZONTAL TWISTED PAIR CABLING

- A. Horizontal cables:
- 1. Application:
 - a. Suitable for indoor installations, exposed within equipment rooms, above suspended ceilings and below raised floors in cable trays, hangers or on deck, or within walls. If space is used as an air plenum, cable shall either be plenum rated or installed in EMT conduit.
 - b. Each cable run shall be continuous single cable, homogenous in nature, without splices.
 - c. Cables shall meet CAT6A performance criteria for Wireless Access Points
 - d. Cables shall meet CAT6e performance criteria for all other applications
 - e. Cables shall be plenum rated.
 - 2. Conductors:
 - a. Insulated conductors: Eight #23 AWG, solid copper wire insulated with fluorinated-ethylene-propylene (FEP) for plenum rated applications.
 - b. Twisted pairs: Two insulated conductors twisted together to form a pair and four such paired cables to form a unit with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).
 - 3. Cable sheath:
 - a. Outer jacket: Seamless outer jacket, flame-retardant PVC (low smoke for plenum application), applied to and completely covering the internal components (twisted pairs).
 - b. Flame rating: CMP according to NEC Article 800, tested to NFPA 262 and UL Listed as such.
- B. Modular patch cords:
- 1. Application: Suitable for indoor installations within equipment rooms or workstation environments.
 - 2. Cords assembled from a single, continuous length of cordage, homogenous in nature and terminated at both ends via 8-position modular plugs. Splices are not permitted anywhere.
 - 3. Cordage:
 - a. Insulated conductors: Eight solid copper wire insulated with thermoplastic polyethylene or high-density polyolefin for non-plenum rated applications.
 - b. Twisted pairs: Two insulated conductors twisted together to form a pair and four such paired cables to form a unit with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).
 - 4. Cable sheath:

- a. Outer jacket: Seamless outer jacket, flame-retardant PVC, applied to and completely covering the internal components (twisted pairs).
 - b. Flame rating: CM according to NEC Article 800, tested to UL listed as such.
 5. Electrical performance: Meet or exceed TIA/EIA-568-C.2-10 Augmented and ISO 11801 Edition 2.1 Class E specifications for CAT6A UTP cabling.
- C. Crossconnect wires:
 1. Crossconnect wires shall be suitable for installation within equipment rooms and fully compatible with the termination apparatus specified within this Section.
 2. Crossconnect wires shall be manufactured from a single, continuous length of insulated wire, homogenous in nature. Splices are not permitted anywhere.
 3. Conductors:
 - a. Insulated conductors: #24 AWG, solid copper wire insulated with thermoplastic polyethylene or high-density polyolefin for non-plenum rated applications.
 - b. Twisted pairs: Two insulated conductors twisted together to form a pair with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).
- D. Modular patch panels:
 1. Application:
 - a. Modular patch panels shall be suitable for installation within a equipment room for the terminations of horizontal cables specified within this Section.
 - b. Patch panels shall be horizontally oriented for rack-mounted configuration within a 19" rack.
 - c. Patch panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and the equipment termination field.
 2. Modular patch panels shall have 110-type terminations on back for horizontal cabling.
 3. Patch panels shall have 24 or 48 ports on front and each port shall be an 8-position modular jack, matning the criteria of the cable and shall becompliant to TIA/EIA 568-C.2 Chapter 5.
 4. Each port shall be T568A wired.
 5. Also, include 24 or 48 port modular patch panels with pre-wired RJ-21C (50 Pin) connectors. Panels shall conform to all above requirements, except performance shall meet TIA/EIA-568-B.2 for CAT3 UTP cabling.
- E. Modular connectors:
 1. Modular connectors shall be 8-position jacks, compliant to TIA/EIA-568-C.2, and shall be compatible with the specified cable within this Section, both electrically and physically
 2. Modular connectors shall be T568A wired.
- F. Outlets:
 1. Application:
 - a. Outlet faceplates and mounting frames shall be suitable for indoor installations to standard single or double-gang flush wall mounted outlet box plaster rings, furniture partition outlets and floor boxes.
 - b. Refer to Specification Section 262726: Wiring Devices for device coverplate finish.
 2. Standard wall mounted faceplates:
 - a. Modular faceplates shall have 4-ports and shall include required accessories, such as icons, blank inserts, label windows and labels.
 - b. Faceplates shall be single-ganged.
 - c. Faceplates shall be flush mounted.
 - d. Faceplates shall be single-gang decora-style to match power wiring devices.
 3. Modular outlet frame:
 - a. Modular outlet frame shall have 234-ports and shall include required accessories, such as icons, blank inserts, label windows and labels.
 - b. Outlet frame shall be decora-style.

- c. Outlet frame shall attach like a duplex receptacle strap attaches to a box.
- 4. Wall mounted phone faceplates:
 - a. Faceplate shall be single-gang, flush mounted with 1 port and shall include required accessories.
 - b. Faceplate shall include two mounting studs for standard wall phone instrument.
 - c. Faceplate shall be stainless steel.
- 5. Surface mounted outlets:
 - a. Surface outlets shall be fully compatible with the specified modular connector/jacks.
 - b. Surface outlets shall have 4-ports.
- 6. Partition furniture mounted faceplates:
 - a. Faceplates shall be single-gang type with 2346-ports and shall include required accessories, such as icons, blank inserts, label windows and labels.
 - b. Faceplates shall be black.
- G. Labels:
 - 1. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer or hand-held printer.
 - 2. Labels for horizontal cables:
 - a. Adhesive backed labels and self-laminating feature.
 - b. Fit the horizontal cables specified herein by fully wrapping around the cable jacket.
 - c. Size: 2" x .05" printable area, minimum.
 - d. Color: White.
- H. Miscellaneous components:
 - 1. Velcro cable ties:
 - a. Width: 0.75".
 - b. Color: Velcro cable ties the same color as the cable to which it is applied.
 - 2. Plenum cable ties:
 - a. Suitable for use in plenums or air handling spaces.
 - b. Color: Maroon or other distinctive non-white color.

2.07 CABLE TESTING EQUIPMENT

- A. Fiber optic cabling:
 - 1. Fiber optic light source:
 - a. Connection interfaces shall be factory installed.
 - b. Output shall be continuous wavelengths.
 - c. The light sources may contain internal lenses, pigtails, and modal conditioners, provided they meet the launch conditions as described in "Post-Installation" Passive Link Attenuation Testing Procedures.
 - d. LASER-based light source for multimode fiber testing shall have the following:
 - 1) Center wavelength of 850nm \pm 30nm and 1300nm \pm 20nm
 - 2) Special width (FWHM) of \leq 50nm at 850nm and \leq 150nm at 1300nm.
 - 3) Minimum output power level of \geq 20dBm.
 - e. LASER-based light source for singlemode fiber testing shall have the following:
 - 1) Center wavelength of 1320nm \pm 20nm and 1550nm \pm 20nm
 - 2) Special width (FWHM) of \leq 5nm at 1310nm and \leq 5nm at 1550nm.
 - 3) Minimum output power level of \geq 3dBm.
 - 2. Fiber optic power meter:
 - a. Power meter for multimode and singlemode testing shall be capable of measuring relative of absolute power (or both) and must be independent of modal distribution.
 - b. Power meters used must be calibrated and traceable to the National Bureau of Standards.
 - c. Power meter used shall have the following:
 - 1) Dynamic range of 0dBm to -40dBm minimum.
 - 2) Accuracy of \pm 0.2dBm.
 - 3. Fiber optic mandrel:

- a. Mandrel diameter for 50/125µm jacketed (3.0mm) fiber shall be 22mm.
 - b. Mandrel diameter for 50/125µm unjacketed (0.9mm) fiber shall be 25mm.
4. Fiber optic OTDR:
- a. Multimode source module:

Wavelength	Dynamic Range	Attenuation Deadzone	Reflective Deadzone	Loss Resolution	Distance Accuracy
850nm	24dB	6.5mt	3.0mt	0.001dB	0.1mt
1300nm	27dB	7.0mt	3.0mt	0.001dB	0.1mt

- b. Singlemode source module:

Wavelength	Dynamic Range	Attenuation Deadzone	Reflective Deadzone	Loss Resolution	Distance Accuracy
1310nm	40dB	6.0mt	3.5mt	0.001dB	0.1mt
1550nm	28dB	12.0mt	3.5mt	0.001dB	0.1mt

- c. Reader software: Windows-based software capable of reading stored traces and is fully functional with the testing equipment.

5. Fiber optic test cords:

- a. Multimode fiber optic test cords:

- 1) The fiber of the multimode test cords shall have the core diameter and numerical aperture nominally equal to that of the multimode fiber optic passive link.
- 2) Test cord length for testing insertion loss: 1m to 5m.
- 3) Connectors of the test cords shall be compatible with the connector types of the light source and the power meter, and with the cabling plant.
- 4) The connectors shall exhibit ≤0.5dB loss per connection @ both 850nm and 1300nm, as measured per FOTP-171 D2.

- b. Singlemode fiber optic test cords:

- 1) The fiber of the singlemode test cords shall have the core diameter and numerical aperture nominally equal to that of the singlemode fiber optic passive link.
- 2) Test cord length for testing insertion loss: 1m to 5m.
- 3) Connectors of the test cords shall be compatible with the connector types of the light source and the power meter, and with the cabling plant.
- 4) The connectors shall exhibit ≤0.5 dB loss per connection @ both 1300 nm and 1550 nm, as measured per FOTP-171 D3. The connectors shall inhibit Fresnel reflections (i.e. have a “PC” finish).

- B. Twisted pair cabling:

- 1. Backbone cable tester: Areas of test measurement shall be Wire Map for continuity, opens, shorts, crossed pairs and split pairs, as a minimum.
- 2. Horizontal cable tester:
 - a. Equipment shall meet TIA/EIA-568B.2 Addendum 1 requirements for Level III accuracy, as applicable for cable type specified herein.
 - b. Test standards: ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-Y, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5.
 - c. Areas of test measurement (minimum):
 - 1) Wire Map.
 - 2) Length.
 - 3) Insertion Loss.
 - 4) The following at both master unit and remote unit:
 - a) Near End Crosstalk (NEXT) loss.
 - b) Power Sum NEXT (PSNEXT) loss.
 - c) Equal Level Far End Crosstalk (ELFEXT).
 - d) Power Sum ELFEXT.

- e) Return Loss (RL).
- f) Attenuation-to-Crosstalk Ratio (ACR).
- g) Power Sum ACR (PSACR).
- 5) Propagation Delay and Delay Skew.
- 6) Characteristic Impedance.
- 7) DC Loop Resistance.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of the telecommunication cabling system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.
- B. Verify that pathways and supporting devices are properly and completely installed prior to cable installation.
- C. Verify dimensions of pathways to include length, i.e. "true tape" conduit runs.
- D. Prior to installation, verify that equipment rooms are ready to accept cables and terminations.

3.02 INSTALLATION

- A. Equipment rooms:
 - 1. Rack bays:
 - a. Equipment racks:
 - 1) Provide parts and accessories required to complete each rack per manufacturer's instructions and as detailed on drawings.
 - 2) Anchoring and bracing:
 - a) Anchor racks to the floor using structural engineer approved concrete anchors.
 - b) Each rack must be attached to the floor at four points.
 - c) If required for seismic bracing, provide bracing devices (i.e. brackets, threaded rod with strut, etc.) attached to wall or structure above using appropriate fasteners.
 - 3) Tolerances:
 - a) Verify dimensions to establish proper clearances as follows:
 - (1) Front: 40" clearance from channel front mounting flange.
 - (2) Back: 57" clearance from channel back mounting flange.
 - b) Provide the correct amount of space between each rack for proper installation (according to manufacturer's written instructions) of the vertical management sections.
 - b. Vertical management sections:
 - 1) Provide vertical management sections mounted to racks with one between each rack and one on both ends.
 - 2) Bolt sections to the racks at the points designed by the manufacturer and per the manufacturer's instructions.
 - c. Horizontal management panels:
 - 1) Provide the horizontal management panels mounted to racks with one above each patch panel and one below the bottom patch panel in each rack bay where patch panels occur.
 - 2) Provide fasteners and parts required to complete the installation.
 - d. Accessories: Provide all accessories as required for a complete installation. Include one bag of rack mounting screws, as come packaged with rack product. Attach the screws directly to the rack, which shall constitute turn-over to the Owner.

2. Overhead cable runway support:
 - a. Provide support devices (i.e. brackets, threaded rod with strut, etc.) attached to wall or structure above using appropriate fasteners. Installation shall meet manufacturer's instructions and layout on the drawings.
 - b. Provide all parts and accessories required for a complete installation.
 - c. Cable runway support shall be centered over equipment racks where shown running parallel.
 - d. Coordinate the installation of the overhead cable runway support with other trades having Work in same area.
 3. Vertical cable runway support:
 - a. Install cable runway vertically on walls where noted and/or shown on the drawings. Runway shall be for the support of cables routed vertically on walls within the equipment rooms.
 - b. Provide parts and accessories as required for a complete installation.
 - c. Install the cable runway such that the rungs are facing outward (the greater distance from the rung to the stringer edge is facing inward).
- B. Equipment bonding:
1. Provide telecommunication bonding conductor and appropriate hardware between the telecommunication system grounding backbone bus in each equipment room and the equipment racks/rack bays, overhead cable support, vertical cable support, telecommunication conduits, primary pathways that exit/enter the rooms (if applicable), and all other metallic telecommunication infrastructure components.
 2. Telecommunication bonding conductor:
 - a. The minimum size for the bonding conductor shall be #6 AWG THHN/THWN.
 - b. Install the bonding conductors in a manner that will protect them from physical and mechanical damage.
 - c. Route the bonding conductors in the shortest possible path, using right angles for turns and routed parallel to building lines.
 - d. Utilize a minimum of 1'-0" bending radius.
 - e. At the backbone ground busbar:
 - 1) Thoroughly clean the busbar prior to attaching connectors and terminating conductors.
 - 2) Attach connectors to the busbar with appropriate size cadmium bronze bolt, flat washer and Belleville washer.
 - 3) Torque all connectors.
 3. Rack bays:
 - a. Bond equipment racks, frames, frame bays, cabinets, server racks, and all other similar support systems located within the same equipment room or space to the backbone ground busbar in same room.
 - b. Rack bays may be bonded in series using either of the following configurations:
 - 1) Provide a bonding conductor from the backbone busbar to the closest rack and route through ground lug connected to rack, extending the conductor the full length of the rack bay. Each individual rack shall have a ground lug attached that the bonding conductor passes through. Insulation on bonding conductor, where it passes through the lug, shall be removed prior to tightening connection around conductor.
 - 2) Provide a bonding conductor from the backbone busbar to the closest rack and then along the entire length of rack bay. "T" tap a pigtail, sized the same as the bonding conductor, from the bonding conductor to each individual rack and terminate on ground lug connected to rack.
 4. Overhead and vertical cable runway support:
 - a. Bond cable runway located within the same equipment room or space to the backbone ground busbar in same room.
 - b. Provide a "ground kit" (straps and connectors) to bond sections of the runway for ground continuity. This requirement applies to runway sections and junctions within the same equipment room.

- C. ISP backbone fiber optic cabling:
1. Cabling:
 - a. Cable runs shall have continuous sheath continuity, homogenous in nature, without any splices.
 - b. Maximum cable length of 1,600 feet (500m) between the terminations at MPOE, MDF's and IDF's.
 - c. Placement:
 - 1) Place cables within designated pathways.
 - 2) Maintain a minimum bend radius of 20 times the cable diameter during installation and a minimum bending radius of 10 times the cable diameter after installation.
 - 3) Maintain pulling tension within manufacturer's limits.
 - 4) Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
 - 5) Do not use cable-pulling compounds for indoor installations.
 - 6) Provide 20 to 30 feet minimum sheath cable slack at each end of the run within the equipment rooms. Store cable slack in the fiber slack storage reel mounted on wall.
 - 7) Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of pull rope.
 - d. Routing:
 - 1) Within equipment rooms, neatly dress and organize cables on designated cable routing facilities and fasten cables to routing facilities via tie wraps or Velcro type straps.
 - 2) When routing horizontally within equipment rooms, utilize the overhead cable support system. When routing vertically within equipment rooms, utilize the vertical cable support system and provide approved cable straps at 24" intervals.
 - e. Terminations:
 - 1) Properly relieve strain from cables at termination points, at or within the fiber optic termination panels) per manufacturer's instructions.
 - 2) Provide breakout kits to furcated fibers from buffer tubes. Provide required accessories and consumables for the complete termination of fiber strands.
 - 3) Terminate fiber strands at both ends using the specified finer optic connectors appropriate for the mode type of the fiber. Perform termination in accordance with manufacturer's instructions.
 - 4) Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the routing rings, per manufacturer's instructions.
 2. Termination apparatus:
 - a. Provide fully assembled termination patch panels in designated equipment racks, located a top of rack. "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
 - b. Provide accessories required for proper installation of each termination patch panel, including connector panels and adapters.
 - c. Termination sequence:
 - 1) Rack-mount panels: Terminate singlemode fibers first (upper left-most position), then multimode fibers, all in sequential strand order.
- D. OSP backbone fiber optic cabling:
1. Innerduct:

- a. Provide innerduct and accessories for all conduits containing outside plant fiber optic cables. Innerducts shall consist of either three 1.25" or four 1" innerducts per 4" conduit. Assume the latter unless indicated otherwise on the Drawings.
 - b. Install innerduct per manufacturer's instructions. Use pulling equipment and consumables (such as lubricants) allowed by the manufacturer. Place multiple innerduct using pulling harness designed specifically for the use and also using pulling swivel.
 - c. At each vault or pullbox, building entrance, and equipment room, secure innerducts with triplex (for use with three 1.25" innerducts) or quadplex (for use with four 1" innerducts) duct plugs.
2. Cabling:
- a. Cable runs shall have continuous sheath continuity, homogenous in nature, between either termination points or designated splice points. Only splices as noted on the Construction Documents are permitted.
 - b. Maximum cable length of 4,900 feet (1,500m) between the terminations at MPOE or MDF's.
 - c. Placement:
 - 1) Place cables within designated pathways.
 - 2) Maintain a minimum bend radius of 20 times the cable diameter during installation and a minimum bend radius of 10 times the cable diameter after installation.
 - 3) Maintain pulling tension within manufacturer's limits.
 - 4) Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
 - 5) Only use UL approved cable-pulling compounds when necessary to reduce pulling tension.
 - 6) Provide 20 to 30 feet minimum sheath cable slack at each end of the run within the equipment rooms. Store cable slack in the fiber slack storage reel mounted on wall.
 - 7) Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of pull rope.
 - d. Routing:
 - 1) Route cables in innerduct between points of termination throughout entire length, except at the fiber take up reel.
 - 2) Within equipment rooms, neatly dress and organize cables on designated cable routing facilities and fasten cables to routing facilities via tie wraps or Velcro type straps.
 - 3) When routing horizontally within equipment rooms, utilize the overhead cable support system. When routing vertically within equipment rooms, utilize the vertical cable support system and provide approved cable straps at 24" intervals.
 - e. Terminations:
 - 1) Properly relieve strain from cables at termination points, at or within the fiber optic termination panels) per manufacturer's instructions.
 - 2) Provide breakout kits to furcated fibers from buffer tubes. Provide required accessories and consumables for the complete termination of fiber strands.
 - 3) Terminate fiber strands at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform termination in accordance with manufacturer's instructions.
 - 4) Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the routing rings, per manufacturer's instructions.
3. Duct plugs:
- a. Install plugs per manufacturer's instructions.

- b. Provide duct plugs at conduit ends, both within inground vaults/pullboxes and at building entrances. Provide fillers in each used duct port.
- 4. Termination apparatus:
 - a. Provide fully assembled termination patch panels in designated equipment racks, located a top of rack. "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
 - b. Provide accessories required for proper installation of each termination patch panel, including connector panels and adapters.
 - c. Termination sequence:
 - 1) Rack-mount panels: Terminate singlemode fibers first (upper left-most position), then multimode fibers, all in sequential strand order.
- E. OSP backbone twisted pair cabling:
 - 1. Cabling:
 - a. Cable runs shall have continuous sheath continuity, homogenous in nature, between either termination points or designated splice points. Only splices as noted on the Construction Documents are permitted.
 - b. Maximum cable length of 4,900 feet between the terminations at MPOE or MDF's.
 - c. Placement:
 - 1) Place cables within designated pathways.
 - 2) Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
 - 3) Maintain pulling tension within manufacturer's limits. Only use UL approved cable pulling compounds when necessary to reduce pulling tensions.
 - 4) Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
 - 5) Neatly dress and organize cables in the cable routing facilities and fasten to support devices via tie wraps.
 - 6) Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of pull rope.
 - d. Routing:
 - 1) When routing horizontally within equipment rooms, utilize the overhead cable support system. Within overhead cable support, route backbone cables to avoid crossing over horizontal cabling or horizontal cabling crossing over backbone cables. When routing vertically within equipment rooms, utilize the vertical cable support system and provide approved cable straps at 24" intervals.
 - 2) Route cables a minimum of 6" away from power sources to reduce interference from EMI.
 - e. Terminations:
 - 1) Provide 15 feet cable slack loop at each end of the cable run. Store slack in overhead cable support system or on backboard.
 - 2) Properly relieve strain from cables at termination points per manufacturer's recommendations.
 - 3) Bond metallic components of the cable sheath (i.e. shield) to the telecommunication ground system in accordance with the NEC and manufacturer's instructions.
 - 4) Terminate twisted pairs at both ends onto the specified BEP terminals. Perform terminations in accordance with manufacturer's latest instructions and TIA/EIA-568-B standard installation practices.
 - 2. Building entrance protection:
 - a. Provide BEP system to include terminals, modules and accessories required for a complete installation. Install BEP per manufacturer's written instructions.

- b. Install BEP terminals plumb and square with building lines. Install such that the bottom row of terminations is no lower than 24" above finished floor and the top row of terminations is no higher than 60" above finished floor.
 - c. Grounding and bonding:
 - 1) Bond BEP terminals to the telecommunication ground system in accordance with the NEC and per the manufacturer's instructions.
 - 2) Provide #6 AWG bonding conductor.
 - d. Provide quantity of protector modules to completely populate terminals.
- F. Horizontal twisted pair cabling:
- 1. Horizontal cable installation and routing:
 - a. Cable runs shall have continuous sheath continuity, homogenous in nature with no splicing.
 - b. No cabling shall exceed a cable length of 295' (90m) from the termination point at the equipment room to the termination at the workstation outlet, including service slack, when measured using test equipment.
 - c. Place cables within the designated pathways, such as cable tray or basket tray, cable runway, cable hangers, etc. Do not fasten, support or attach cables to other building infrastructures (i.e. ducts, pipes, conduits, etc.), other systems (i.e. ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays and non-approved pathway systems.
 - d. Place and suspend cables during installation and termination in a manner to protect them from physical damage or interference. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
 - e. Route cables at 90° angles, allowing for bending radius.
 - f. Do not exceed pulling tension of 25 lbs.
 - g. Do not use cable-pulling compounds.
 - h. Do not exceed a minimum bend radius of 6 times the cable diameter during and after installation.
 - i. Route cables beneath other building infrastructures (i.e. ducts, pipes, conduits, etc.) in above ceiling applications. Do not route cables over building infrastructures. The installation shall result in easy accessibility to the cables in the future.
 - j. Place cables 6" minimum away from power sources to reduce interference from EMI.
 - k. Do not set 360° service loops in place for slack storage. Instead, set slack as forward-and-back or as figure eights.
 - l. Place a pull string along with cables where run in conduits and spare capacity in conduit remains. Tie off ends of the pull string to prevent the string from falling onto the conduit.
 - m. When exiting the primary pathway, such as cable or basket tray, to the workstation outlets, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.
 - 2. Cable routing and dressing within equipment rooms:
 - a. Within equipment rooms, only use Velcro type straps.
 - b. Place cables within the overhead cable support system. When routing vertically on walls, fasten the cables onto vertical supports every 24" on center.
 - c. Provide 12" minimum sheath cable slack, length not to exceed permanent link maximum length requirement. Place the slack in the overhead cable support system.
 - d. At the rack bay, route and neatly dress cables from the overhead cable support system into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination. Fasten the cables to the cable support bar at the back of the patch panel using approved ties.
 - 3. Termination in the equipment rooms:
 - a. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.

- b. Properly relieve strain from the cables to and at termination points per manufacturer's instructions. Provide a strain relief bar at the back of the modular patch panels for proper strain relief.
 - c. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA/EIA-568-B standard installation practices. Terminate cable pairs onto the termination apparatus compliant to T568A wiring.
 - d. Modular patch panels and horizontal management panels:
 - 1) Provide quantity of modular patch panels to support the terminations of cables served from respective IDF. Provide quantity of horizontal management panels based on the quantity of patch panels.
 - 2) Install and assemble modular patch panels and horizontal management panels according to the manufacturer's instructions.
 - 3) Install the patch panels and the horizontal management panels as shown on the Drawings.
 - 4) Terminate cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.
4. Cable routing and dressing at workstations:
- a. Provide 12" to 18" cable slack at each workstation outlet, length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger or other approved cable support device.
 - b. Route to partition furniture mounted faceplates:
 - 1) Route cables from primary or secondary pathway within ceiling through the furniture partition feed pathway (stub from wall or floor box) into opening at bottom of furniture system. Exercise caution to prevent scraping, cutting or other damage to cable jacket.
 - 2) Provide spiral wrap around cables from furniture-feed pathway to point where cables enter furniture.
5. Termination at the workstation outlets:
- a. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
 - b. Connector color shall match the faceplate.
 - c. Provide "fog white" connectors for data links and "dark blue" connectors for voice links.
 - d. Wall mounted standard devices:
 - 1) Install devices at heights indicated on drawings.
 - 2) Mount faceplates plumb, square and at the same level as adjacent power receptacles.
 - 3) Patch gaps around faceplates so that faceplate covers the entire wall opening.
 - e. Partition furniture mounted devices:
 - 1) Coordinate installation of the faceplate adapters with the furniture contractor, including color.
 - 2) Mount faceplate adapters into the designated openings for horizontal cables.
 - f. Terminate cables and twisted pairs in accordance with the manufacturer's latest installation requirements and TIA/EIA-568-B standard installation practices. Terminate cable pairs onto the connector compliant to T568A wiring.
6. Patching and crossconnecting:
- a. In equipment rooms, provide one modular patch cord for the first data connector in each workstation outlet. Install from the horizontal termination field to the network switches/equipment. Neatly dress patch cords within the horizontal and vertical cable management components.
 - b. In equipment rooms, provide one modular patch cord for the first voice connector in each workstation outlet. Install from the horizontal termination field to the voice field.

Neatly dress patch cords within the horizontal and vertical cable management components.

- c. Provide one 1-pair crossconnect for each workstation outlet. Install from backbone twisted pair 110 terminal blocks to the pre-wired 110 terminal blocks. Neatly dress patch cords within the horizontal and vertical cable management components.

3.03 LABELING

- A. General requirements:
 1. Labeling, label colors, and identifier assignments shall conform to EIA/EIA-606-A Administration Standards and as approved by the Owner.
 2. Provide permanent and machine-generated labels. Hand written labels will not be accepted.
- B. Equipment room labeling:
 1. Equipment rack: Provide one label plate per rack and cabinet/frame. Permanently affix label plate centered on the rack's top angle or the cabinet's top front frame.
 2. Identifier assignment for equipment racks:
 - a. Prefix: "RACK"
 - b. First field: The IDF identity.
 - c. Second field: The rack number.
- C. Backbone fiber optic cable labeling:
 1. Cables:
 - a. Text color shall be black with #10 font size.
 - b. Identifier assignment:
 - 1) First field: Type of cable.
 - 2) Second field: Total strand count.
 - 3) Third field: Cable number.
 - 4) Fourth field: Strands in use and dead strands.
 - 5) Fifth field: Source and destination.
 - 6) Sixth field: Terminal number (MPOE, MDF, IDF).
 - c. Label installation:
 - 1) Provide labels on both ends of cables.
 - 2) Install such that they are visible by a technician from normal stance.
 - 3) Fully wrap label around the cable jacket (self lamination).
 - 4) Provide one label within 12" of the termination apparatus.
 - 5) Provide one label at the point where the cable enters/exits the equipment room.
 - 6) Provide one label at the approximate mid-point between where the cable enters/exits the room and the termination apparatus.
 2. Fiber patch panels:
 - a. Text color shall be black, #10 font size.
 - b. Label installation:
 - 1) Provide labels at each port.
 - 2) Install labels into label window.
- D. Backbone twisted pair cable labeling:
 1. Cables:
 - a. Text color shall be black with #10 font size.
 - b. Identifier assignment:
 - 1) First field: Type of cable.
 - 2) Second field: Total number of pairs.
 - 3) Third field: Cable number.
 - 4) Fourth field: Active cable count and "dead" pairs.
 - 5) Fifth field: Source and destination.
 - 6) Sixth field: Terminal number (MPOE, MDF, IDF).

- c. Label installation:
 - 1) Provide labels on both ends of cables.
 - 2) Install such that they are visible by a technician from normal stance.
 - 3) Fully wrap label around the cable jacket (self lamination).
 - 4) Provide one label within 12" of the termination apparatus.
 - 5) Provide one label at the point where the cable enters/exits the equipment room.
 - 6) Provide one label at the approximate mid-point between where the cable enters/exits the room and the termination apparatus.
 - 2. BEP terminals:
 - a. Text color shall be black with #10 font size.
 - b. Identifier assignment:
 - 1) First field: Building identifier.
 - 2) Second field: Building zone identifier.
 - 3) Third field: Incoming cable pair identifier.
 - 4) Fourth field: Outgoing cable pair identifier.
 - c. Label installation:
 - 1) Install labels such that they are visible by technician form normal stance.
 - 2) Provide one label on the terminal cover or housing.
 - 3. Modular patch panels:
 - a. Text color shall be black, #10 font size.
 - b. Label installation:
 - 1) Provide labels at each port.
 - 2) Install labels into label window.
 - 4. Label installation in manholes/vaults/pullboxes:
 - a. Provide at least one label within the manholes/vaults/pullboxes.
 - b. Install labels such that they are visible by technician from above grade.
 - 5. Label installation at splice points:
 - a. Provide one label on each side of splice case.
 - b. Install labels such that they are visible by technician from above grade.
 - E. Horizontal twisted pair labeling:
 - 1. Cables:
 - a. Text color shall be black, #10 font size.
 - b. Label installation:
 - 1) Provide labels on both ends of cable.
 - 2) Install labels such that they are visible by technician from a normal stance.
 - 3) Fully wrap label around the cable jacket (self lamination).
 - 4) Provide one label within 4" of the termination apparatus.
 - 2. Modular patch panels:
 - a. Text color shall be black, #10 font size.
 - b. Label installation:
 - 1) Provide labels at each port.
 - 2) Install labels into label window.
 - 3. Outlets:
 - a. Text color shall be black, #10 font size.
 - b. Label installation:
 - 1) At faceplates, provide labels above and below jacks.
 - 2) At surface boxes, provide labels on the top of the box.

3.04 FIELD QUALITY CONTROL AND TESTING

- A. General:
 - 1. Calibrate test sets and associated equipment per the manufacturers instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

2. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer’s discretion, halt testing activity and clean testing equipment, test cords and related apparatus.
3. Permanently record test results electronically within test equipment at the time of testing.

B. Fiber optic testing:

1. Test fiber optic passive links as follows:

TESTS FOR FIBER OPTIC CABLING TABLE				
Subsystem	Type	Test	Direction	Wavelength
OSP backbone	Multimode	Characterization, passive link insertion loss	Both	850nm and 1300nm
OSP backbone	Singlemode	Characterization, passive link insertion loss	Both	1310nm and 1550nm
ISP backbone	Multimode	Passive link insertion loss	Both	850nm and 1300nm
ISP backbone	Singlemode	Passive link insertion loss	Both	1310nm and 1550nm

2. Precautions:
 - a. Adhere to the equipment manufacturer’s instructions during testing.
 - b. Prior to testing activity or measurements taken, complete the following activities:
 - 1) Ensure the test equipment is at room temperature, approximately 70°F.
 - 2) Turn the light source and power meter power on for at least 5 minutes.
 - 3) Clean test/launch cords and system cords, if applicable, connectors and the cabling system adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
 - c. Do not power off OTDR’s light source during testing activity.
 - d. Do not remove launch cord from the OTDR’s light source at any time (unless the testing is complete or the equipment is being put away for the evening or during trouble shooting).
 - e. Do not bend the launch cord smaller than 20 times the cord diameter during testing activities, as this may induce loss into the cord reducing the accuracy of the measurements).

C. Fiber optic characterization testing:

1. Equipment settings/measurement parameters:
 - a. Index of refraction: Match cable-under-test fiber parameters, default settings as follows:
 - 1) Multimode: 1.481 – 1.483 @ 850nm and 1.476-1.478 @ 1300nm.
 - 2) Singlemode: 1.466-1.467 @ 1310nm and 1.467-1.4677 @ 1559nm.
 - b. Pulse width (20ns for multimode and 50ns for singlemode):
 - 1) Multimode: 4ns for cable lengths up to 980 feet (300m); 20ns for cable lengths between 980 feet (300m) and 6,560 feet (2,000m).
 - 2) Singlemode: 10ns for cable lengths up to 6,560 feet (2,000m); 50ns for cable lengths between 6,560 feet (2,000m) and 32,800 feet (10,000m).
 - c. Backscatter:
 - 1) Multimode: -67dB @ 850nm, -74dB @ 1300nm.
 - 2) Singlemode: -74dB @ 1310nm and 1550nm.
 - d. Event threshold: 0.05dB.
 - e. Reflection threshold:
 - 1) Multimode: -45dB.
 - 2) Singlemode: -60dB.
 - f. Fiber break/end-of-fiber: 3dB.

2. Waveform: The waveform shall be real-time and normal density.
 3. Obtain measurements using a “launch” cord connected to the test instrument and the cable under test.
 - a. The fiber of the launch cord shall match the fiber of the cable under test in physical and performance parameters (i.e. type, core/cladding size, index of reflection, refraction profile, etc.). The fiber of the launch cord should match the fiber of the cable under test in manufacturer and product.
 - b. Use launch cord length between 25 and 100 meters.
- D. Fiber optic passive link insertion loss testing:
1. Test cords performance verification:
 - a. Connect test cord #1 between the light source and the power meter.
 - b. The value displayed on the power meter is the Reference Power (P_{ref}) measurement. If the power meter has a Relative Power Measurement Mode, enter this Reference Power Measurement (P_{ref}) value into the meter. If it does not, hand-write P_{ref} onto the record document for future reference.
 - c. Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
 - d. Connect the “open” end of test cord #1 to an adapter of matching connector type. Connect one end of test cord #2 to the adapter and the other end to the power meter.
 - e. The value displayed on the power meter is the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the test cord #2 connection attenuation. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the connection attenuation:
 - 1) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.):
Connection attenuation (dB) = ($P_{sum} - P_{ref}$)
 - 2) If P_{sum} and P_{ref} are in watts: Connection attenuation (dB) = $[10 \times \log_{10} (P_{sum}/P_{ref})]$
 - 3) The measured connection attenuation must be less than or equal to the value found in the Table below.
 - f. Flip the ends of test cord #2, so that the end connected to the power meter is now connected to the adapter, and the end connected to the adapter is now connected to the power meter.
 - g. The meter reading is the reversed Power Measurement (P_{sum}). Perform the proper calculations if not using Relative Power Measurement Mode.
 - h. Verify that both connection attenuation measurements are less than or equal to the value found in the following Table:

ACCEPTABLE TEST CORD CONNECTION ATTENUATION	
Cable Type	LC (or other Mini-Connector) Cord
Multimode	0.20dB maximum
Singlemode	0.30dB maximum

- i. If both measurements are found to be less than or equal to the values found in the Table, then test cord #1 is acceptable for testing purposes. Unacceptable attenuation measurements may be attributable to test cord #1 or #2. Examine each cord with a portable microscope and clean, polish or replace as necessary.
 - j. Repeat this test procedure from the beginning, reversing the test cords in order to verify the performance of test cord #2.
2. Test equipment set-up:
 - a. Follow the test equipment manufacturer’s initial adjustment and set-up instructions.
 - b. If the meter has a Relative Power Measurement Mode, select this mode.
 - c. If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
 - d. Set the light source and power meter to the same wavelength.

3. Multimode passive link insertion loss testing procedure:
 - a. Determine launch conditions (from the light source as Category 1 per OFSTP-14):
 - 1) General: The launch category of a light source can be determined by measuring its Coupled Power Ratio “CPR.” The CPR is a measurement of the modal power distribution launched into a multimode fiber. A light source that launches a higher percentage of its power into the higher order modes of a multimode fiber produces a more over-filled condition and is classified as a lower Category than a light source that launches more of its power into just the lower order modes producing an under-filled condition. Under-filled conditions result in lower link attenuation, while over-filled conditions produce higher attenuation. Therefore, adjusting the acceptable link attenuation to compensate for a light source’s launch characteristic increases the accuracy of the test procedure.
 - 2) Provide two test cords, one multimode (test cord #1) and one singlemode (test cord #2). Directly terminate both cords on connectors that are compatible with the light source and power meter.
 - a) The fiber of the multimode test cord shall have the core diameter and numerical aperture nominally equal to those of the permanent link.
 - b) The fiber of the singlemode test cord shall contain Class IVa singlemode fiber with a mode field diameter of $5.0\mu\text{m} \pm 0.5\mu\text{m}$ for 850nm tests and $9.0\mu\text{m} \pm 1.0\mu\text{m}$ for 1300nm tests.
 - 3) Connect test cord #1 between the light source and the power meter. Avoid placing bends in the cord that are less than 4” in diameter.
 - 4) The meter reading is the Reference Power Measurement (P_{ref}). If the power meter has a Relative Power Measurement Mode, enter the P_{ref} value into the meter. If it does not have this mode, then hand-write the P_{ref} for future reference.
 - 5) Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
 - 6) Connect test cord #2 between the power meter and test cord #1, using an appropriate adapter between the test cords. Test cord #2, the singlemode cord, shall include a high order mode filter. This can be accomplished by twice wrapping the cord around a 1.2” diameter (30mm) mandrel.
 - 7) The meter reading is the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the CPR. If the meter does not have this mode, perform the following calculation to determine the CPR:
 - a) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.): $\text{CPR (dB)} = (P_{\text{sum}} - P_{\text{ref}})$
 - b) If P_{sum} and P_{ref} are in watts: $\text{CPR (dB)} = [10 \times \log_{10} (P_{\text{sum}}/P_{\text{ref}})]$

COUPLED POWER RATIO (CPR) TABLE					
	Cat-1 Overfilled	Cat-2	Cat-3	Cat-4	Cat-5 Underfilled
850nm source	20 - 24	16 – 19.9	11 – 15.9	7 – 10.9	0 – 5.9

- b. Test method: Perform the passive link insertion loss testing of multimode fibers according to the “Test Method B: One Jumper Reference,” per OFSTP-14, for permanent links, and perform according to the “Test Method C: Three Jumper Reference,” per OFSTP-14, for channel links.
 - 1) After setting up the test equipment, verifying the performance of the test cords and determining the light source’s CPR, the insertion loss of the passive link segments can be measured.
 - 2) Connect test cord #1 between the light source and the power meter.

- 3) The meter reading is the Reference Power Measurement (P_{ref}). If the power meter has a Relative Power Measurement Mode, enter the P_{ref} value into the meter. If it does not have this mode, then hand-write the P_{ref} for future reference.
 - 4) Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
 - 5) Connect test cord #1 to the passive link segment input.
 - 6) At the opposite end of the passive link segment, connect test cord #2 to the link segment input and the power meter.
 - 7) The meter reading is the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the insertion loss. If the meter does not have this mode, perform the following calculation to determine the insertion loss:
 - a) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.): Link segment attenuation (dB) = $(P_{sum} - P_{ref})$
 - b) If P_{sum} and P_{ref} are in watts: Link segment attenuation (dB) = $[10 \times \log_{10} (P_{sum}/P_{ref})]$
 - 8) Record P_{sum} for inclusion into the record documents.
4. Singlemode passive link insertion loss testing procedure:
- a. Determine the launch conditions:
 - 1) Use the launch conditions as described in FOTP-78.
 - 2) Employ a method to remove high-order propagating modes as described in FOTP-77.
 - b. Test method: Perform the passive link insertion loss testing of singlemode fibers according to the "Test Method A.1: One Jumper Reference," per OFSTP-7.
 - 1) After setting up the test equipment and verifying the performance of the test cords, the insertion loss of the passive link segments can be measured.
 - 2) Connect test cord #1 between the light source and the power meter.
 - 3) The meter reading is the Reference Power Measurement (P_{ref}). If the power meter has a Relative Power Measurement Mode, enter the P_{ref} value into the meter. If it does not have this mode, then hand-write the P_{ref} for future reference and to be included in the Record Documents.
 - 4) Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
 - 5) Connect test cord #1 to the passive link segment input.
 - 6) At the opposite end of the passive link segment, connect test cord #2 to the link segment input and the power meter.
 - 7) The meter reading is the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the insertion loss. If the meter does not have this mode, perform the following calculation to determine the insertion loss:
 - a) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.): Link segment attenuation (dB) = $(P_{sum} - P_{ref})$
 - b) If P_{sum} and P_{ref} are in watts: Link segment attenuation (dB) = $[10 \times \log_{10} (P_{sum}/P_{ref})]$
 - 8) Record P_{sum} for inclusion into the record documents.
5. Acceptable measurement values:
- a. Remove and replace any cabling links failing to meet the criteria described in this Specification, at no cost to the Owner, with cables that prove to meet the minimum requirements.
 - b. The general insertion loss equation for any link segment is as follows:
 - 1) Insertion loss = cable loss + connection loss + splice loss + CPR adjustment.
 - 2) Note: A connection is defined as the joint made by two mating fibers terminated with remateable connectors.
 - c. 50/125 μ m multimode attenuation coefficients:

- 1) Cable loss = Cable length (km) x (3.0dB/km @ 850nm) or (1.0dB/km @ 1300nm).
- 2) Connection loss = (Connections x 0.14dB) + 0.24dB.
- 3) Splice loss = Splice x 0.05dB.
- 4) CPR adjustment = See Table below.

MULTIMODE LIGHT SOURCE CPR ADJUSTMENT TABLE					
	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5
Links w/ LC connectors	+0.25	0.00	-0.10	-0.20	-0.30

- d. Singlemode attenuation coefficients:
- 1) OSP cable loss = Cable length (km) x (0.40dB/km @ 1310nm) or (0.30dB/km @1550nm).
 - 2) ISP cable loss = Cable length (km) x (0.650dB/km @ 1310nm) or (0.50dB/km @1550nm).
 - 3) Connection loss = (Connection x 0.24dB) + 0.24dB.
 - 4) Splice loss = Splices x 0.07dB.
 - 5) CPR adjustment = Not applicable for singlemode.

- E. Twisted pair testing:
1. Test for UTP cabling as follows:

TESTS FOR FIBER OPTIC CABLING TABLE				
Subsystem	Type	Test	Configuration	Notes
Backbone	OSP	See Notes	-	Wire map & length
Backbone	ISP/Riser	See Notes	-	Wire map & length
Horizontal	CAT6A	Category 6A	Permanent Link	Per TIA/EIA-568-C.2

2. Precautions:
 - a. Adhere to the equipment manufacturer's instructions during all testing.
 - b. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature, approximately 70°F.
 - c. Fully charge power sources before each day's testing activity.
3. Backbone twisted pair testing:
 - a. The installation will be accepted when testing has indicated availability of 100% terminated pairs.
 - b. Test continuity and wire map for all pairs.
 - c. Test length for 2% of pairs of each cable. Pairs shall be from different 25 pair binder groups.
4. Horizontal twisted pair testing:
 - a. Test equipment set-up:
 - 1) Set-up the tester to perform a full CAT6A test, as a Permanent Link configuration.
 - 2) If the tester has the capability, set the cable type as product specific setting. If not, set as generic CAT6A cable.
 - 3) Set the tester to save the full test results (all test points, graphs, etc.).
 - 4) Save the test results with associated cable link identifier.
 - 5) Calibrate the test set per the manufacturer's instructions.
 - b. Acceptable test results measurements:
 - 1) Overall test results:
 - a) Links which report a Fail, Fail or Pass for any of the individual tests shall result in an overall link Fail. All individual test results must result in a Pass to achieve an overall Pass.

- b) Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.
- c) Remove and replace any cabling links failing to meet the criteria described in this Specification, at no cost to the Owner, with cables that prove to meet the minimum requirements.
- 2) Wire map: Provide continuous pairs and terminate all of the cabling links correctly at both ends, no exceptions taken.
- 3) Length: Ninety-four meters (308 feet) is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.
- 4) Insertion loss: The acceptable insertion loss measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-B.2.
- 5) Worst pair-to-pair near end crosstalk (NEXT) loss: The acceptable worst pair-to-pair NEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-B.2.
- 6) Power sum NEXT loss: The acceptable power sum PS-NEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-B.2.
- 7) Worst pair-to-pair ELFEXT and FEXT loss: The acceptable worst pair-to-pair ELFEXT and FEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-B.2.
- 8) Power sum ELFEXT and FEXT loss: The acceptable PS-ELFEXT and PS-FEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-B.2.
- 9) Return loss: The acceptable return loss measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-B.2.
- 10) Propagation delay and delay skew: The acceptable propagation delay and delay skew measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-B.2.

F. Record documents:

- 1. Permanently record all test results.
- 2. Export test results' numerical values to a single Microsoft Excel spreadsheet.
- 3. Submit test results in a format acceptable to the Owner, Owner's Representative and the Engineer before system acceptance.
- 4. Cable, fiber and pair identifiers of the test reports shall match the identifiers as labeled in the field, i.e. use the same ID on the cable/termination label as what appears on the test report.
- 5. Measurements shall carry a precision through one significant decimal place, minimum.
- 6. Use feet for the units for measurements shown on the print of the test measurements.
- 7. Print report such that fiber strands of a given cabling link have matching axis scales. The "X" and the "Y" axis shall be the same from report-to-report.
- 8. The trace of the printed test report shall show the launch cord.
- 9. For each fiber optic backbone cable test, report shall contain the following information:
 - a. Project name and address.
 - b. Test company's and Operator's name.
 - c. Date measurements were taken.
 - d. Test equipment type to include model and serial numbers.
 - e. Cable identification number, fiber/strand number and fiber type (i.e. multimode, singlemode, etc).
 - f. Measurement direction.
 - g. Set-up parameters (i.e. wavelength, pulse width, refractive index, event threshold, etc.)
 - h. OTDR trace.
 - i. Length of fiber.

- j. Overall link loss.
- k. Passive link insertion loss testing:
 - 1) Wavelength.
 - 2) Loss measurement.
- 10. For each cabling link, include either a schematic graphic or a brief narrative accurately describing the test set-up. The description shall include test/launch cord (with length), expected events (connectors, slices, etc.) with expected distances, etc. This information will eliminate many questions the Engineer will have while reviewing the reports.
- 11. For each twisted pair backbone and horizontal cable test, report shall contain the following information:
 - a. Project name and address.
 - b. Test company's and Operator's name.
 - c. Date measurements were taken.
 - d. Test equipment type to include model and serial numbers.
 - e. Cable identification number and pair number.
 - f. Measurement results.

3.05 INSPECTION AND ADJUSTMENTS

- A. Contractor shall inspect all installed Work in conjunction with the General Contractor and develop a "punchlist" for all items needing correction. Provide punchlist to the Engineer prior to their final walk of Project.
- B. Punchlist work and the required remediation shall be performed prior to system final acceptance.
- C. Replace or repair work completed by others that was defaced or destroyed during the installation of the telecommunication cabling system by this contractor.
- D. Make changes to adjust the system to optimum operation for final use. Contractor is responsible for making changes to the system such that any defects in workmanship are correct and all cables and the associated termination hardware passes the minimum test requirements.

3.06 CLEANING

- A. Remove all unused, excess and left over products, to include debris, spills, and installation equipment.
- B. Leave finished work and adjacent surfaces in neat, clean conditions with no evidence of damage.
- C. Legally dispose of debris.
- D. Clean installed products in accordance with manufacturer's instructions prior to final punchlist.

3.07 TRAINING

- A. Refer to Specification Section 260800: Electrical Commissioning.
- B. At the completion of all Work, a period of not less than 16 hours shall be allocated by the Contractor for instruction and training for the Owner Representative. The Cabling Contractor will need to describe how the cable from each coverplate is separated between different patch panels, how cross-connects are made and other basic cable plant management skills.
- C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION - 26 7113

DOCUMENT 00 41 13

BID FORM

To: Governing Board of Franklin Elementary School District (“District” or “Owner”)

From: _____
(Legal Name of Bidder)

The Bidder declares that the Contract Documents including, without limitation, the Notice to Bidders, the Instructions to Bidders, and the Special Conditions have been read, and agrees and proposes to furnish all necessary labor, materials, and equipment to perform and furnish all Work in accordance with the terms and conditions of the Contract Documents, including, without limitation, the Drawings and Specifications of Project No. **23-01-01**

PROJECT: **TK & KINDER BUILDING ADDITIONS – SITE DEVELOPMENT RE-BID**

(“Project” or “Contract”) and will accept in full payment for that Work the following total lump sum amount, all taxes included:

Site Development

_____ Dollars \$ _____
BASE BID –

Bid Alternates – Play Ground Fill

_____ Dollars \$ _____
Bid Alternate #1 – Playground fill surface – pour-in-place high density rubber surfacing in lieu of Synthetic turf Base Bid

_____ Dollars \$ _____
Bid Alternate #2 – Playground fill surface – 9” of loose fill wood mulch safety surfacing in lieu of Synthetic turf Base Bid

Bid Alternate #3 – Concrete Foundations for AMS Modular Building

_____ Dollars \$ _____
Bid Alternate #3 – Complete Concrete Foundations, Vents, and Embedded components and elements for AMS building option.

Value of Work within the Sutter County Franklin Road Right of Way

Value identified below is to be included in the Base Bid Value and is to include the costs of site demo, grading and engineered fill, concrete & asphalt paving, and pavement delineation within the Sutter County Franklin Road Right of Way. Cost identified below *does not* increase the base bid value.

_____ Dollars \$ _____
Value of Scope of Work within the Sutter County Franklin Road Right of Way .

1. **Contract Review.** The Bidder has reviewed the Work outlined in the Contract Documents and fully understands the scope of Work required in this Bid, understands the construction and project management function(s) described in the Contract Documents, and that if Bidder is awarded a contract, Bidder shall be in fact a prime contractor, not a subcontractor, to the District, and agrees that its Bid, if accepted by the District, will be the basis for the Bidder to enter into a contract with the District in accordance with the intent of the Contract Documents.
2. **Requests for Clarification.** The Bidder has notified the District in writing of any discrepancies or omissions or of any doubt, questions, or ambiguities about the meaning of any of the Contract Documents, and has contacted the Construction Manager before bid date to verify the issuance of any clarifying Addenda.
3. **Contract Time.** The Bidder agrees to commence Work under this Contract on the date established in the Contract Documents and to complete all Work within the time specified in the Contract Documents.
4. **Contractual Provisions.** The Bidder hereby acknowledges and agrees to be bound by the following provisions and all provisions in the Contract Documents:
 - The liquidated damages clause of the General Conditions and Agreement.
 - The “Changes in the Work” provisions in the General Conditions that limit the permitted charges and mark-ups on change orders and on the amount of home office overhead that the successful bidder can receive from the District.
 - The “Claims” provisions in the General Conditions that delineate the required process to submit and process Claims.

5. **Bid Open for 90 Days.** It is understood that the District reserves the right to reject this Bid and that the Bid shall remain open to acceptance and is irrevocable for a period of ninety (90) days.

6. **Attachments.** The following documents are attached hereto:

- The Bid Bond on the District’s form or other security.
- The Designated Subcontractors List.
- The Noncollusion Declaration.
- Certification: Iran Contracting Act.

7. **Addenda Acknowledgement.** Receipt and acceptance of the following addenda is hereby acknowledged:

No.____, Dated _____	No.____, Dated _____
No.____, Dated _____	No.____, Dated _____
<input type="checkbox"/> Or check here if <u>no</u> addenda were issued.	

8. **Bidder’s License.**

- The Bidder acknowledges that the license required for performance of the Work is as stated in the Invitation to Bid.
- The Bidder certifies that it is, at the time of bidding, and shall remain throughout the period of the Contract, licensed by the State of California to do the type of work required under the terms of the Contract Documents. The Bidder further certifies that it is regularly engaged in the general class and type of work called for in the Contract Documents.

9. **Labor Harmony.** The Bidder certifies that it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work.

10. **DIR Registration.** The Bidder shall ensure that it and its Subcontractors comply with the registration and compliance monitoring provisions of Labor Code section 1771.4, including furnishing its CPRs to the Labor Commissioner, and are registered pursuant to Labor Code section 1725.5.

11. **General Acknowledgement.** The Bidder represents that it is competent, knowledgeable, and has special skills with respect to the nature, extent, and inherent conditions of the Work to be performed. The Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the Work that may create, during the Work, unusual or peculiar unsafe conditions hazardous to persons and property. The Bidder expressly acknowledges that it is aware of such peculiar risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the Work with respect to such hazards.

12. **False Claims Act.** The Bidder expressly acknowledges that it is aware that if a false claim is knowingly submitted (as the terms “claim” and “knowingly” are defined in the California False Claims Act, Cal. Gov. Code, §12650 et seq.), the District will be entitled to civil remedies set forth in the California False Claim Act. It may also be considered fraud and the Bidder may be subject to criminal prosecution.

Furthermore, the Bidder hereby certifies to the District that all representations, certifications, and statements made by the Bidder, as set forth in this bid form, are true and correct and are made under penalty of perjury.

Dated this _____ day of _____ 20 _____

Name of Bidder _____

Type of Organization _____

Signed by _____

Title of Signer _____

Address of Bidder _____

Taxpayer's Identification No. of Bidder _____

Telephone Number _____

Fax Number _____

E-mail _____ Web page _____

Bidder's DIR Registration No.: No.: _____

Contractor's License No(s): No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

No.: _____ Class: _____ Expiration Date: _____

If Bidder is a corporation, provide the following:

Name of Corporation: _____

President: _____

Secretary: _____

Treasurer: _____

Manager: _____

END OF DOCUMENT

SECTION 1 GENERAL REQUIREMENTS

- 1. GENERAL
A. THE REQUIREMENTS OF THE GENERAL CONDITIONS OF THE AGREEMENT AND THIS GENERAL REQUIREMENT APPLY TO THE SEVERAL TRADE SECTIONS WITH THE SAME FORCE AS THOUGH FULLY REPEATED IN EACH TRADE SECTION.
B. NAME BRANDS ARE INDICATED TO ESTABLISH A STANDARD OF QUALITY. ITEMS OF EQUAL OR BETTER QUALITY MAY BE SUBSTITUTED FOR THE LISTED BRAND NAMED PRODUCTS WITH THE WRITTEN APPROVAL OF D.S.A. AND THE RDPRC.
C. ALL WORK SHALL COMPLY WITH THE REQUIREMENTS OF TITLES 19 AND 24 CALIFORNIA CODE OF REGULATIONS, 2019 C.B.C. NO CHANGES SHALL BE MADE FROM D.S.A. APPROVED DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR WRITTEN APPROVAL OF D.S.A. AND THE RDPRC.

- 2. SCOPE OF WORK
A. THE WORK CONSISTS OF MANUFACTURING OFF-SITE IN A PLANT AND INSTALLING ON-SITE MODULAR RELOCATABLE BUILDINGS AS DEFINED HEREIN AND SHOWN AND DETAILED ON DRAWINGS.
B. ALL REQUIREMENTS OF TITLE 24 OF THE STATE OF CALIFORNIA, CODE OF REGULATIONS, RELATING TO INSPECTIONS AND VERIFIED REPORTS SHALL BE COMPLIED WITH AND SHALL INCLUDE:
1. GENERAL RESPONSIBLE CHARGE OF FIELD ADMINISTRATION TO BE PROVIDED BY THE RDPRC.
2. INSPECTION IN-PLANT DURING THE COURSE OF CONSTRUCTION BY AN INSPECTOR APPROVED BY THE DIVISION OF THE STATE ARCHITECT AND THE DISTRICT ARCHITECT. THE INSPECTOR SHALL BE RESPONSIBLE FOR AND APPROVED TO INSPECT THE GENERAL CONSTRUCTION WELDING, MECHANICAL, AND ELECTRICAL WORK. COST OF THESE INSPECTIONS SHALL BE BORNE BY THE SCHOOL DISTRICTS.
3. ON-SITE INSPECTION OF THE BUILDING INSTALLATION ELECTRICAL AND UTILITY INSTALLATION OR CONNECTIONS BY AN INSPECTOR APPROVED BY THE DIVISION OF THE STATE ARCHITECT AND THE DISTRICT ARCHITECT AND RETAINED BY THE SCHOOL DISTRICT.
4. OTHER SPECIAL TESTS OR INSPECTIONS AS MAY BE REQUIRED BY THE DIVISION OF THE STATE ARCHITECT.
5. ADDENDUMS SHALL BE SIGNED BY THE RDPRC & APPROVED BY D.S.A.
6. CHANGES TO CONSTRUCTION DOCUMENT AFFECTING ACS, FLS & SSS SHALL BE SIGNED BY THE OWNER & THE RDPRC & APPROVED BY D.S.A. PRIOR TO COMMENCING WORK. CHANGES TO THE CONSTRUCTION COST ARE REPORTED TO D.S.A. USING FORM DSA-188 AT THE CONCLUSION OF THE PROJECT.
7. THE TESTING LAB SHALL BE IN THE EMPLOY OF THE OWNER.
8. ALL CONTRACTORS SHALL VERIFY ALL WORK CONDITIONS, DIMENSIONS AND DETAILS AND REPORT ANY OR ALL OMISSIONS AND DISCREPANCIES TO THE RDPRC/OWNER IMMEDIATELY BEFORE COMMENCING WORK.
9. EACH CONTRACTOR TO BE RESPONSIBLE TO SEE THAT THEIR WORK CONFORMS TO ALL GOVERNMENTAL CODES WHETHER OR NOT SO STATED ON THE DRAWINGS.
10. ALL MATERIALS AND WORKMANSHIP TO CONFORM TO THE LATEST REQUIREMENTS OF THE GOVERNING BUILDING CODES IN EFFECT AT TIME OF DSA APPLICATION.
11. ALL MANUFACTURED ARTICLES, MATERIALS AND EQUIPMENT SHALL BE APPLIED, INSTALLED, CONNECTED AND ERRECTED PER MANUFACTURER'S DIRECTIONS AND INSTRUCTIONS.
12. SHOP DRAWINGS MAY BE REQUIRED. IF SO, THEY WILL BE ACCURATELY DRAWN TO A LARGE ENOUGH SCALE TO SHOW ALL PERTINENT FEATURES OF THE ITEM AND ITS CONNECTION TO RELATED WORK.
13. THE MANUFACTURER OF BUILDING IS TO PLACE TWO PERMANENT METAL IDENTIFICATION LABEL ON EACH MODULE, MECHANICALLY FASTENED TO THE FRAME SEE "GENERAL DESIGN REQUIREMENTS", SHEET N2.0. FOR PROJECTS MANUFACTURED OFF-SITE, THE PLANT INSPECTOR IS TO INDICATE THE MANUFACTURER'S NAME AND SERIAL NUMBER OF EACH MODULE ON THE VERIFIED REPORT AND D.S.A. APP. NUMBER.
14. ALL TESTS AND INSPECTIONS REQUIRED BY DSA SHALL BE COMPLIED WITH ALL TESTS REQUIRED BY FIRE AND LIFE SAFETY REGULATIONS SHALL BE BY A NATIONALLY RECOGNIZED TESTING LABORATORY.

SECTION 2 FOUNDATION

- 1. ASSUMED ALLOWABLE SOIL BEARING:
• 1500 P.S.F. FOR CONCRETE FOUNDATIONS EMBEDDED 12" MINIMUM BELOW GRADE. (PC DESIGNED USING ALTERNATIVE BASIC LOAD COMBINATIONS PER CBC SECTION 1605A.3.2)
2. FOOTINGS SHALL BE LOCATED ON UNDISTURBED, FIRM, NATURAL SOIL OR APPROVED COMPACTED FILL.
3. WORK NOT INCLUDED:
A. ALL ON-SITE OR OFF-SITE UTILITIES AND THE CONNECTION OF THEM TO THE BUILDING UNLESS INDICATED ON THE DRAWINGS.
B. ALL LEVELING, GRADING OR OTHER SITE PREPARATION EXCEPT CONCRETE OR WOOD LEVELING STRIPS WHERE REQUIRED, UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
C. FIRE ALARM SYSTEM, PROGRAM BELL, PUBLIC ADDRESS SYSTEM, INTERCOM SYSTEM, TV, TELEPHONE SYSTEM, UNLESS OTHERWISE INDICATED ON THE DRAWINGS, OR MODIFIED BY CHANGE ORDER.
4. WHEELS AND HITCH SHALL REMAIN THE PROPERTY OF THE CONTRACTOR.
5. ACCESSIBILITY OF SITE: THE SCHOOL DISTRICT SHALL PROVIDE ACCESS TO THE SITE FOR THE INSTALLATION OF BUILDINGS. REMOVAL OF TREES, SHRUBS, FENCING, SPRINKLERS ETC. NECESSARY FOR THE MOVE-IN OF BUILDINGS SHALL BE THE RESPONSIBILITY OF THE SCHOOL DISTRICT.

SECTION 3 CONCRETE

- 1. CONCRETE CONSTRUCTION SHALL CONFORM TO ACI 318-14.
2. THE MINIMUM 28 DAY STRENGTH AND TYPE OF CONCRETE SHALL BE AS FOLLOWS: FOUNDATIONS.....PER SHEET N1.0A (150 PCF) FOUNDATION VENTS & ACCESS WELLS.....PER SHEET N1.0A (150 PCF) CONCRETE OVER METAL DECK.....3000 PSI (110 PCF)
3. THE MAXIMUM WATER TO CEMENT (W/C) RATIO SHALL BE PER SHEET N1.0A FOR FOUNDATIONS AND 0.45 FOR CONCRETE OVER METAL DECK SLABS.
4. CONCRETE SLUMP SHALL BE 4" ± 1" PRIOR TO ADDING ANY WATER REDUCING ADMIXTURES. CONCRETE SLUMP SHALL NOT EXCEED 8" ± 1 1/2" WHEN USING A WATER REDUCING ADMIXTURE.
5. CEMENT SHALL CONFORM TO ASTM C150. CEMENT TYPE SHALL BE PER SHEET N1.0A FOR FOUNDATIONS, TYPE I OR II FOR CONCRETE OVER METAL DECK SLABS.
A. FLY ASH SHALL CONFORM TO ASTM C618 CLASS 'F' OR 'N' AND SHALL NOT EXCEED 25% CEMENT REPLACEMENT BY WEIGHT.
B. SLAG CEMENT SHALL CONFORM TO ASTM C989, GRADE 100 OR 120 AND SHALL NOT EXCEED 50% CEMENT REPLACEMENT BY WEIGHT.
C. COMBINATION OF FLY ASH CEMENT SHALL NOT EXCEED 50% CEMENT REPLACEMENT BY WEIGHT.
6. CONCRETE AGGREGATES:
A. NATURAL SAND AND ROCK AGGREGATES SHALL CONFORM TO ASTM C33.
B. LIGHTWEIGHT AGGREGATE SHALL CONFORM TO ASTM C330.
C. MAX AGGREGATE SIZE SHALL BE 1" x 1/4" FOR NORMAL WT. CONCRETE EXCEPT 3/8" OR 1/2" MAX MAY BE USED FOR FOUNDATION VENTS & ACCESS WELLS.
D. MAX AGGREGATE SIZE SHALL BE 3/8" OR 1/2" FOR LIGHT WT. CONCRETE.
7. REINFORCING SHALL CONFORM TO ASTM A615-GRADE 60, UNLESS OTHERWISE NOTED.

CONCRETE continued

- 8. CONCRETE COVER OVER REINFORCING STEEL SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED ON DRAWINGS:
CONCRETE DIRECTLY AGAINST GROUND (EXCEPT SLABS)3"
CONCRETE EXPOSED TO GROUND BUT PLACED IN FORMS2"
SLABS (ON GROUND)POSITION IN CENTER OF SLAB
9. ALL BARS SHALL HAVE A CLASS B MINIMUM LAP SPLICE PER DETAILS 6 & 9/S1.4 AND SPLICES IN ADJACENT BARS SHALL BE STAGGERED, U.N.O.
10. REINFORCING BARS SHALL NOT BE WELDED UNLESS SPECIFICALLY DETAILED IN THE APPROVED DRAWINGS. BARS DETAILED TO BE WELDED SHALL BE ASTM A706 BARS AND WELDING ELECTRODES SHALL BE E80XX. WELDING SHALL CONFORM WITH AWS D1.4-2017 AND SHALL BE CONTINUOUSLY INSPECTED.
11. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185 AND SHALL BE LAP SPLICED TWO SQUARES MINIMUM EACH DIRECTION.
12. NOTIFY THE RDPRC PRIOR TO PLACING CONCRETE.
13. CHEMICAL ADMIXTURES SHALL CONFORM TO ASTM C494.
14. AIR-ENTRAINING ADMIXTURE SHALL CONFORM TO ASTM C260.
15. NON-SHRINK GROUT: ASTM C1107, 5000 PSI MIN AT 7 DAYS.

SECTION 5 STEEL

- 1. GENERAL - ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF AISC 360-16, TITLE 24 OF CALIFORNIA CODE OF REGULATIONS SECTION 2212A.1.2. AND THE AMERICAN IRON AND STEEL INSTITUTE SPECIFICATIONS FOR DESIGN OF STEEL STRUCTURAL MEMBERS. A COPY OF TITLE 24 SHALL BE KEPT AT THE JOBSITE AT ALL TIMES.
A. FABRICATION AND ERECTION SHALL COMPLY WITH AISC 360-16 CHAPTER 'N' AND AISC 341-16 CHAPTER 'I'.
2. WELDING - ALL WELDING DONE BY SHIELDED ELECTRIC-ARC OR FLUX CORED-ARC PROCESS COMPLYING WITH REQUIREMENTS OF THE "STRUCTURAL WELDING CODE" OF THE AMERICAN WELDING SOCIETY. WELDING DONE BY OPERATORS QUALIFIED BY TESTS ACCEPTABLE TO THE DIVISION OF THE STATE ARCHITECT. WELDING INSPECTION PER TITLE 24, PART 2, CCR, SECTIONS 1705A.2.5 WELDING ELECTRODE SHALL BE E70XX. ALL WELDS USED IN PRIMARY MEMBERS AND CONNECTIONS IN THE LATERAL FORCE-RESISTING SYSTEMS SHALL BE MADE WITH A FILLER METAL THAT HAS A MINIMUM CHARPY V-NOTCH TOUGHNESS OF 20FT-LBS AT ZERO DEGREES F AND COMPLYING WITH AWS D1.8-2016, SECTION 6.1.
3. STRUCTURAL STEEL SHAPES SHALL CONFORM TO THE FOLLOWING:
A. WIDE FLANGE BEAMS SHALL CONFORM TO ASTM A992, GRADE 50, TYP. U.N.O.
B. STRUCTURAL STEEL CHANNELS SHALL CONFORM TO ASTM A36 (36 KSI) TYP. U.N.O. WHERE DRAWINGS SPECIFY 50 KSI, CHANNELS SHALL CONFORM TO ASTM A572, GR. 50. NOTE: ASTM A572, GR. 50 MAY BE SUBSTITUTED FOR ASTM A36 (36 KSI).
C. PIPE COLUMNS SHALL CONFORM TO ASTM A-53 WITH SULFUR CONTENT NOT EXCEEDING 0.05% TYP. U.N.O.
D. STRUCTURAL STEEL TUBING (HSS) FOR STEEL MOMENT FRAME COLUMNS PER SHEET S5.0 SHALL CONFORM TO ASTM A1085. ALL OTHER STEEL TUBING (HSS) MAY CONFORM TO ASTM A500 GRADE B OR C OR ASTM A1085, TYP UNO.
E. STEEL PLATES, ANGLES, BARS AND MIS. SHAPES SHALL CONFORM TO ASTM A36 (36 KSI) TYP. U.N.O. WHERE DRAWINGS SPECIFY 50 KSI, STEEL SHALL CONFORM TO ASTM A572, GR. 50. NOTE: ASTM A572, GR. 50, MAY BE SUBSTITUTED FOR ASTM A36 (36 KSI).
4. ERECTION - STRUCTURAL STEEL ERECTED TRUE, STRAIGHT, PLUMB AND TO ITS DESIGNATED LOCATIONS. FIELD CONNECTIONS BOLTED OR WELDED AS INDICATED ON THE DRAWINGS.
5. NAILS, BOLTS, SCREWS AND NUTS, ETC. - FOR EXTERIOR WORK SHALL BE CADMIUM PLATED OR GALVANIZED.
A. BOLTS FOR STRUCTURAL STEEL CONNECTIONS SHALL CONFORM TO ASTM A-307 UNLESS OTHERWISE NOTED. ALL HOLES FOR BOLTS THRU STEEL TO BE DRILLED, OR TORCHED PILOT HOLE AND REAMED TO DIAMETER OF BOLT +1/16" UNLESS OTHERWISE NOTED. NUTS AND WASHERS (TO STEEL) MAY BE SUBSTITUTED FOR BOLTS SAME LENGTH AND DIAMETER.
B. SEE "FASTENERS FOR ATTACHMENT TO STEEL" ON SHEET N2.0 FOR SHOT PINS & SCREWS.
6. HANDRAILS - FABRICATED, AS DETAILED, NON-FILLET WELDS GROUND SMOOTH.
7. SHOP PAINT
A. EXPOSED STEEL COATED WITH ONE SHOP COAT OF RED OXIDE PRIMER.
B. ALL SURFACES THOROUGHLY CLEANED BY EFFECTIVE MEANS PRIOR TO APPLICATION OF SHOP COATS.
8. TESTS
A. PROVIDE MILL CERTIFICATES OR TEST ALL STEEL MEMBERS PER TITLE-24 PART 2, CCR SECTION 1705A.2 & 2202A.

SECTION 6 CARPENTRY

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES TO INSTALL CARPENTRY.
2. MATERIALS
LUMBER - GRADE MARKED IN ACCORDANCE WITH AN APPROVED GRADING AGENCY PER DCC PS20-05 INCLUDING "STANDARD GRADING AND DRESSING RULES" 17" OF WEST COAST LUMBER INSPECTION BUREAU, OR "WESTERN LUMBER GRADING RULES", LATEST EDITION OF WESTERN WOOD PRODUCTS ASSOCIATION. OSB OR PLYWOOD GRADE MARKED IN ACCORDANCE WITH PRODUCT STANDARD P-109, PS 2-10, OR PRP-108 FOR SOFTWOOD OSB OR PLYWOOD, OF THE AMERICAN PLYWOOD ASSOCIATION (APA), EACH SHEET SHALL BEAR THE STAMP OF APA, PITTSBURGH TESTING, OR TECO. MOISTURE CONTENT SHALL NOT EXCEED 19%.
A. JOISTS, HEADERS, PLATES, STUDS: DOUGLAS FIR S4S #2 OR HEM FIR S4S #2 MINIMUM. U.N.O. NOTE: MSR 1650 E1.5 MAY BE SUBSTITUTED FOR #2 GRADE IF IT MEETS THE STRUCTURAL REQUIREMENTS FOR FLOOR AND ROOF MEMBERS.
B. PSL HEADERS, TRUS JOIST PARALLAM PSL BY WEYERHAEUSER (ICC ESR-1387) OR EQUIV. MEETING THE FOLLOWING STRUCTURAL PROPERTIES:
BEAMS ≤ 7" DEEP & COLUMNS BEAMS ≥ 9" DEEP
Fb = 2400 PSI MIN. Fc = 2900 PSI MIN.
Fv = 190 PSI MIN. Fc = 290 PSI MIN.
E = 1.8E6 PSI MIN. E = 2.0E6 PSI MIN.
C. POSTS AND TIMBERS: DOUGLAS FIR S4S #1 OR HEM FIR S4S #1 MIN.
D. BLOCKING: DOUG FIR #3, OR HEM FIR #3, OR STD. & BET.
E. SILLS AND LUMBER & SHIM PLATES IN CONTACT WITH CONCRETE, MASONRY OR EARTH: DOUG FIR #2 OR HEM FIR #2 MIN. PRESSURE TREATED IN ACCORDANCE WITH CBC 2304.12.1. EACH PIECE SHALL BEAR AWP/STAMP, AWP/STANDARD U1 & T1 GROUND CONTACT, D.F. (OR H.F.) #2 ABOVE GROUND.
F. MOISTURE BARRIER: KRAFT WATERPROOF BUILDING PAPER, OR 15 LB. FELT, CBC SECTION 1403.2, & ASTM D226, TYPE I.
G. STUDS - S4S DOUG FIR #2 OR #2 HEM FIR. MAXIMUM MOISTURE CONTENT OF 19% AT TIME OF INSTALLATION.
H. FASTENERS - EXTERIOR USE FASTENERS EXPOSED TO THE OUTSIDE ENVIRONMENT (INCLUDING FASTENERS USED FOR THE ATTACHMENT OF EXTERIOR WALL COVERINGS) SHALL BE CORROSION RESISTANT IN ACCORDANCE WITH C.B.C. SECTION 2304.10.1.1.
I. BUILDING TRIM - 2x RESAWN SELECT D.F., H.F. OR CEDAR.
J. DOOR/WINDOW TRIM - 1x4 RESAWN D.F., H.F. OR CEDAR.
K. FRAMING CONNECTORS SHALL BE FROM SINGER'S CATALOG LATEST ED.
L. FIRE BLOCKS SHALL CONFORM TO CBC SECTION 718.2
M. ALL NAILS SHALL BE COMMON NAILS PER ASTM #1667 UNLESS OTHERWISE NOTED.
N. ALL CUT ENDS AND HOLES IN PRESSURE TREATED LUMBER SHALL BE TREATED WITH "CUPRINOL".
O. ALL BOLTS AND LAG SCREWS SHALL COMPLY WITH THE 2018 NATIONAL DESIGN SPECIFICATION FOR WOOD CONSTRUCTION (ANSI/AWC NDS-2018).

Table with 2 columns: BEAMS ≤ 7" DEEP & COLUMNS, BEAMS ≥ 9" DEEP. Rows for Fb, Fc, Fv, E values.

CARPENTRY continued

- P. HOLES FOR BOLTS IN WOOD SHALL BE BORED WITH A BIT OF THE SAME NOMINAL DIAMETER AS THE BOLT + 1/16".
Q. HOLES FOR LAG SCREWS SHALL BE FIRST BORED TO THE SAME NOMINAL DIAMETER AND DEPTH AS THE SHANK. THE REMAINDER OF THE HOLE SHALL BE 40% TO 70% OF THE SHANK DIAMETER.
R. ALL BOLTS AND LAG SCREWS SHALL BE PROVIDED WITH METAL WASHERS UNDER HEADS AND NUTS WHICH BEAR ON WOOD.
WORKMANSHIP
A. FRAMING - SECURELY NAIL, BRIDGED AND BLOCKED TO FORM RIGID STRUCTURE. WORK SHALL BE FITTED AND ASSEMBLED LEVEL PLUMB AND TRUE TO LINE. TRIM IN AS LONG LENGTHS AS POSSIBLE WITH ALL STANDING TRIM IN ONE PIECE. TRIM SEALED AT ALL EDGES.
B. NAILING - IN ACCORDANCE WITH TITLE 24, CALIFORNIA BUILDING CODE, TABLE 2304.10.1.
C. EXTERIOR WALLS - FACTORY FABRICATED. CAULKING PROVIDED BETWEEN PERIMETER OF WALL AND STRUCTURAL MEMBERS PROVIDING WEATHER-PROOF AND WATER-TIGHT SEAL. NECESSARY CLOSERS, SEALS, AND FLASHINGS PLACED AT TOP AND BASE SUPPORT OF PANELS AND AROUND OPENINGS.
D. NAILS INTO P.T. LUMBER TO BE HOT DIPPED GALVANIZED.
E. MACHINE APPLIED NAILING: USE OF MACHINE NAILING IS SUBJECT TO A SATISFACTORY JOBSITE DEMONSTRATION FOR EACH PROJECT AND THE APPROVAL BY THE RDPRC AND THE DIVISION OF THE STATE ARCHITECT. THE APPROVAL IS SUBJECT TO CONTINUED SATISFACTORY PERFORMANCE. MACHINE NAILING WILL NOT BE APPROVED IN 5/16" OSB. IF NAILHEADS PENETRATE THE OUTER PLY MORE THAN WOULD BE NORMAL FOR A HAND HAMMER OR IF MINIMUM ALLOWABLE EDGE DISTANCES ARE NOT MAINTAINED THE PERFORMANCE WILL BE DEEMED UNSATISFACTORY.
F. MOISTURE BARRIER - APPLIED TO STUDS WEATHER BOARD FASHION, HORIZONTAL JOINTS LAPPED MIN 6" INCLUDING BUILDING CORNERS. SHEATHING APPLIED OVER MOISTURE BARRIER.
G. TRIM SEALED AT ALL EDGES. SEALANT PAINTED TO MATCH TRIM OR SIDING UNLESS TRANSPARENT TYPE.

SECTION 7A SHEET METAL (NON-STRUCTURAL)

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES TO INSTALL INDICATED SHEET METAL.
2. MATERIALS
A. SHEET METAL - STEEL SHEETS HOT DIP GALVANIZED WITH 1.25 OZ. PER SQUARE FOOT ZINC COATING CONFORMING TO ASTM A653 MINIMUM 26 GA. UNLESS OTHERWISE NOTED ON THE DRAWINGS.
B. SOLDER - OF STAND. GRADE "A" OF EQUAL PARTS, ARD BRAND, LEAD AND TIN ANS B32.
C. FLUX - ZINC SATURATED MURIATIC ACID.
D. GUTTERS: 26 GA. G-90 GALV. STEEL
2"x3" CONVOLUTED 30 GA. G-90 GALV. STEEL
GUTTER ENDCAPS: 26 GA. G-90 GALV. STEEL
GUTTER CLIPS: 18 GA. G-90 GALV. STEEL
FLASHING: 22 GA. G-90 GALV. STEEL U.O.N.
E. FASTENERS: SELF-DRILLING OR SELF-TAPPING SHEET METAL SCREWS. LENGTH TO HAVE (3) EXPOSED THREADS MIN.
3. WORKMANSHIP
SHEET METAL ACCURATELY FORMED TO DIMENSIONS AND SHAPES DETAILED WITH TRUE STRAIGHT LINES, CORNERS AND ANGLES. FLASHING INSTALLED IN LONGEST LENGTHS POSSIBLE. EXTERIOR WORK FORMED, FABRICATED AND INSTALLED SO THAT IT ADEQUATELY PROVIDES FOR EXPANSION AND CONTRACTION IN THE COMPLETED WORK AND FINISHES WATER AND WEATHER TIGHT. ALUMINUM SHALL BE SEPARATED FROM FERROUS METAL BY POLYETHYLENE TAPE OR FLOOR COAT OF ASPHALTIC PAINT.

SECTION 7B METAL ROOFING

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES TO INSTALL METAL ROOFING.
2. MATERIALS
A. ROOF SHALL BE CONSTRUCTED OF 3" STANDING SEAM INTERLOCKING (UN-PENETRATED) STEEL SHEETS.
B. PROPERTIES INCLUDING THICKNESS SHALL BE PER SHEET S0.0.
C. BASE MATERIAL SHALL BE EITHER ASTM A1011 SS, GRADE 36 (Fy = 36 KSI) OR ASTM A653 SS, GRADE 37 (Fy = 37 KSI) AND SHALL BE GALVANIZED WITH G90 GALVANIZATION.
D. SHEETS MAY BE PAINTED.
E. CLASS B FIRE RATED.
F. CLIP ANGLES SHALL BE HOT-DIPPED GALVANIZED.
G. FASTENERS SHALL BE EXTERIOR USE SCREWS WITH A CORROSION PROTECTIVE COATING PER THE "FASTENERS FOR ATTACHMENT TO STEEL" SECTION ON SHEET N2.0. ALL SCREWS USED FOR METAL ROOFING ATTACHMENT SHALL HAVE A NEOPRENE OR EPDM WASHER.
3. WORKMANSHIP
SEALANT APPLIED TO DRY CLEAN SURFACES. WHEREVER INDICATED ON DETAILS AND AS NEEDED TO MAKE BUILDING WATERTIGHT IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

SECTION 7C SEALANT

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIAL AND SERVICES TO SEAL BUILDINGS.
2. MATERIALS
VULKEM SEALANT, POLYURETHANE, MANUFACTURED BY MAMECO INTERNATIONAL FOR ROOFS. "GEOCEL" SILICONIZED CAULK, GE, DUPONT, EAGLESEAL OR DAP FOR ALL OTHER APPLICATIONS, OR EQUAL.
A. SEALANT V.O.C. LIMITS PER SCAQMD RULE 1168 (AS SHOWN IN TITLE 24, PART 11, TABLE 5.504.4.1 AND TABLE 5.504.4.2)
3. WORKMANSHIP
SEALANT APPLIED TO DRY CLEAN SURFACES. WHEREVER INDICATED ON DETAILS AND AS NEEDED TO MAKE BUILDING WATERTIGHT IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

SECTION 7D SINGLE-PLY ROOFING

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIAL AND SERVICES TO INSTALL SINGLE-PLY OR BUILT-UP ROOFING. THE ROOFING SYSTEM SHALL WITHSTAND THE UPLIFT OF 100 MPH BASIC WIND SPEED.
2. MATERIALS
MEMBRANE: PVC FILM LAMINATED TO BOTH SIDES OF A REINFORCEMENT FABRIC, OR EQUIV. - PROPRIETARY THERMOPLASTIC, PVC FORMULATION OF RESINS, PLASTICIZERS, STABILIZERS, BIOCIDES, FLAME RETARDANTS, AND U.V. ABSORBENTS. CLASS B FIRE RATING.
A. WOOD NAILERS MUST BE A #2 GRADE LUMBER, OR EQUIVALENT, TO SUBSTRATE.
3. WORKMANSHIP
MEMBRANE APPLIED ON SUBSTRATES THAT ARE DRY, CLEAN, AND FREE OF FINIS, SHARP EDGES AND LOOSE, FOREIGN MATERIALS, WHEREVER INDICATED ON DETAILS. AN INSULATION OR SLIP SHEET HAVING AN APPROVED FACER MUST BE USED WHEN ROOFING OVER ASPHALT OR COAL TAR ROOFS.
4. TESTING:
A. MEMBRANE SHALL BE DESIGNED TO PERFORM IN ALL TYPES OF WEATHER AND SHALL COMPLY TO ASTM D-2136 TESTING METHODS.
B. MEMBRANE SHALL BE DESIGNED IN ACCORDANCE TO ASTM D-4434 "STANDARD SPECIFICATIONS FOR POLY (VINYL CHLORIDE) SHEET ROOFING" AND BE CLASSIFIED AS A TYPE IV, INTERNALLY REINFORCED SHEET.

SECTION 8 HOLLOW METAL DOORS AND FRAMES

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES TO INSTALL HOLLOW METAL DOORS AND FRAMES.
2. MATERIALS
A. DOORS - INSULATED TYPE L FULL FLUSH, MANUFACTURED BY AMWELD MANUFACTURING COMPANY, 18 GA. 1-3/4" THICK PER CS242 MIN. REINFORCE FOR HARDWARE-BOTH FACES FOR CLOSER, SOUND DEADEN INTERIOR.
B. FRAMES - 16 GA FOLD ROLLED, 2" FACES, CS242 MIN. 3 ANCHORS PER JAMB + ADJUSTABLE COLOR ANCHOR, EACH JAMB REINFORCE FOR HARDWARE. PROVIDE STRIKE BOX, PROVIDE SOUND DEADENING: 1/8" UNDERCOATING OR INSULATING FILL.
3. WORKMANSHIP
ALL WORK FABRICATED IN SHOP TO REQUIRED PROFILES BY FORMING AND WELDING, WITH ARISES AND EDGES STRAIGHT, SHARP FIT FABRICATED ACCURATELY WITH SQUARE CORNERS, HAIRLINE JOINTS AND SURFACES FREE FROM WARP, WAIVE, BUCKLE OR OTHER DEFECTS AFTER FABRICATION, DOORS AND FRAMES CLEANED THOROUGHLY, ALL WELDS GROUND SMOOTH AND GIVEN PRIME COAT.

SECTION 9A STUCCO CEMENT PLASTER

- LATHING AND PLASTERING MATERIALS AND ACCESSORIES SHALL BE MARKED BY THE MANUFACTURER'S DESIGNATION TO INDICATE COMPLIANCE WITH THE APPROPRIATE STANDARDS REFERENCED IN THIS SECTION AND STORED IN SUCH A MANNER TO PROTECT THEM FROM THE WEATHER, PER C.B.C. 2507.1.
LATHING AND PLASTERING MATERIALS SHALL CONFORM TO THE STANDARDS LISTED IN C.B.C. TABLE 2507.2 AND CHAPTER 35, AND, WHERE REQUIRED FOR FIRE PROTECTION, SHALL ALSO CONFORM TO THE PROVISIONS OF CHAPTER 7.
GYPSUM BOARD AND GYPSUM PLASTER CONSTRUCTION SHALL BE OF THE MATERIALS LISTED IN TABLES 2506.2 AND 2507.2. THESE MATERIALS SHALL BE ASSEMBLED AND INSTALLED IN COMPLIANCE WITH THE APPROPRIATE STANDARDS LISTED IN TABLES 2508.1 AND 2511.1, AND CHAPTER 35 (PER 2508.1).
WATER-RESISTIVE BARRIERS SHALL BE IN ACCORDANCE WITH C.B.C. SECTION 2510.6. WATER-RESISTIVE BARRIERS SHALL BE INSTALLED AS REQUIRED PER SECTION 1404.2, AND WHERE APPLIED OVER WOOD-BASED SHEATHING, SHALL INCLUDE A WATER-RESISTIVE VAPOR-PERMEABLE BARRIER WITH A PERFORMANCE AT LEAST EQUIVALENT TO TWO LAYERS OF GRADE D PAPER.
EXCEPTION: WHERE THE WATER-RESISTIVE BARRIER THAT IS APPLIED OVER WOOD-BASED SHEATHING HAS A WATER RESISTANCE EQUAL TO OR GREATER THAN THAT 60-MINUTE GRADE D PAPER COMPLYING WITH ASTM 2556, TYPE II AND IS SEPARATED FROM THE STUCCO BY AN INTERVENING, SUBSTANTIAL, NONWATER-ABSORBING LAYER OR DRAINAGE SPACE.

EXCEPTION: WHERE THE WATER-RESISTIVE BARRIER THAT IS APPLIED OVER WOOD-BASED SHEATHING HAS A WATER RESISTANCE EQUAL TO OR GREATER THAN THAT 60-MINUTE GRADE D PAPER COMPLYING WITH ASTM 2556, TYPE II AND IS SEPARATED FROM THE STUCCO BY AN INTERVENING, SUBSTANTIAL, NONWATER-ABSORBING LAYER OR DRAINAGE SPACE.

- 1. PLASTER NOTES: PLASTERING WITH CEMENT PLASTER SHALL NOT BE LESS THAN THREE COATS WHEN APPLIED OVER METAL LATH OR WIRE FABRIC LATH AND SHALL NOT BE LESS THAN TWO COATS WHEN APPLIED OVER MASONRY CONCRETE OR GYPSUM BACKING AS SPECIFIED IN SECTION 2510.5.
A. THE FIRST COAT SHALL BE MIN. 3/8" THICK & APPLIED WITH SUFFICIENT MATERIAL AND PRESSURE TO FILL SOLIDLY ALL OPENINGS IN THE LATH. THE SURFACE SHALL BE SCORED HORIZONTALLY SUFFICIENTLY ROUGH TO PROVIDE ADEQUATE BOND TO RECEIVE THE SECOND COAT.
B. THE SECOND COAT SHALL BE BROUGHT OUT TO MIN. 3/8" THICKNESS, RODDED AND FLOATED SUFFICIENTLY ROUGH TO PROVIDE ADEQUATE BOND FOR THE FINISH COAT. THE SECOND COAT SHALL HAVE NO VARIATION GREATER THAN 1/4 INCH (6.4 mm) IN ANY DIRECTION UNDER 5-FOOT STRAIGHT EDGE.
C. THE FINISH COATS SHALL BE MIN. 1/8" THICK & APPLIED OVER BASE COATS THAT HAVE BEEN IN PLACE FOR THE TIME PERIODS SET FORTH IN ASTM C 926. THE THIRD OR FINISH COAT SHALL BE APPLIED WITH SUFFICIENT MATERIAL AND PRESSURE TO BOND TO AND TO COVER THE BROWN COAT AND SHALL BE OF SUFFICIENT THICKNESS TO CONCEAL THE BROWN COAT.

SECTION 9B PAINTS & COATINGS

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES TO PAINT BUILDING. ALL EXPOSED SURFACES OF BUILDING AND RAMPS SHALL BE PAINTED EXCEPT ALUMINUM WINDOW FRAMES, THRESHOLDS, AND ROOFING.
2. MATERIALS
A. FOR EXTERIOR WOOD:
REF BRAND DUNN EDWARDS KELLY MOORE SHERWIN SINCLAIR
PRIMER W450-XX M400 1240-XXX B54W2102 289-N
FINISH QD-60-XX 1710 1700-XXX B50N26 40XX
GE2-NXX
B. FOR INTERIOR TRIM:
REF BRAND DUNN EDWARDS KELLY MOORE SHERWIN SINCLAIR
PRIMER W450-XX M400 1240-XXX B54W2102 289-N
FINISH W450-XX M400 1240-XXX B54W2102 40XX
C. FOR METAL:
REF BRAND DUNN EDWARDS KELLY MOORE SHERWIN SINCLAIR
PRIMER 43-4 1710 1700-XXX B50N26 15N
FINISH 10-XX 1700-XXX B54W2102 GE2-NXX
D. INTERIOR PAINT & COATINGS SHALL COMPLY WITH TITLE 24, PART 11, "CAL-GREEN" SECTION 5.504.4.3, AND V.O.C. LIMITS PER TABLE 5.504.4.3.
3. WORKMANSHIP
ALL EXPOSED SURFACES SHALL BE PAINTED EXCEPT ALUMINUM WINDOW FRAMES, THRESHOLDS AND METAL ROOFING. MATERIAL SHALL BE OF THE GRADE SPECIFIED OR EQUAL.
A. EXTERIOR WOOD SIDING, TRIM AND SKIRTING - FLAT OR SEMI-GLOSS LATEX. APPLY ONE COAT OF PRIME AND AT LEAST ONE FINISH COAT. PRIME COAT SHALL BE BRUSHED ON OR SPRAYED AND BACK BRUSHED INTO ALL GROOVES IN THE SIDING. IF NECESSARY, IN THE OPINION OF THE INSPECTOR, AN EXTRA COAT SHALL BE APPLIED TO ALL GROOVES SO THAT THE FINISH COAT WILL HAVE A UNIFORM APPEARANCE. UNLESS OTHERWISE NOTED, ALL FINISH COATS SHALL BE COMPATIBLE AND MANUFACTURED BY THE SAME COMPANY.

SECTION 9C INTERIOR AIR QUALITY CONTROL

- THE INTERIOR ENVIRONMENT SHALL BE ASSEMBLED WITH PRODUCTS THAT CONTRIBUTE TO A HEALTHY INDOOR AIR QUALITY (IAQ). THE FOLLOWING SHALL COMPLY WITH CARB & GREEN BUILDING ADDITIONS - SITE DEVELOPMENT - REBID #1:
1. ADHESIVES, SEALANTS, CAULKS SECTION 5.504.4.1
2. PAINTS, COATINGS SECTION 5.504.4.3
3. AEROSOL PAINTS & COATINGS SECTION 5.504.4.3.1
4. CARPET SYSTEMS SECTION 5.504.4.4
A. CARPET SHALL MEET CRIS "GREEN LABEL PLUS" PROGRAM, NSF/ANSI "140 GOLD" LEVEL, OR OTHER APPROVED TESTING PER 5.504.4.4.
5. CARPET CUSHION OR PAD SECTION 5.504.4.4.1
A. CUSHION/PAD SHALL MEET THE CRIS "GREEN LABEL" PROGRAM.
6. CARPET ADHESIVE SECTION 5.504.4.4.2
7. COMPOSITE WOOD PRODUCTS SECTION 5.504.4.5
A. ALL COMPOSITE WOODS MUST NOT EXCEED THE FORMALDEHYDE LIMITS AS SPECIFIED IN AIRB'S "AIR TOXICS CONTROL, MEASURE" (17 CCR 93120), OR NON-EXEMPT MATERIALS PER TABLE 5.504.5.
8. RESILIENT FLOORING SYSTEMS SECTION 5.504.4.6
A. RESILIENT FLOORING SHALL BE CERTIFIED UNDER THE "FLOORSCORE" PROGRAM BY RFCI, COMPLY WITH CA-CHPS, OR OTHER APPROVED TESTING PER 5.504.4.6.
9. HVAC FILTER (MERV RATING OF 13 AND MINIMUM 2-INCH DEPTH) SECTION 5.504.5.3.1
A. SEE SHEET M1.7 FOR HVAC FILTER REQUIREMENTS

SECTION 13 SITE ASSEMBLY

- 1. SCOPE OF WORK
CONTRACTOR SHALL PROVIDE ALL LABOR MATERIALS AND SERVICES TO PREPARE THE BUILDING ELEMENTS, TRANSPORT THEM FROM THE PLANT TO THE SITE AND TO COMPLETE THE ASSEMBLY AT THE SITE. THE CONDITION OF THE SITE, SUCH AS DRAINAGE AND SOIL BEARING CAPACITY, SHALL BE THE RESPONSIBILITY OF THE SCHOOL DISTRICT, UNLESS SPECIFICALLY CALLED FOR IN THE CONTRACT. STEPS, RAMPS, OR HANDRAILS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
2. ASSEMBLY OF ELEMENTS
A. IN A LOCATION ON THE SITE AS DETERMINED BY THE SCHOOL DISTRICT. (APPROVED BY DSA) THE CONTRACTOR SHALL PLACE WOOD LEVELING STRIPS OR OTHER SUITABLE SUPPORTS AS DETAILED ON THE DRAWINGS.
B. THE ELEMENTS SHALL BE BROUGHT TO THE SITE ON WHEEL ASSEMBLY AND TRANSPORTED TO THE PREPARED SITE. GREAT CARE SHALL BE TAKEN TO AVOID DAMAGE TO THE ELEMENTS BY RACKING OR BUMPING EACH OTHER.
C. CONNECTION OF THE ELEMENTS TOGETHER SHALL BE DONE ACCORDING TO INSTRUCTION ON THE DRAWINGS. FLASHINGS, TRIM AND OTHER LOOSE ITEMS SHALL BE INSTALLED PER DETAILS ON THE DRAWINGS.

SECTION 23 AIR CONDITIONING

- 1. SCOPE OF WORK (SEE SHEET M1.7 FOR HVAC SPEC. AND NOTES)
CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES TO INSTALL THE AIR CONDITIONING SYSTEM AS SHOWN ON THE DRAWINGS AND SPECIFICATIONS, INCLUDING A/C UNITS AND ACCESSORIES, REMOTE THERMOSTAT, GRILLS AND POWER WIRING COMPLETE TO LOAD CENTER. CONTRACTOR SHALL INSTRUCT OWNER'S OPERATORS ON OPERATION AND MAINTENANCE OF A/C SYSTEM.
2. EQUIPMENT
SEE NOTE ON FLOOR PLAN FOR SIZE AND TYPE.
3. WORKMANSHIP
UNITS SHALL BE INSTALLED COMPLETE AND OPERATING WITH ALL ACCESSORIES IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

SECTION 26 ELECTRICAL

- 1. SCOPE OF WORK
A. CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS AND SERVICES FOR ELECTRICAL INSTALLATION COMPLETE WITH ASSOCIATED EQUIPMENT AND FIXTURES, IN OPERATING CONDITION READY FOR USE. THE WORK INCLUDES: LIGHT AND POWER SYSTEMS, LIGHTING FIXTURES COMPLETE WITH LAMPS, CONNECTIONS AND DISCONNECTS TO A/C EQUIPMENT, EMERGENCY VOICE ALARM COMMUNICATION SYSTEMS (EVACS).
B. PROVIDE CONDUIT WITH PULL STRINGS AND JUNCTION BOXES FOR AUTOMATIC DETECTION FIRE ALARM SYSTEM AND NOTIFICATION PER NFPA 72.
2. MATERIALS
ALL NEW COMPLYING WITH REQUIREMENTS OF CALIFORNIA ELECTRIC CODE AND NATIONAL FIRE PROTECTION ASSOCIATION.
A. ELECTRIC METALLIC TUBING - COUPLING AND FLEX CONDUIT GALVANIZED OR SHERARDIZED. EXTERIOR FLEX-GALV. STEEL WITH FACTORY APPLIED P.V.C. JACKET.
B. PANEL BOARDS - FLUSH MOUNTED.
C. CONDUCTORS - COPPER, INSULATED FOR 600 VOLTS, TYPE THHN FOR SIZES #12 TO #6, TYPE THW FOR LARGER SIZES. MINIMUM SIZE #14.
D. RECEPTACLES - AS NOTED. +18" A.F.F. MIN. TO BOTTOM OF BOX
E. CLOCK RECEPTACLE - AS NOTED.
F. SWITCHES - AS NOTED. +48" A.F.F. MAX. TO TOP OF BOX
G. LIGHTING FIXTURES - AS NOTED ON THE DRAWINGS.
3. WORKMANSHIP
MATERIALS AND EQUIPMENT INSTALLED IN A SECURE, NEAT, WORKMANLIKE MANNER IN ACCORDANCE WITH CODE REQUIREMENTS. PANEL BOARD CARDS SHALL BE FILLED OUT. CONDUIT AND CABLE INSTALLED IN WALL AND CEILING SPACES. WORK PIERCING WATERPROOFED AREAS FLASHED AND SEALED TO A WATERTIGHT CONDITION. BUILDING CONDUIT/WIRING FROM FACE OF BUILDING TO SITE TERMINATION BY SITE CONTRACTOR (N.I.C.). (FLEXIBLE CONDUIT S-BEND SEALTITE).

INSPECTION

- INSPECTION OF PREFABRICATED BUILDINGS IS DIVIDED INTO TWO SEPARATE FUNCTIONS:
1. IN-PLANT INSPECTION
2. ON-SITE INSPECTION.
THE CONTRACTOR SHALL ALLOW UP TO SEVEN (7) DAYS FROM THE DATE OF PLAN APPROVAL TO OBTAIN AN IN-PLANT INSPECTOR APPROVED BY D.S.A.
IN-PLANT INSPECTION AND MATERIAL TESTING SHALL BE ACCOMPLISHED UNDER THE SUPERVISION OF THE DISTRICT ARCHITECT. THE CONTRACTOR SHALL NOTIFY THE DISTRICT ARCHITECT, DSA, AND THE DESIGNATED INSPECTOR/INSPECTION AGENCY AT LEAST 48 HOURS PRIOR TO COMMENCING WORK. THE MANUFACTURER SHALL PROVIDE THE INSPECTOR WITH FULL ACCESS TO ALL PLANT OPERATIONS INVOLVING WORK UNDER THIS CONTRACT AND SHALL ADVISE THE INSPECTOR IN ADVANCE OF THE TIME AND PLACE OF OPERATIONS THAT THE INSPECTOR WANTS TO OBSERVE TAKE PLACE. BEFORE THE BUILDING(S) ARE REMOVED FROM THE PLANT FOR DELIVERY TO THE STORAGE FACILITY, OR FROM THE STORAGE FACILITY TO THE SITE, THE INSPECTOR SHALL DETERMINE THAT THEY ARE ACCEPTABLE AND ISSUE A WRITTEN RELEASE WHICH SHALL BE IN THE FORM OF A VERIFIED REPORT (FORM DSA 152-IP).
A COPY OF THE INSPECTOR'S VERIFIED REPORT SHALL ACCOMPANY EACH BUILDING TO STORAGE OR TO THE SITE. THE INSPECTOR SHALL PUT ONE COPY IN EACH BUILDING.

Franklin Elementary School District
KAR & Kinder Building Additions - Site Development - Rebid
Addendum #1, Item 1.2
BID ALTERNATE #3



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PRE-CHECKED SET NAME
24' x 40' THRU 120' x 40' (LOW SEISMIC)
GEN7 by AMS

SITE SPECIFIC PROJECT NAME

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 02-118326 PC
REVIEWED FOR
SS [] FLS [] ACS [] CG []
DATE: 07/22/2021

2019 CBC PRE-CHECK (PC) DOCUMENT
A SEPARATE PROJECT APPLICATION FOR CONSTRUCTION IS REQUIRED.
MANUFACTURER PROFESSIONAL OF RECORD ON PC



- A. ELECTRIC METALLIC TUBING - COUPLING AND FLEX CONDUIT GALVANIZED OR SHERARDIZED. EXTERIOR FLEX-GALV. STEEL WITH FACTORY APPLIED P.V.C. JACKET.
B. PANEL BOARDS - FLUSH MOUNTED.
C. CONDUCTORS - COPPER, INSULATED FOR 600 VOLTS, TYPE THHN FOR SIZES #12 TO #6, TYPE THW FOR LARGER SIZES. MINIMUM SIZE #14.
D. RECEPTACLES - AS NOTED. +18" A.F.F. MIN. TO BOTTOM OF BOX
E. CLOCK RECEPTACLE - AS NOTED.
F. SWITCHES - AS NOTED. +48" A.F.F. MAX. TO TOP OF BOX
G. LIGHTING FIXTURES - AS NOTED ON THE DRAWINGS.
3. WORKMANSHIP
MATERIALS AND EQUIPMENT INSTALLED IN A SECURE, NEAT



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REGISTERED ARCHITECT
PATRICK GANNETT
No. C12631
Ren. 2-31-23
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
ROBERT J. GOMES
No. 6322
STATE OF CALIFORNIA

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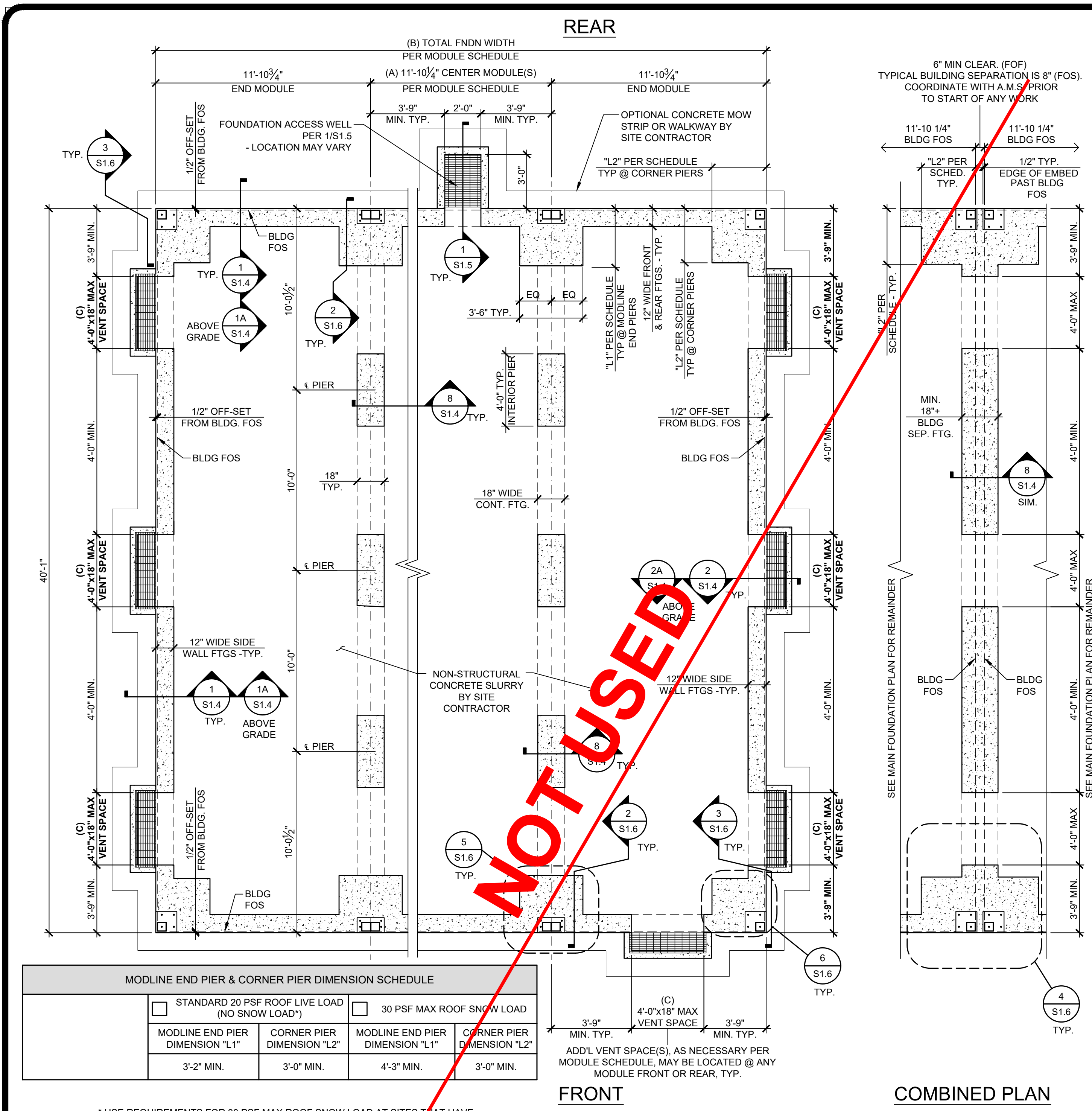
REVISIONS

DRAWN BY: _____
SCALE: AS NOTED
DATE: MMDDYY
PROJECT NO: XXXX-20

SHEET TITLE:
CONCRETE FOUNDATION PLAN (100 PSF MAX FLOOR LIVE LOAD)

SHEET NUMBER:

S1.2



MODLINE END PIER & CORNER PIER DIMENSION SCHEDULE

<input type="checkbox"/> STANDARD 20 PSF ROOF LIVE LOAD (NO SNOW LOAD)	<input type="checkbox"/> 30 PSF MAX ROOF SNOW LOAD (NO SNOW LOAD)
MODLINE END PIER DIMENSION "L1"	CORNER PIER DIMENSION "L2"
3'-2" MIN.	3'-0" MIN.
MODLINE END PIER DIMENSION "L1"	CORNER PIER DIMENSION "L2"
4'-3" MIN.	3'-0" MIN.

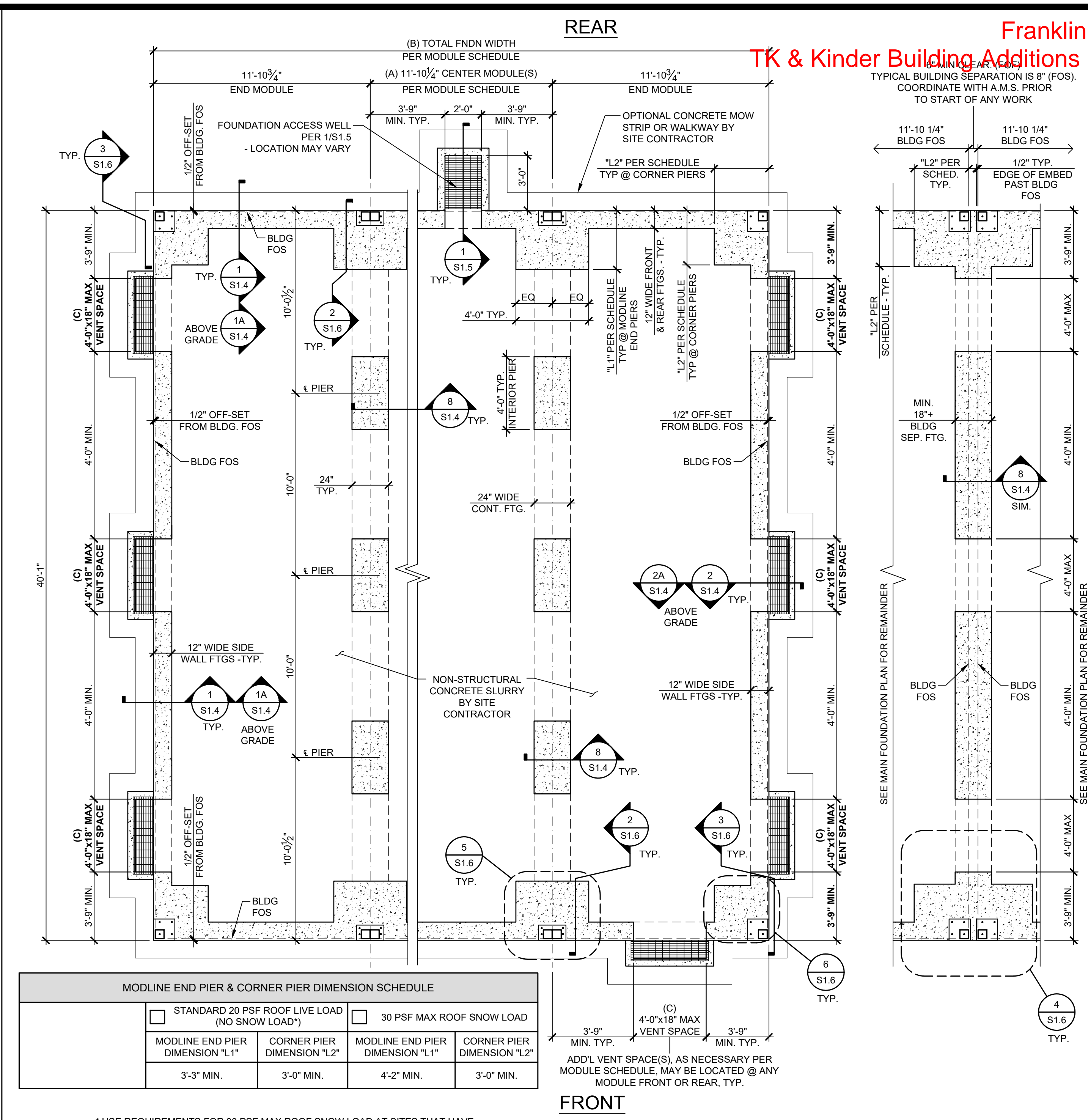
ADD'L VENT SPACE(S), AS NECESSARY PER MODULE SCHEDULE, MAY BE LOCATED @ ANY MODULE FRONT OR REAR, TYP.

* USE REQUIREMENTS FOR 30 PSF MAX ROOF SNOW LOAD AT SITES THAT HAVE ANY AMOUNT OF ROOF SNOW LOAD UP TO A MAXIMUM OF 30 PSF.

CONCRETE FOUNDATION PLAN (PLYWOOD FLOOR) 100 PSF LIVE LOAD SCALE: 1/4"=1'-0"

- CONCRETE MIXTURES:
 - ULTIMATE 28-DAY CONCRETE COMPRESSIVE STRENGTH (f_c) SHALL BE PER SHEET N1.0A
 - PROPORTIONING OF CONCRETE MIXTURES SHALL BE IN ACCORDANCE WITH ACI 318-14, SECTION 26.4.3.
 - DOCUMENTATION OF CONCRETE MIXTURE CHARACTERISTICS SHALL BE IN ACCORDANCE WITH ACI 318-14, SECTION 26.4.4.
 - CEMENT SHALL BE CERTIFIED PER TITLE 24, PART 2, SECTION 1910A.1.
 - SEE SHEET N1.0 FOR ADDITIONAL CONCRETE NOTES.
- BUILDINGS MAY BE SET ON CONCRETE FOUNDATIONS THAT HAVE REACHED A MINIMUM CONCRETE COMPRESSIVE STRENGTH OF 2,500 PSI. PRIOR TO THE SETTING OF THE MODULAR BUILDING ON CONCRETE FOUNDATIONS THAT HAVE NOT YET CURED 28 DAYS POST PLACEMENT OF FOUNDATION CONCRETE, THE FOUNDATION CONTRACTOR SHALL
 - HAVE THE PROJECT TESTING LAB PERFORM CONCRETE CYLINDER COMPRESSION TESTS OF THE FOUNDATION CONCRETE USED AT THE SITE.
 - FURNISH THE PROJECT IOR AND THE REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE WITH THE CONCRETE TEST REPORTS VERIFYING THAT THE FOUNDATION CONCRETE HAS REACHED THE MINIMUM STRENGTH AS SPECIFIED ABOVE, AND
 - NOTIFY THE PROJECT IOR AND THE REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE OF THEIR INTENT TO SET THE MODULAR BUILDING PRIOR TO 28 DAYS POST PLACEMENT OF FOUNDATION CONCRETE.
- REINFORCING STEEL SHALL BE 60,000 PSI MINIMUM PER ASTM A615. THE REINFORCING BARS SHALL BE TESTED PER TITLE 24, PART 2, SECTION 1910A.2. TEST OF REINFORCING BARS MAY BE WAIVED PROVIDED CERTIFIED MILL TEST REPORTS ARE PROVIDED FOR EACH SHIPMENT OF SUCH REINFORCEMENT.
- DESIGN SOIL BEARING CAPACITY: 1500 PSF (PC DESIGNED USING ALTERNATIVE BASIC LOAD COMBINATIONS PER CBC SECTION 1605A.3.2)
- THE REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE SHALL VERIFY THE NET AREA OF THE UNDER-FLOOR VENTING IS EQUAL TO OR LARGER THAN THE VENT AREA REQUIRED (AS SHOWN ON THE ADJACENT TABLE).

NOTES



MODLINE END PIER & CORNER PIER DIMENSION SCHEDULE

<input type="checkbox"/> STANDARD 20 PSF ROOF LIVE LOAD (NO SNOW LOAD)	<input type="checkbox"/> 30 PSF MAX ROOF SNOW LOAD (NO SNOW LOAD)
MODLINE END PIER DIMENSION "L1"	CORNER PIER DIMENSION "L2"
3'-3" MIN.	3'-0" MIN.
MODLINE END PIER DIMENSION "L1"	CORNER PIER DIMENSION "L2"
4'-2" MIN.	3'-0" MIN.

ADD'L VENT SPACE(S), AS NECESSARY PER MODULE SCHEDULE, MAY BE LOCATED @ ANY MODULE FRONT OR REAR, TYP.

* USE REQUIREMENTS FOR 30 PSF MAX ROOF SNOW LOAD AT SITES THAT HAVE ANY AMOUNT OF ROOF SNOW LOAD UP TO A MAXIMUM OF 30 PSF.

CONCRETE FOUNDATION PLAN (CONCRETE FLOOR) 100 PSF LIVE LOAD SCALE: 1/4"=1'-0"

NOMINAL BLDG SIZE (FT)	TOTAL # OF 12' WIDE MODULES	"A" TOTAL # OF CENTER MODULES	"B" TOTAL FNDN WIDTH	TOTAL NOMINAL FLOOR AREA (FT ²)	NET FREE VENT AREA REQ'D ³ (FT ²)	IF 4'x12" VENTS ARE USED SOLELY		IF 4'x18" VENTS ARE USED SOLELY	
						"C" MIN. TOTAL VENTS REQ'D ³	NET FREE VENT AREA PROVIDED ³ (FT ²)	"C" MIN. TOTAL VENTS REQ'D ³	NET FREE VENT AREA PROVIDED ³ (FT ²)
<input type="checkbox"/> 24'x40'	2	0	23'-9 1/2"	960	6.4	3	8.7	2	8.8
<input type="checkbox"/> 36'x40'	3	1	35'-7 1/4"	1440	9.6	4	11.6	3	13.1
<input type="checkbox"/> 48'x40'	4	2	47'-6"	1920	12.8	5	14.6	4	17.5
<input type="checkbox"/> 60'x40'	5	3	59'-4 1/2"	2400	16.0	6	17.5	4	17.5
<input checked="" type="checkbox"/> 72'x40'	6	4	71'-2 1/2"	2880	19.2	7	20.4	5	21.9
<input type="checkbox"/> 84'x40'	7	5	83'-0 1/4"	3360	22.4	8	23.3	6	26.3
<input type="checkbox"/> 96'x40'	8	6	94'-11"	3840	25.6	9	26.2	6	26.3
<input type="checkbox"/> 108'x40'	9	7	106'-9 1/4"	4320	28.8	10	29.2	7	30.7
<input type="checkbox"/> 120'x40'	10	8	118'-6 1/2"	4800	32.0	11	32.1	8	35.0

- NOTES:
- TOTAL FOUNDATION WIDTH INCLUDES 1/4" PER MODULE CONSTRUCTION TOLERANCE IN ADDITION TO 1/2" ADDED TO EACH SIDE OF THE BUILDING. THE FOUNDATION LENGTH NOTED ON THE PLANS ALSO INCLUDES 1/2" ADDED TO EACH ENDWALL OF THE BUILDING.
 - UNLESS NOTED OTHERWISE, DIMENSIONS ARE FROM FACE OF CONCRETE TO FACE OF CONCRETE (FOC TO FOC)
 - THE NUMBER OF VENTS REQUIRED IS BASED ON THE VENT NET FREE AREA (NFA) PROVIDED BEING GREATER OR EQUAL TO THE VENT NFA REQUIRED. VENT NFA REQUIRED IS BASED ON A 1:150 VENTILATION RATIO OF THE NOMINAL BUILDING FLOOR AREA. VENT NFA PROVIDED IS THE ACTUAL OPEN AREA WITH A VENT GROSS AREA REDUCTION PERCENTAGE OF 73% & NUMBER OF VENTS PROVIDED.
 $NFA_{REQUIRED} = A_{FLOOR} / 150$ $NFA_{PROVIDED} > NFA_{REQUIRED}$ $A_{VENT,GROSS} \times 73\% \times (\# \text{ OF VENTS}) > NFA_{REQUIRED}$
 - REQUIRED VENTING MAY BE ACHIEVED BY A COMBINATION OF ACCESS VENT(S) AND VENTS OF DIFFERENT SIZES BASED ON THE VALUES LISTED BELOW.
 $4' \times 12" \text{ VENTS} \times 0.73 \times (\# \text{ OF VENTS}) = 2.92 \text{ FT}^2 \times (\# \text{ OF VENTS})$ $4' \times 18" \text{ VENTS} \times 0.73 \times (\# \text{ OF VENTS}) = 4.38 \text{ FT}^2 \times (\# \text{ OF VENTS})$
 $ACCESS \text{ VENTS} - 2' \times 1.5' \times (\# \text{ OF VENTS}) = 3.00 \text{ FT}^2 \times (\# \text{ OF VENTS})$

MODULE SCHEDULE AND VENTING



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APP: 02-118326 PC
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LICENCED ARCHITECT
PATRICK CANNON
No. C12631
Ren. 2-31-23
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
ROBERT J. GOMES
No. 6322
STATE OF CALIFORNIA

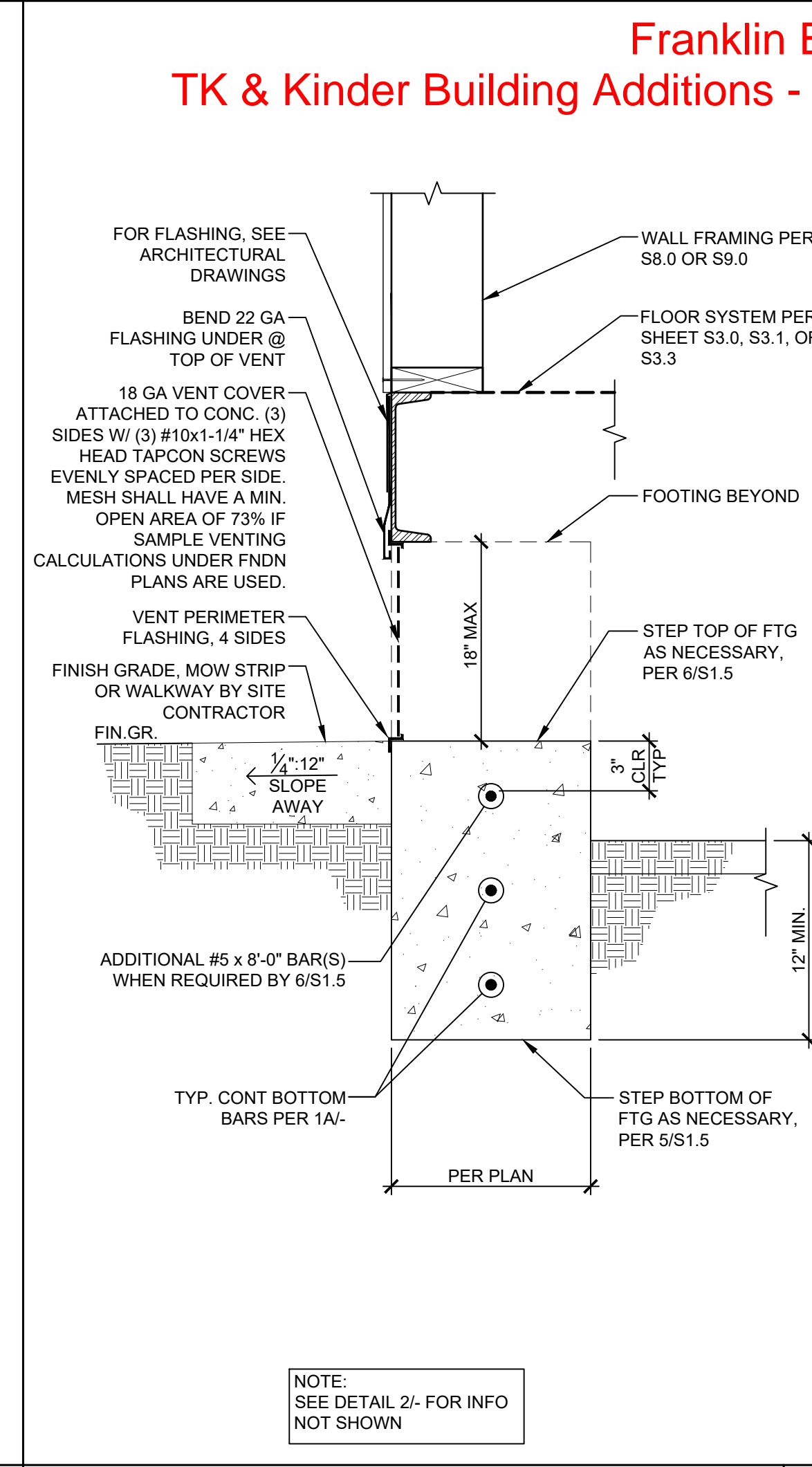
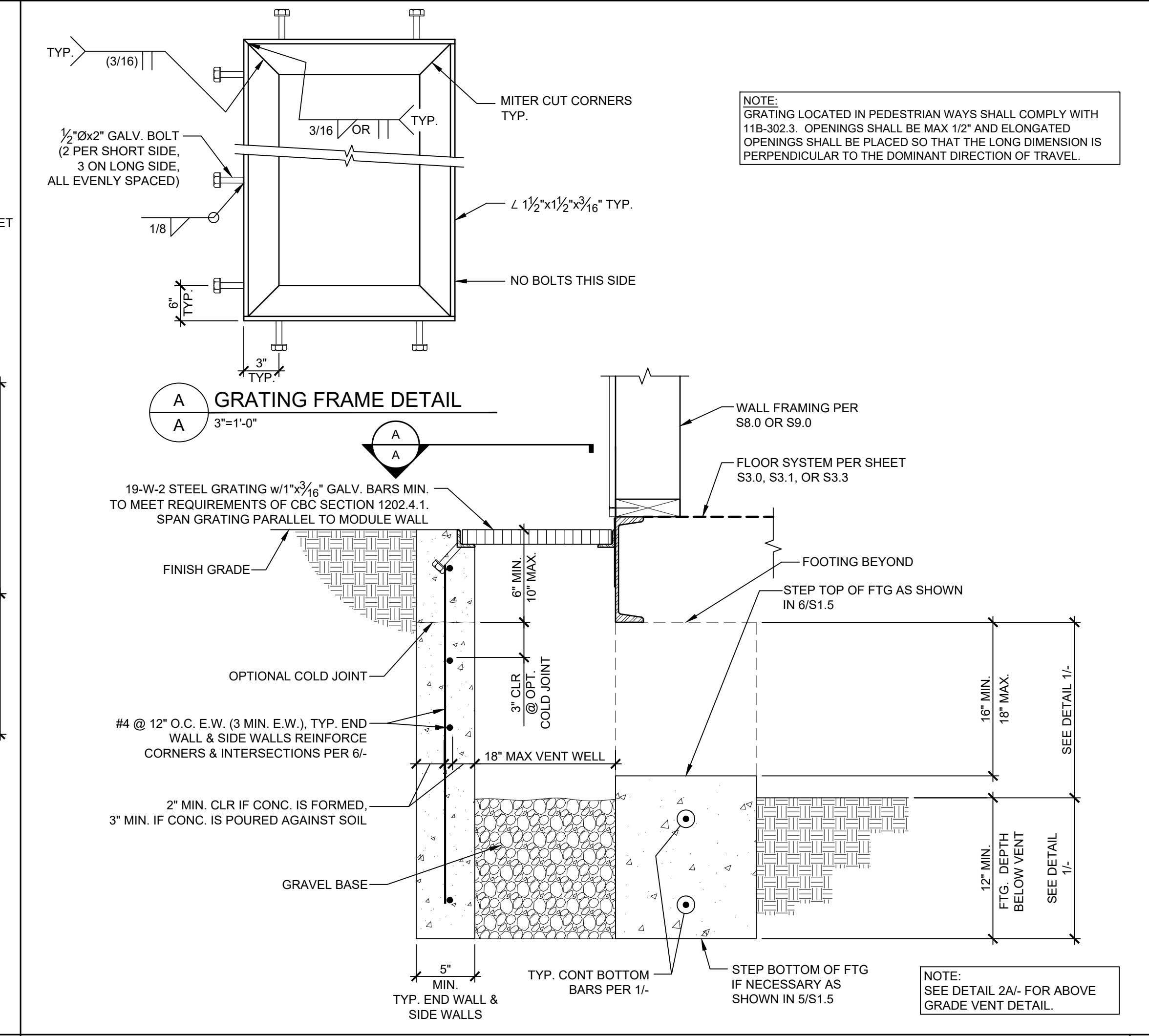
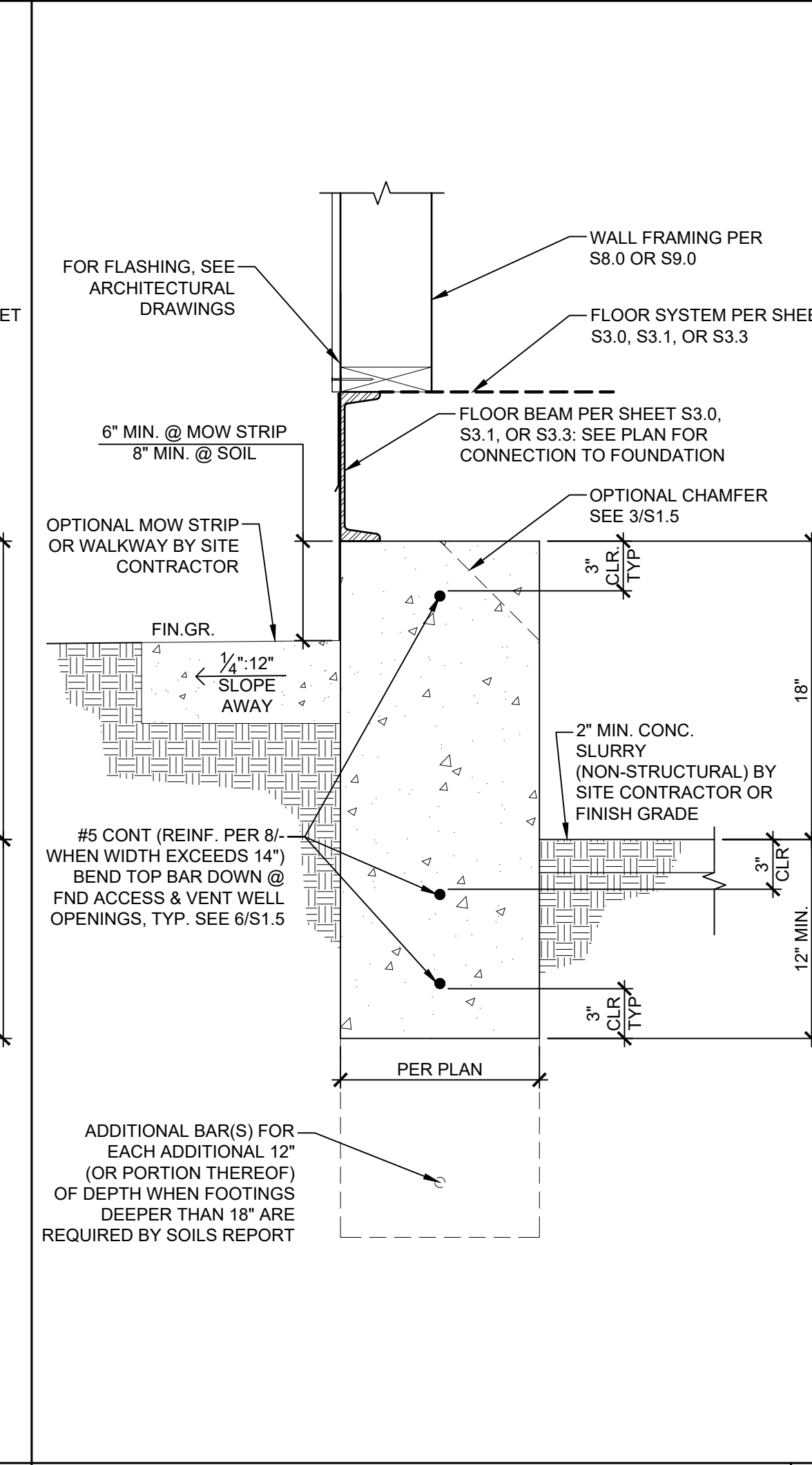
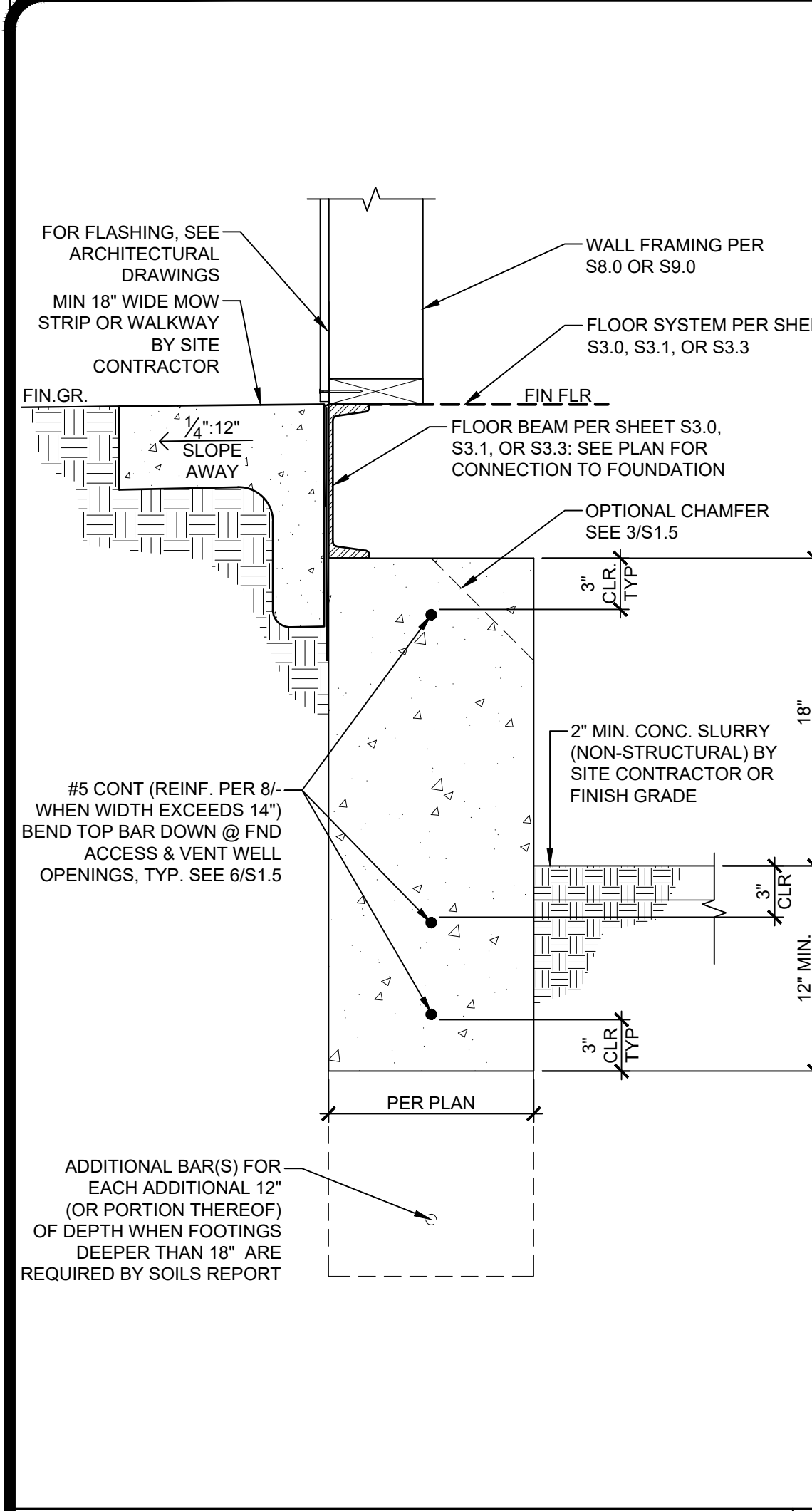
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REVISIONS

DRAWN BY: AS NOTED
SCALE: AS NOTED
DATE: MM/DD/YYYY
PROJECT NO: XXXX-20
SHEET TITLE: CONCRETE FOUNDATION DETAILS

SHEET NUMBER:

S1.4

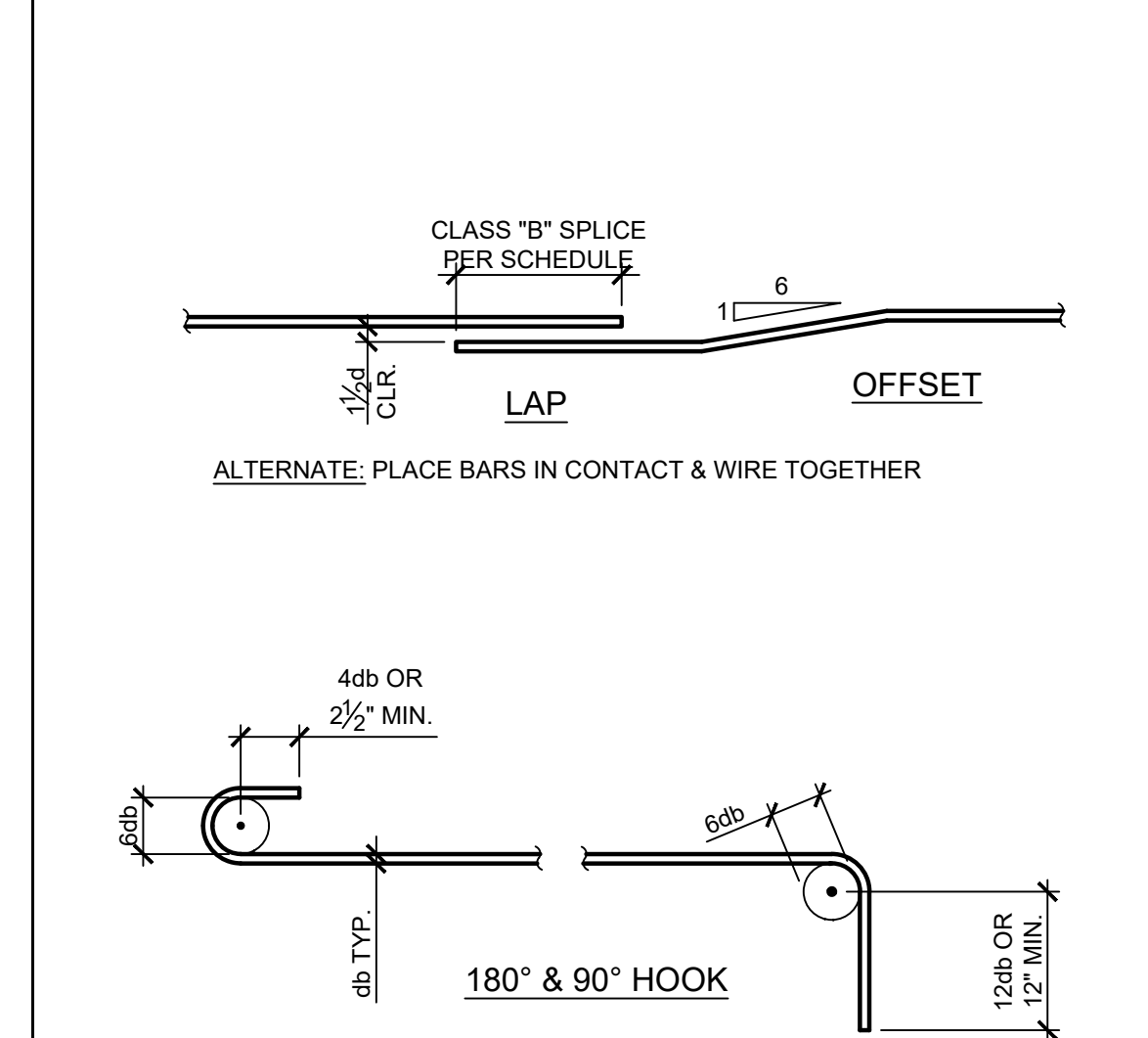
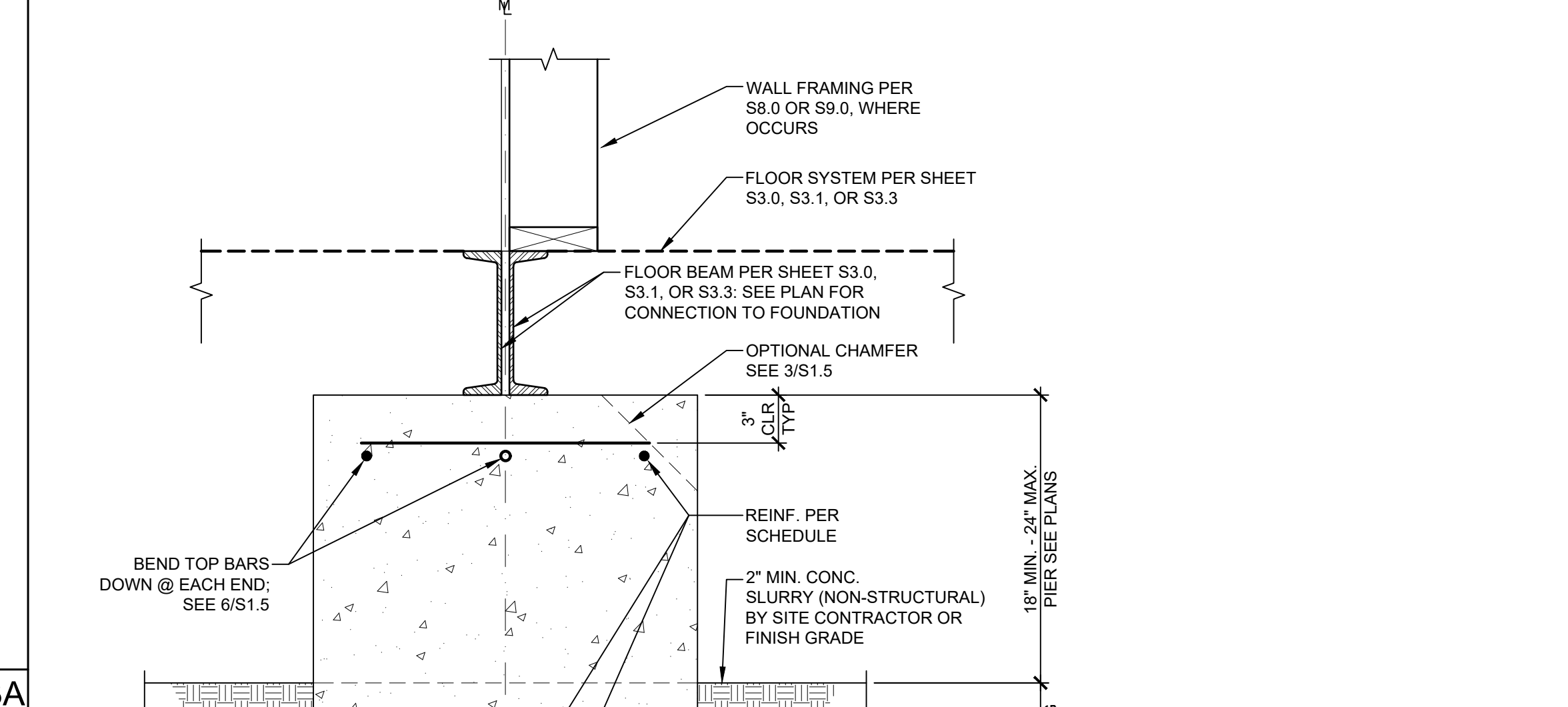
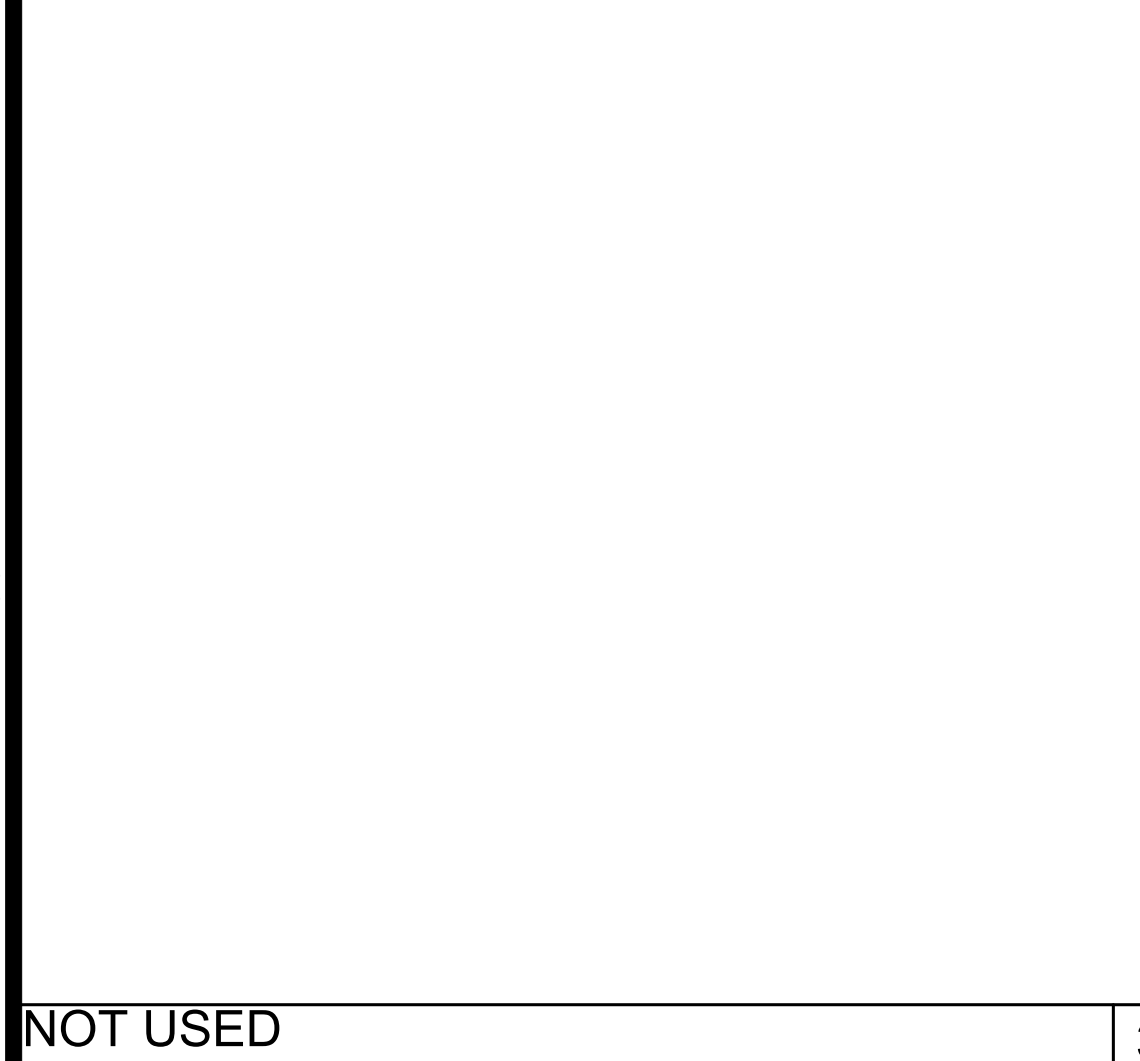


TYP. FOOTING - BELOW GRADE SCALE: 1-1/2" = 1'-0" 1

TYP. FOOTING - ABOVE GRADE SCALE: 1-1/2" = 1'-0" 1A

TYP. VENT DETAIL - BELOW GRADE SCALE: 1-1/2" = 1'-0" 2

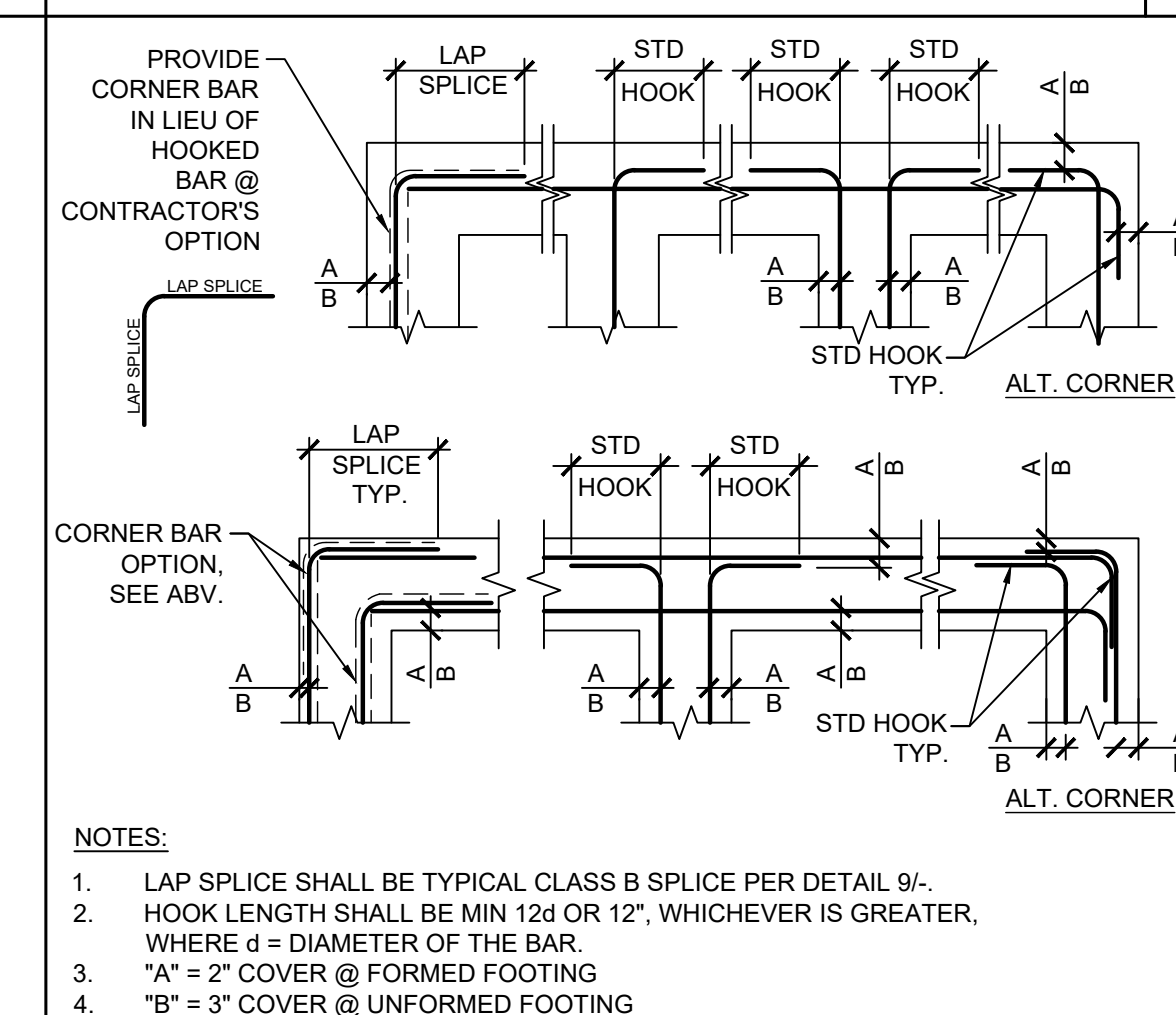
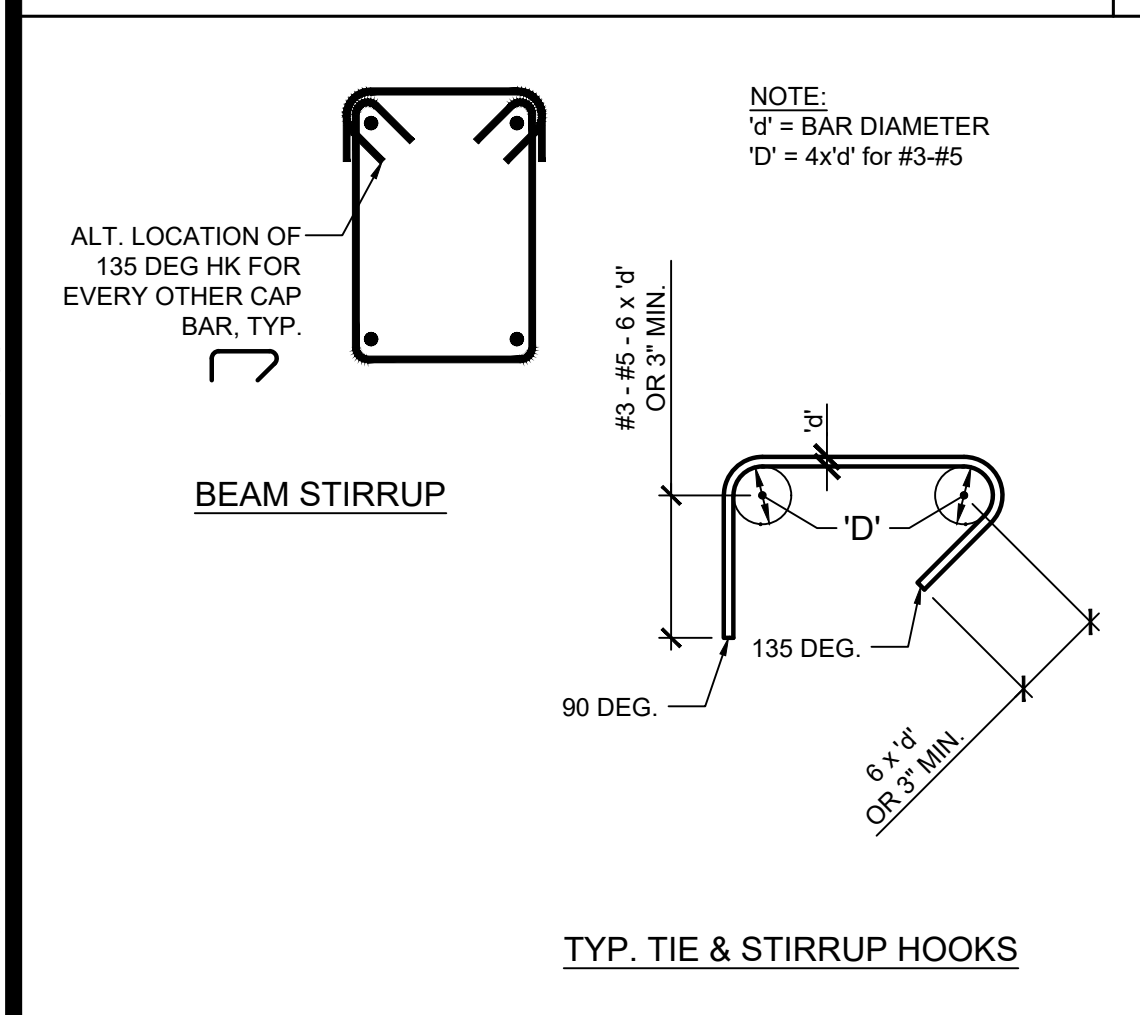
TYP. VENT DETAIL - ABOVE GRADE SCALE: 1-1/2" = 1'-0" 2A



FOOTING WIDTH (IN.)	CONTINUOUS LONGITUDINAL REINFORCING (EACH HORIZ. LEVEL)		TRANSVERSE REINFORCING (EACH HORIZ. LEVEL)	
	(1) #5	NOT REQ'D	(1) #6	NOT REQ'D
12"	(1) #5	NOT REQ'D	(1) #6	NOT REQ'D
12" < W ≤ 16"	(2) #5	NOT REQ'D	#4 @ 24" O.C.	#4 @ 24" O.C.
16" < W ≤ 24"	(2) #5	#4 @ 24" O.C.	#4 @ 24" O.C.	#4 @ 24" O.C.
24" < W ≤ 36"	(3) #5	#4 @ 24" O.C.	#4 @ 24" O.C.	#4 @ 24" O.C.
36" < W ≤ 48"	(4) #5	#4 @ 24" O.C.	#4 @ 24" O.C.	#4 @ 24" O.C.

BAR SIZE #	DEVELOPMENT LENGTH ³			TYPICAL CLASS B LAP SPLICE LENGTH ⁴					
	3000 PSI (IN)	3500 PSI (IN)	4000+ PSI (IN)	3000 PSI		3500 PSI		4000+ PSI	
	TOP ²	BOTTOM	TOP ²	BOTTOM	TOP ²	BOTTOM	TOP ²	BOTTOM	TOP ²
3	13	12	12	21	16	20	16	20	16
4	17	16	15	28	22	26	20	24	19
5	21	20	18	35	27	33	25	30	24
6	25	23	22	42	32	39	30	36	28

NOTES:
1. THE ABOVE TABLE IS BASED ON GRADE 60 STEEL.
2. TOP BARS ARE ANY BARS WITH MORE THAN 12" OF CONCRETE PLACED BELOW.
3. DEVELOPMENT LENGTH IS CALCULATED FOR TYP. BARS - $v_c = 1.0$
4. LAP SPLICES IN ADJACENT BARS SHALL BE STAGGERED, UNLESS OTHERWISE NOTED.

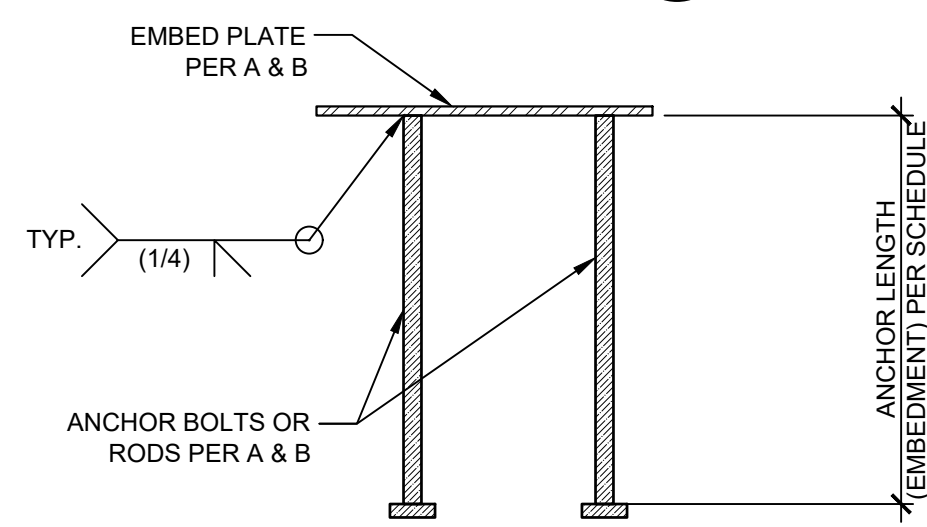
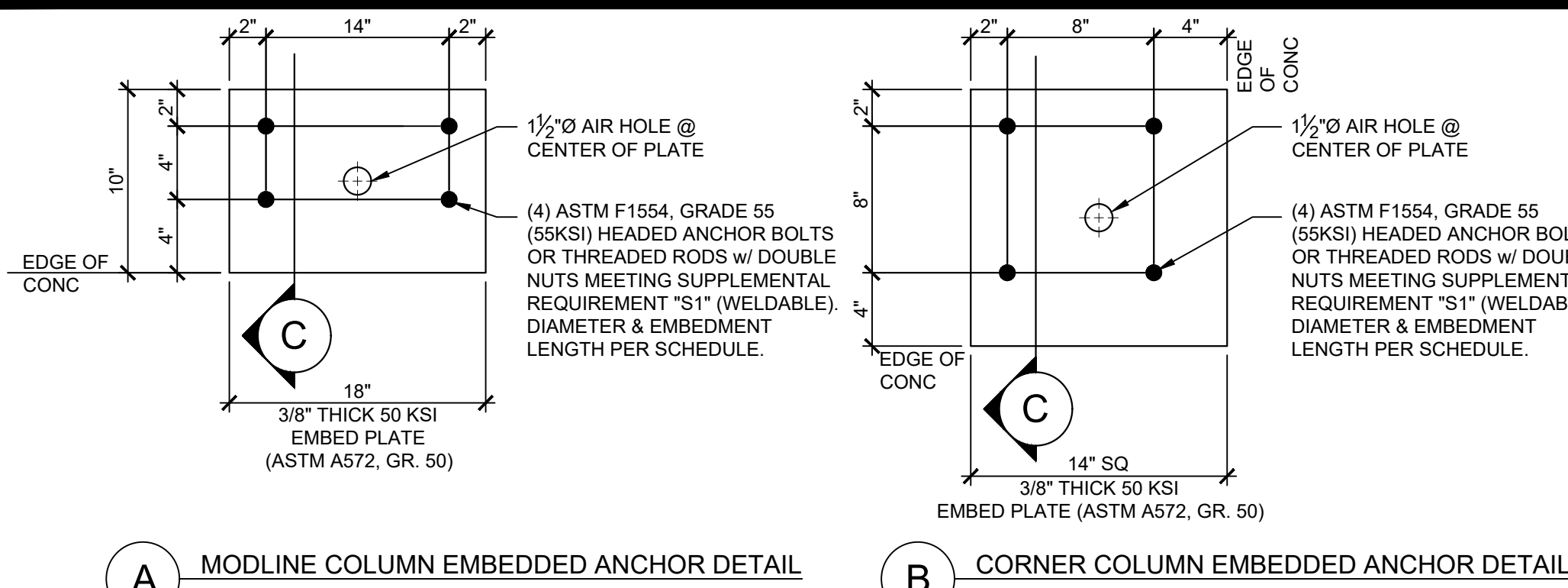


TYPICAL HOOP-STIRRUP DETAIL SCALE: 1-1/2" = 1'-0" 5

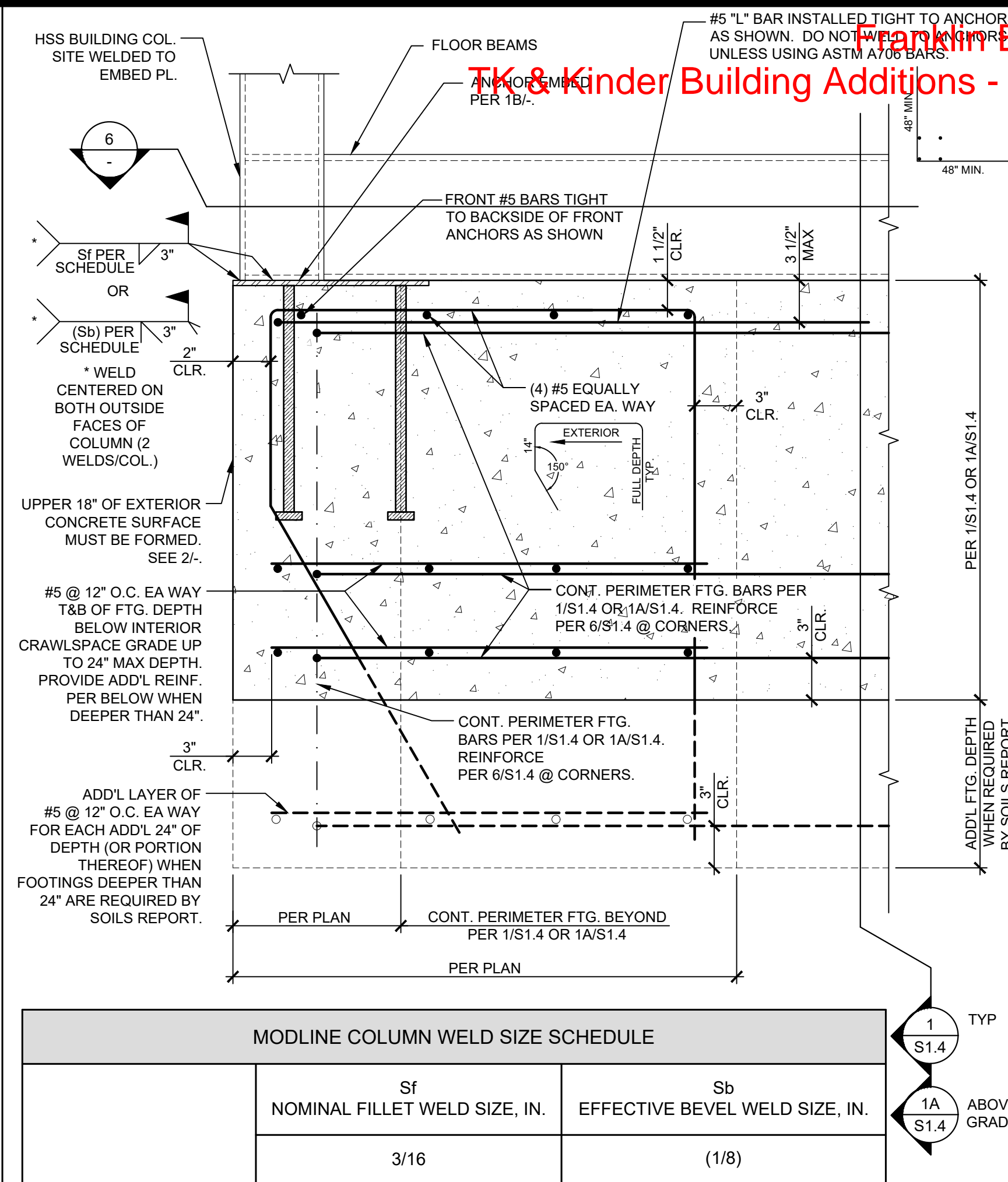
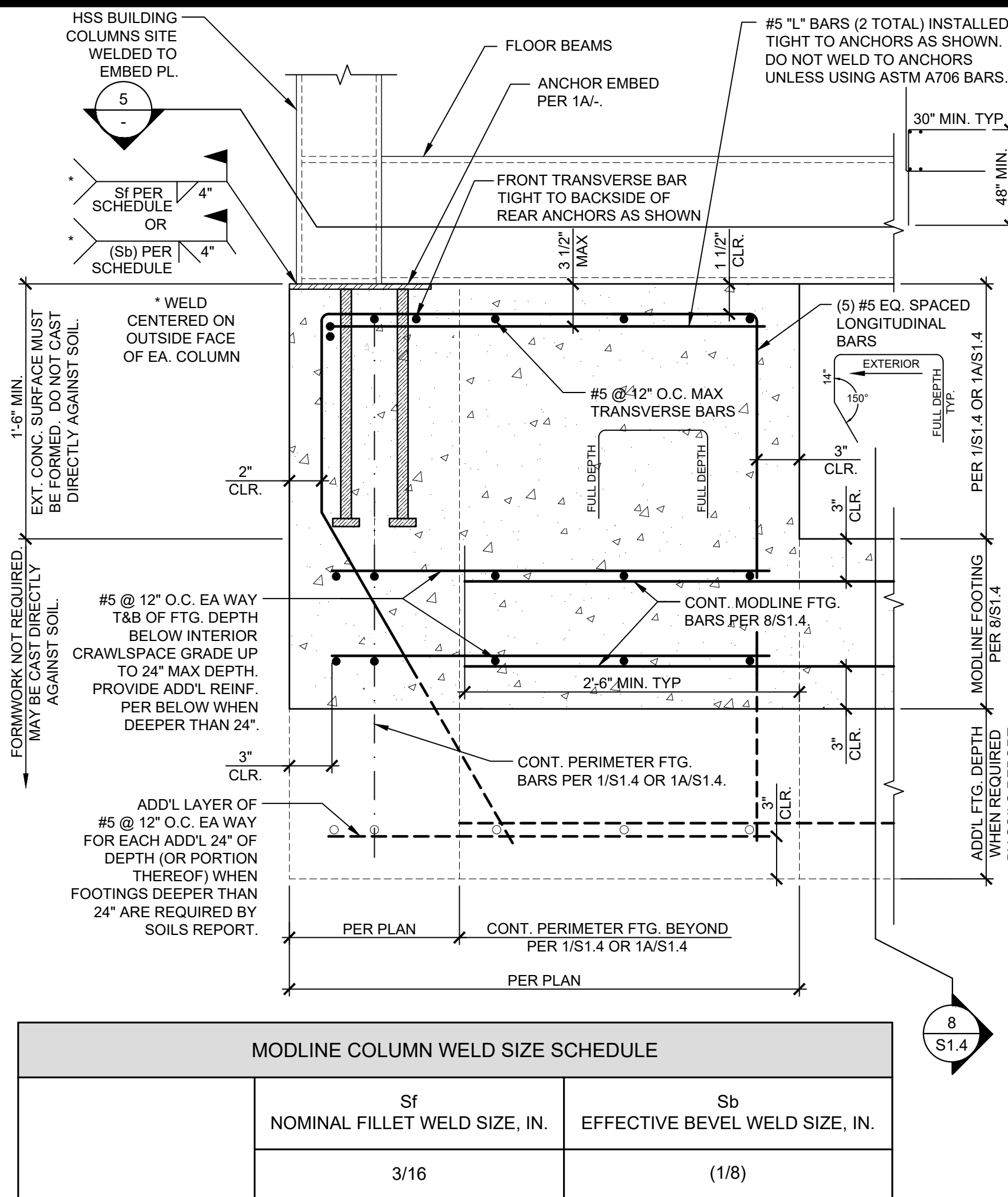
CORNER FOOTING REINFORCING SCALE: 1-1/2" = 1'-0" 6

TYPICAL INTERIOR MODLINE PIER SECTION 8

TYP. REINFORCING LAPS & BENDS SCALE: 1-1/2" = 1'-0" 9



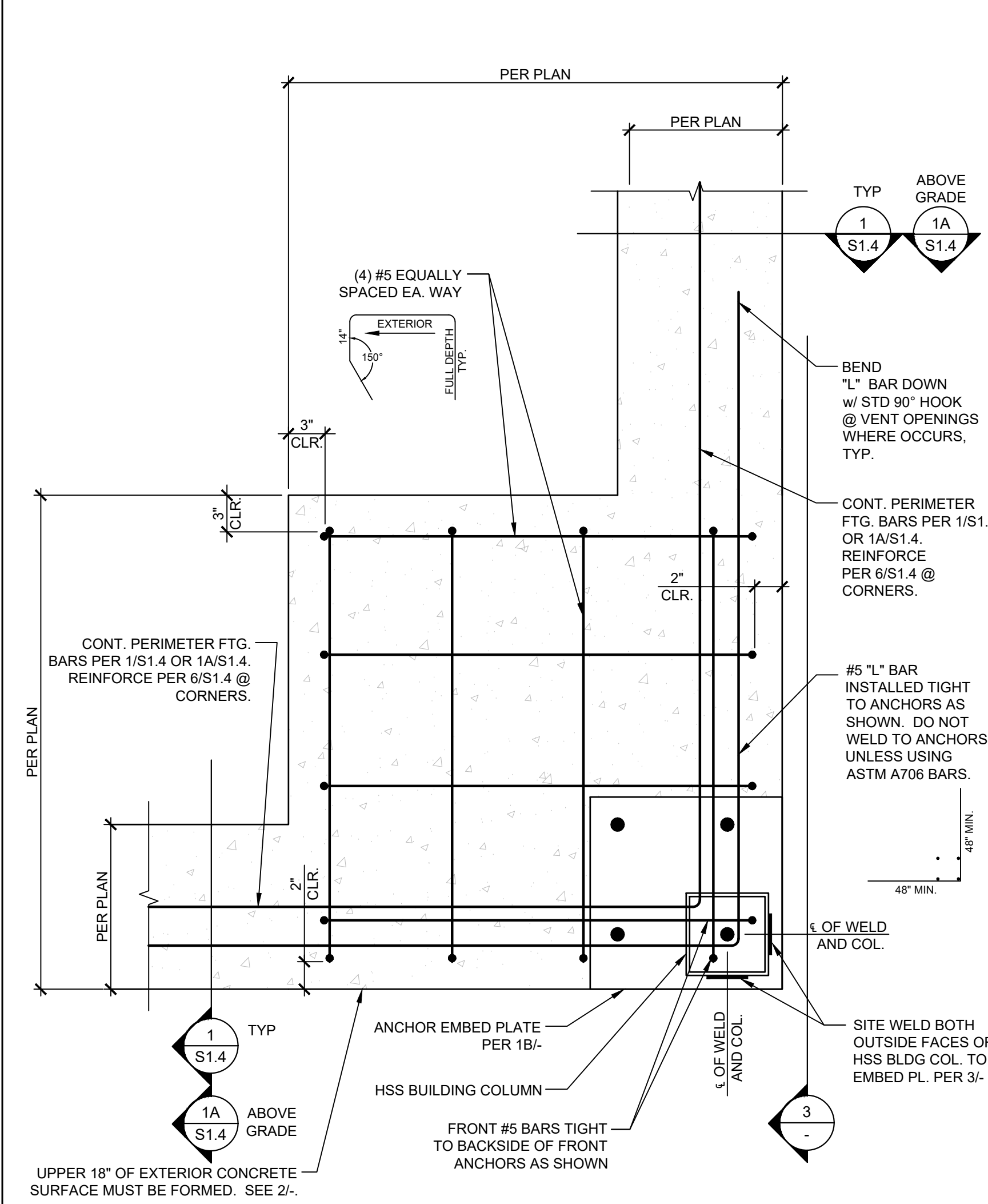
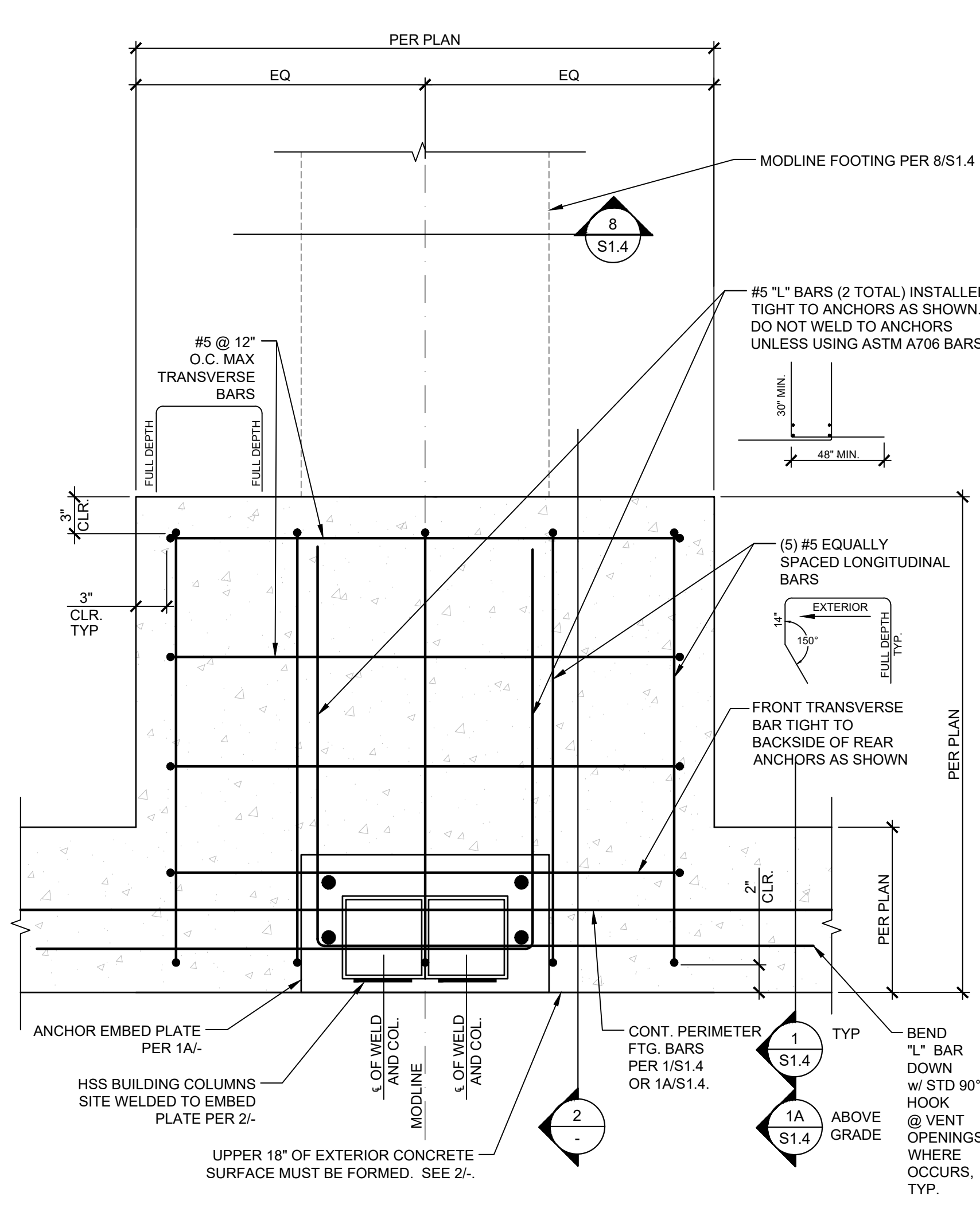
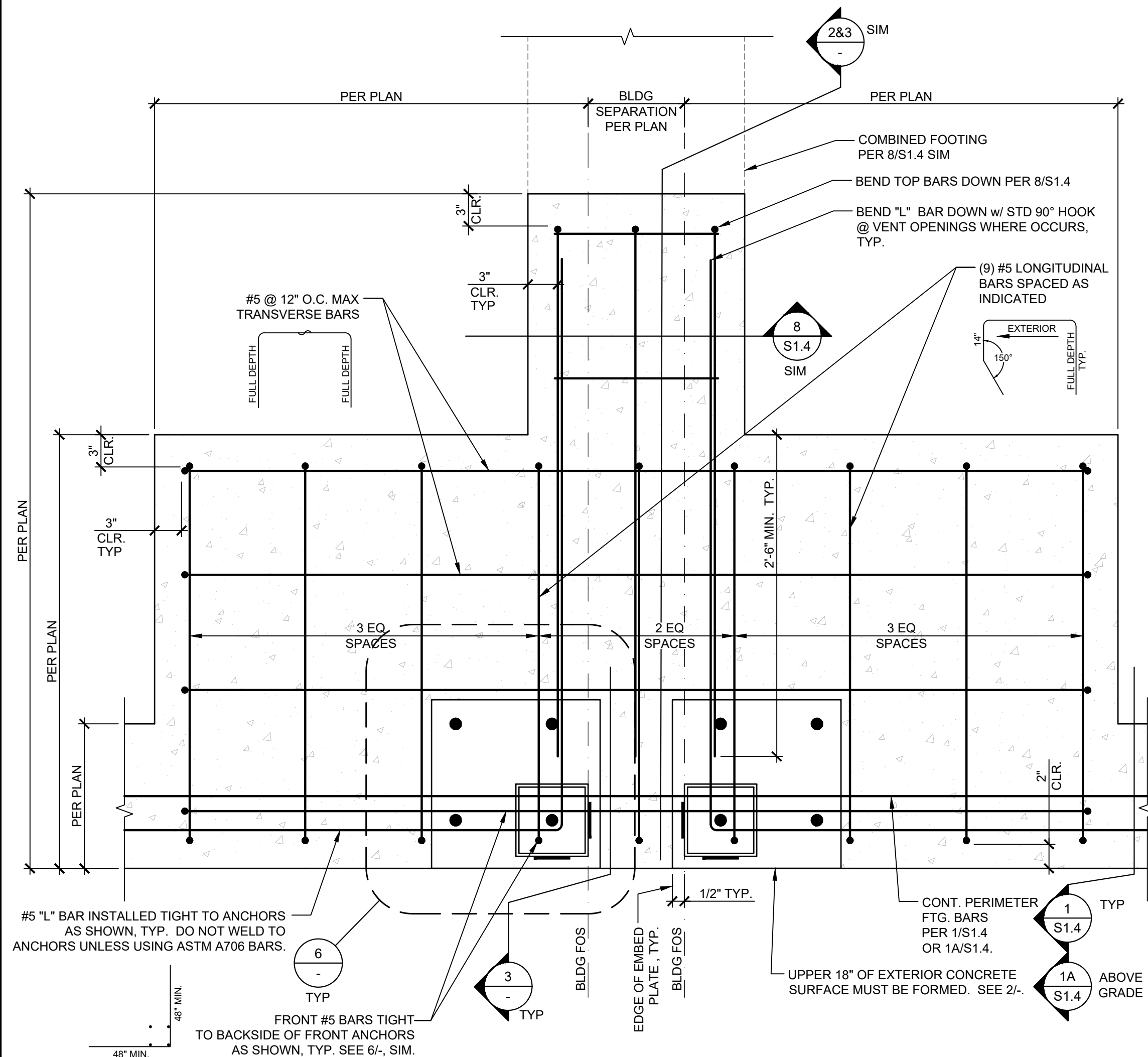
	FOUNDATION EMBED ANCHOR SCHEDULE			
	MODLINE COLUMN EMBED ANCHOR		CORNER COLUMN EMBED ANCHOR	
	ANCHOR DIAMETER	ANCHOR LENGTH (EMBEDMENT)	ANCHOR DIAMETER	ANCHOR LENGTH (EMBEDMENT)
<input type="checkbox"/> WOOD FLOOR	3/4"	10"	3/4"	16"
<input type="checkbox"/> CONC FLOOR	7/8"	12"	3/4"	18"



FOUNDATION ANCHORAGE EMBED DETAILS SCALE: 1-1/2" = 1'-0"

MODLINE COLUMN FOOTING & ANCHORAGE SECTION SCALE: 1-1/2" = 1'-0"

CORNER COLUMN FOOTING & ANCHORAGE SECTION SCALE: 1-1/2" = 1'-0"



COLUMN FOOTING & ANCHORAGE @ COMBINED FOOTING SCALE: 1-1/2" = 1'-0"

MODLINE COL. FOOTING & ANCHORAGE PLAN DETAIL SCALE: 1-1/2" = 1'-0"

CORNER COL. FOOTING & ANCHORAGE PLAN DETAIL SCALE: 1-1/2" = 1'-0"

Franklin Elementary School District
 TK & Kinder Building Additions - Site Development - Rebid
 Addendum #1, Item 1.2
BID ALTERNATE #3



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PRE-CHECKED SET NAME
 24' x 40' THRU 120' x 40'
 (LOW SEISMIC)
GEN7
 by AMS

SITE SPECIFIC PROJECT NAME

1	1A
1 S1.4	1A S1.4

IDENTIFICATION STAMP
 DIV. OF THE STATE ARCHITECT
 APP: 02-118326 PC
 REVIEWED FOR
 SS FLS ACS CG
 DATE: 07/22/2021

2019 CBC PRE-CHECK (PC) DOCUMENT
 A SEPARATE PROJECT APPLICATION FOR CONSTRUCTION IS REQUIRED.
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REVISIONS

NO.	DATE	DESCRIPTION

DRAWN BY: AS NOTED
 SCALE: AS NOTED
 DATE: MMDDYY
 PROJECT NO: XXXX-20
 SHEET TITLE: **FOUNDATION ANCHORAGE DETAILS**
 SHEET NUMBER: **S1.6**



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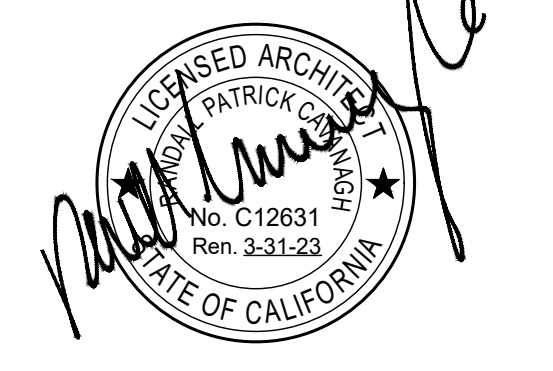
PRE-CHECKED SET NAME
24' x 40' THRU 120' x 40'
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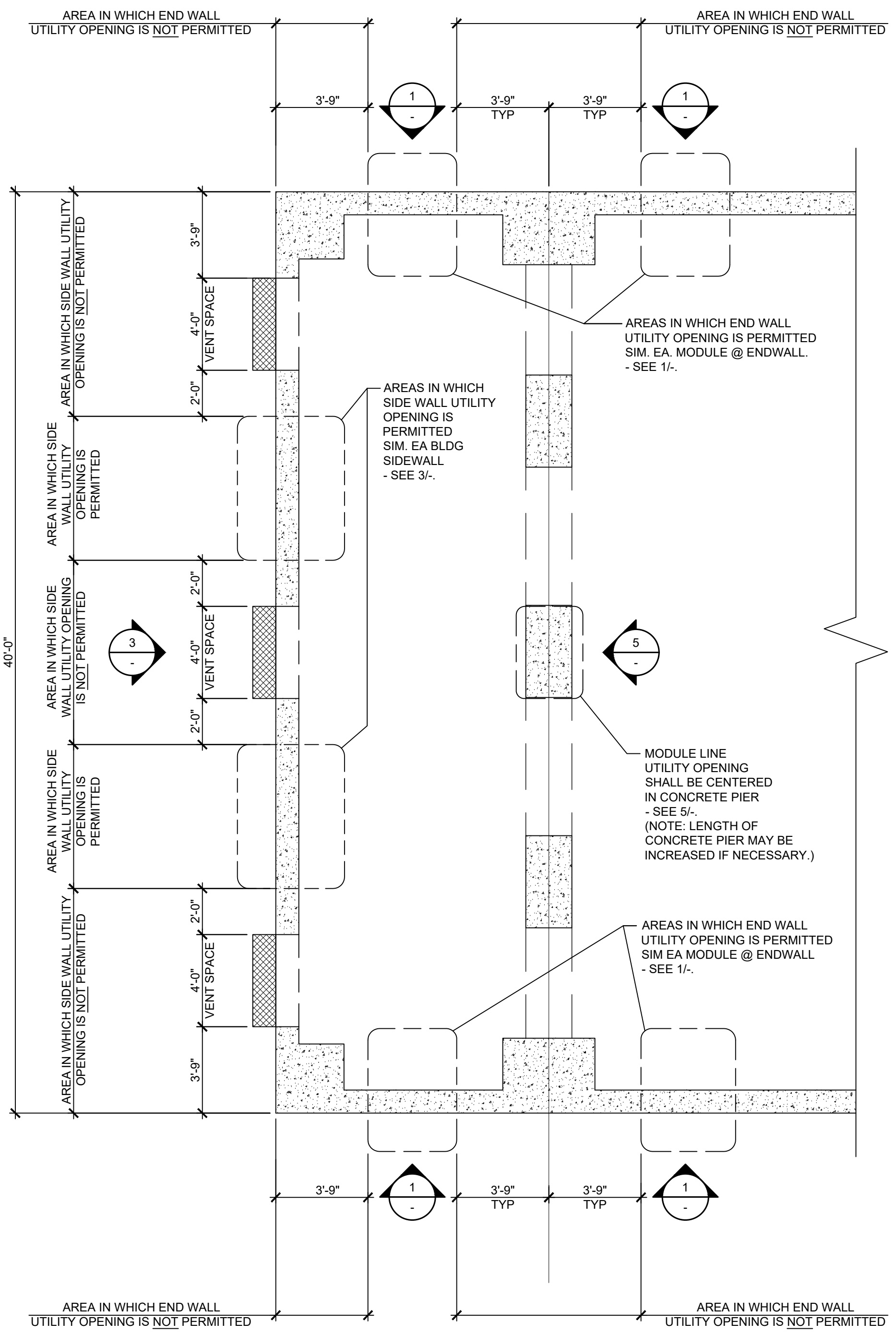


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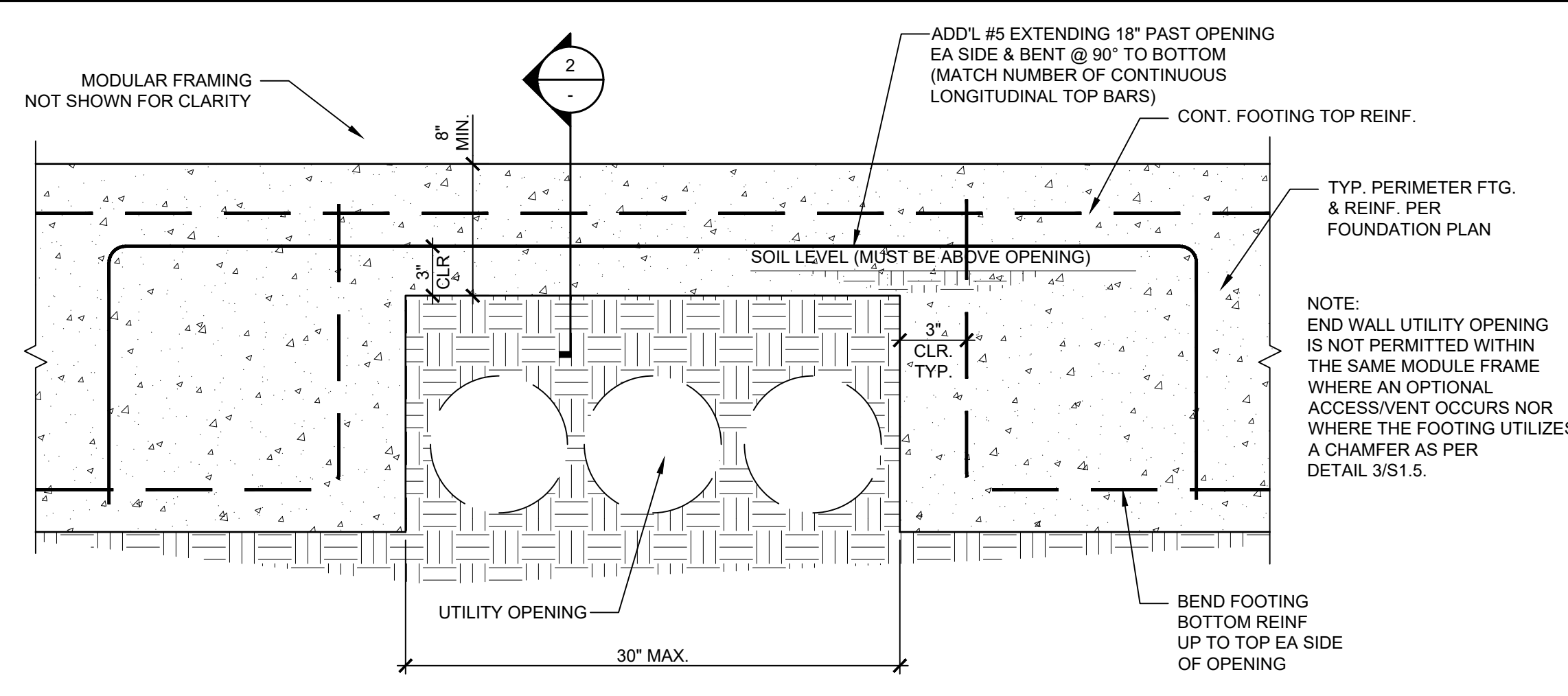
REVISIONS

DRAWN BY: _____
SCALE: AS NOTED
DATE: MM/DD/YY
PROJECT NO: XXXX-20
SHEET TITLE:
**CONCRETE FOUNDATION
OPTIONAL UTILITY
OPENINGS IN FOOTINGS**
SHEET NUMBER:

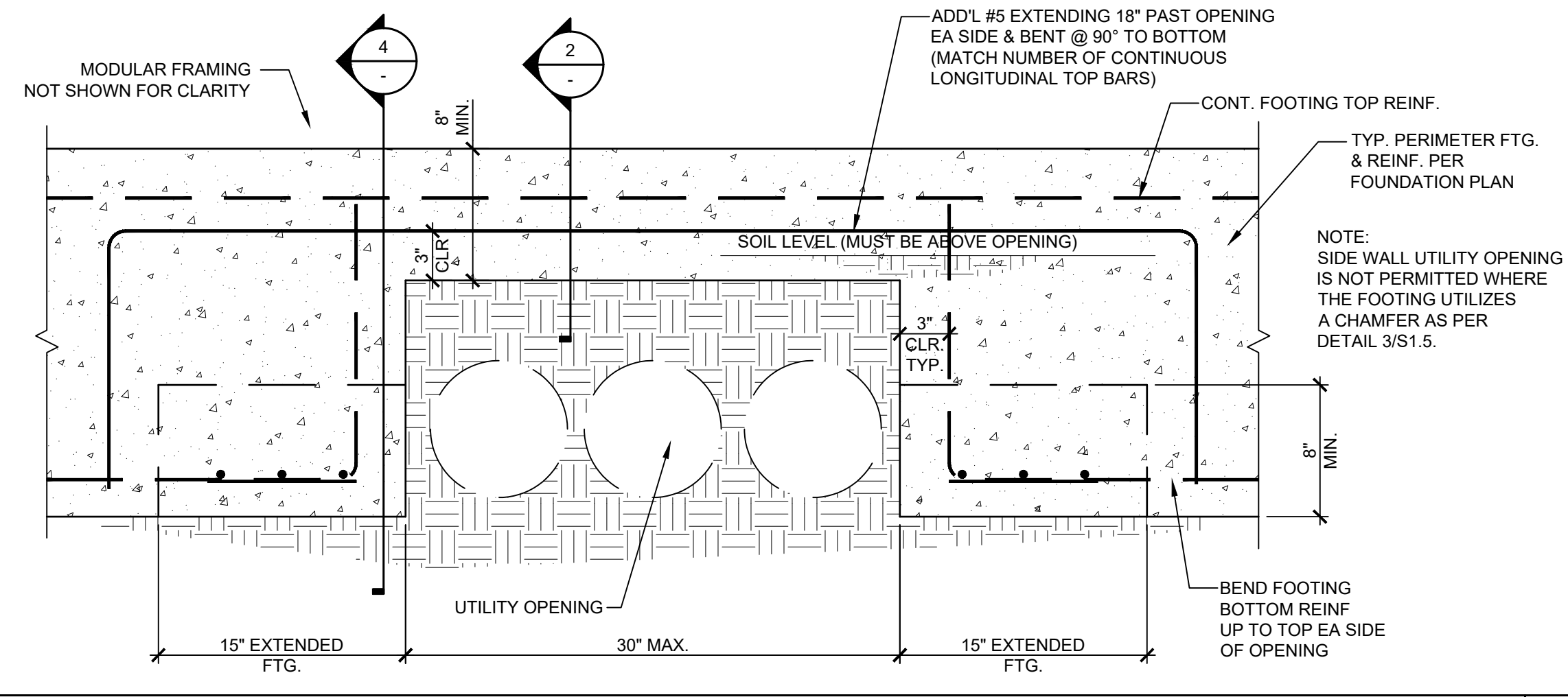
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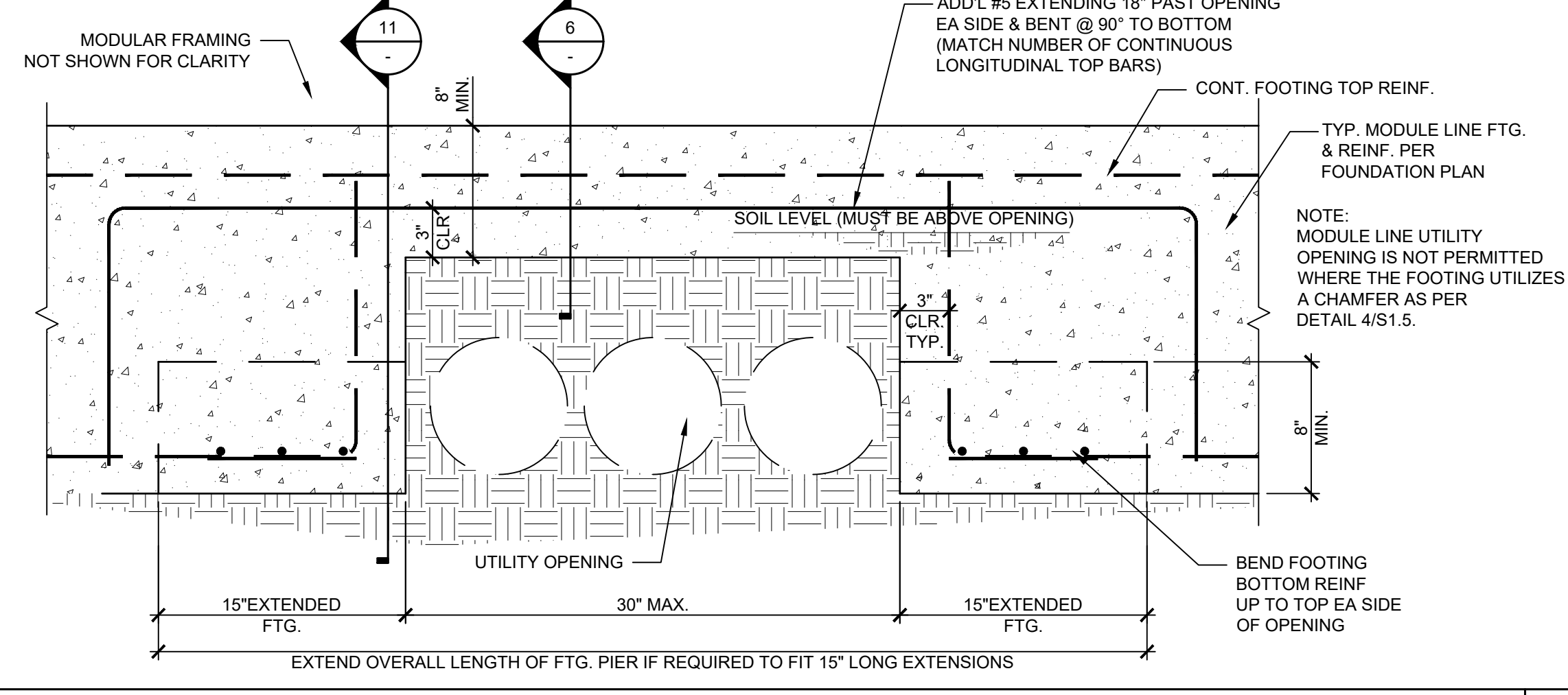
OPTIONAL UTILITY OPENINGS PLAN SCALE: 1/4"=1'-0"



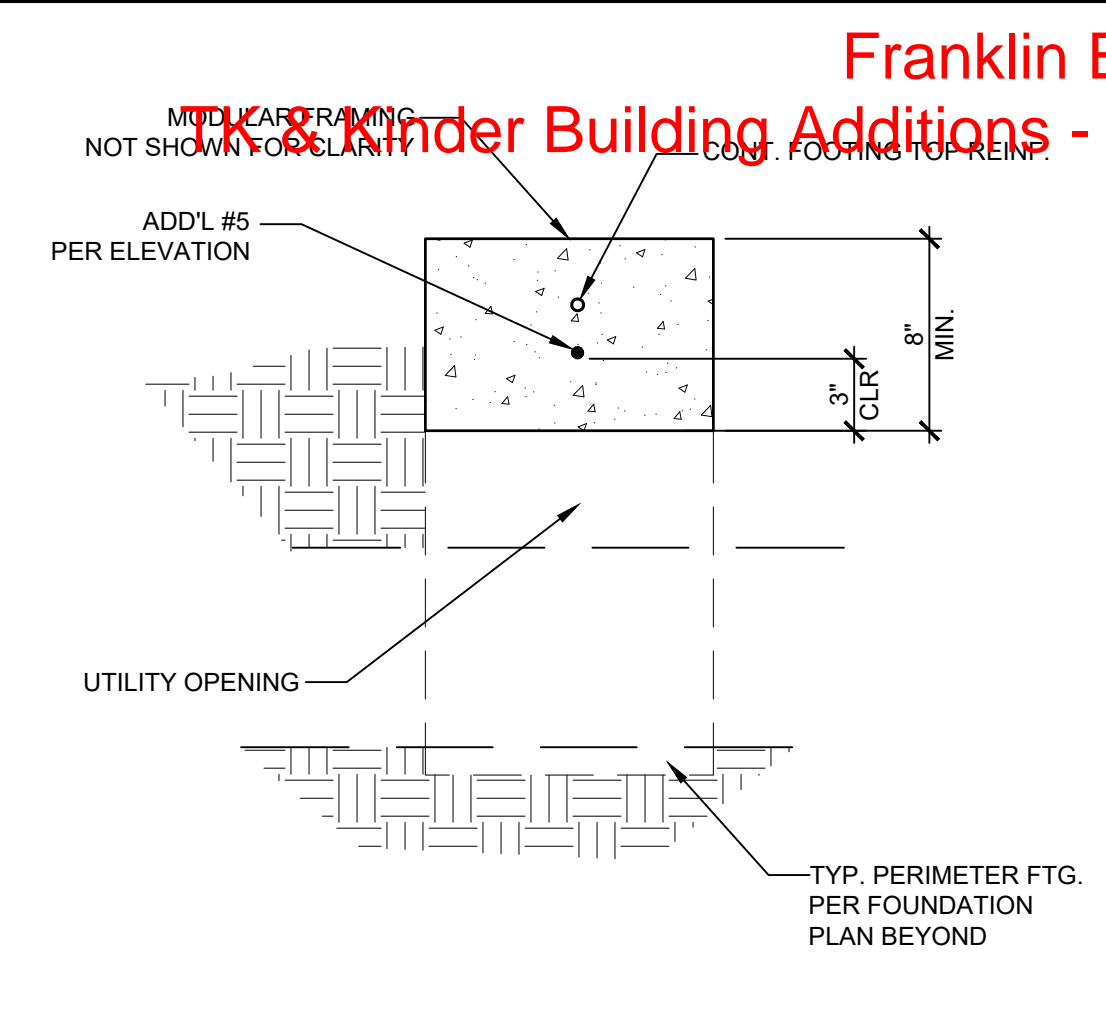
OPTIONAL UTILITY OPENINGS IN END WALL FOOTINGS SCALE: 1 1/2"=1'-0" 1



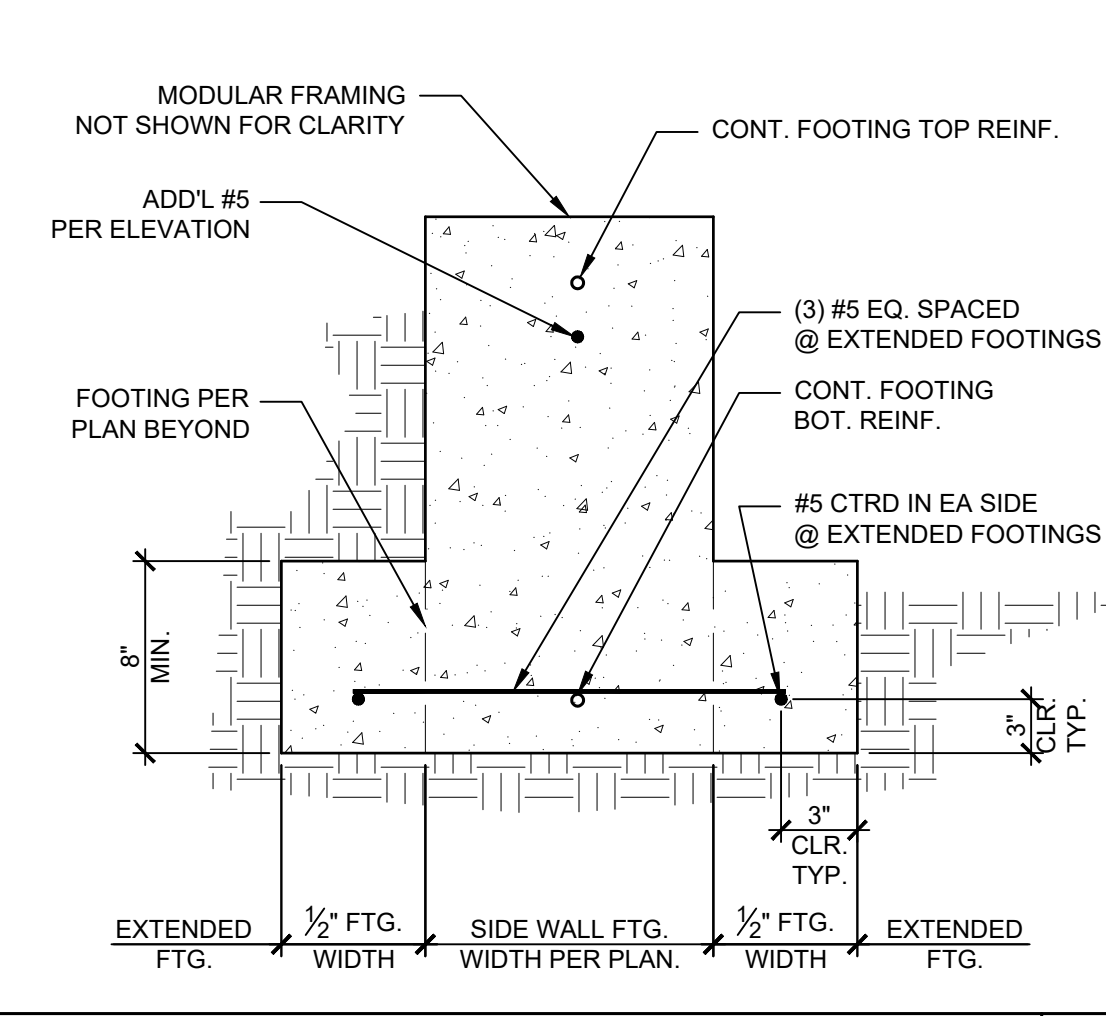
OPTIONAL UTILITY OPENINGS IN SIDE WALL FOOTINGS SCALE: 1 1/2"=1'-0" 3



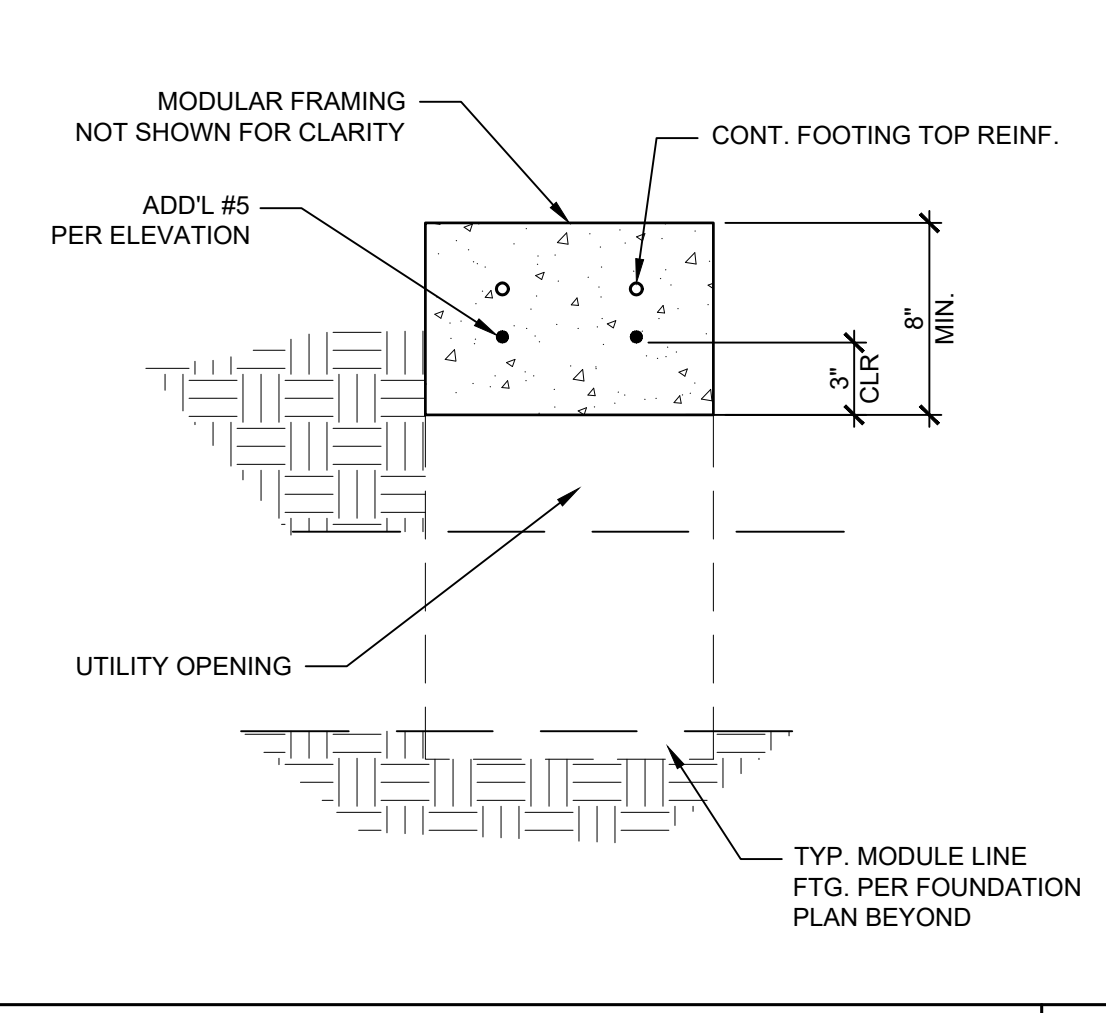
OPTIONAL UTILITY OPENINGS IN MODULE LINE FOOTINGS SCALE: 1 1/2"=1'-0" 5



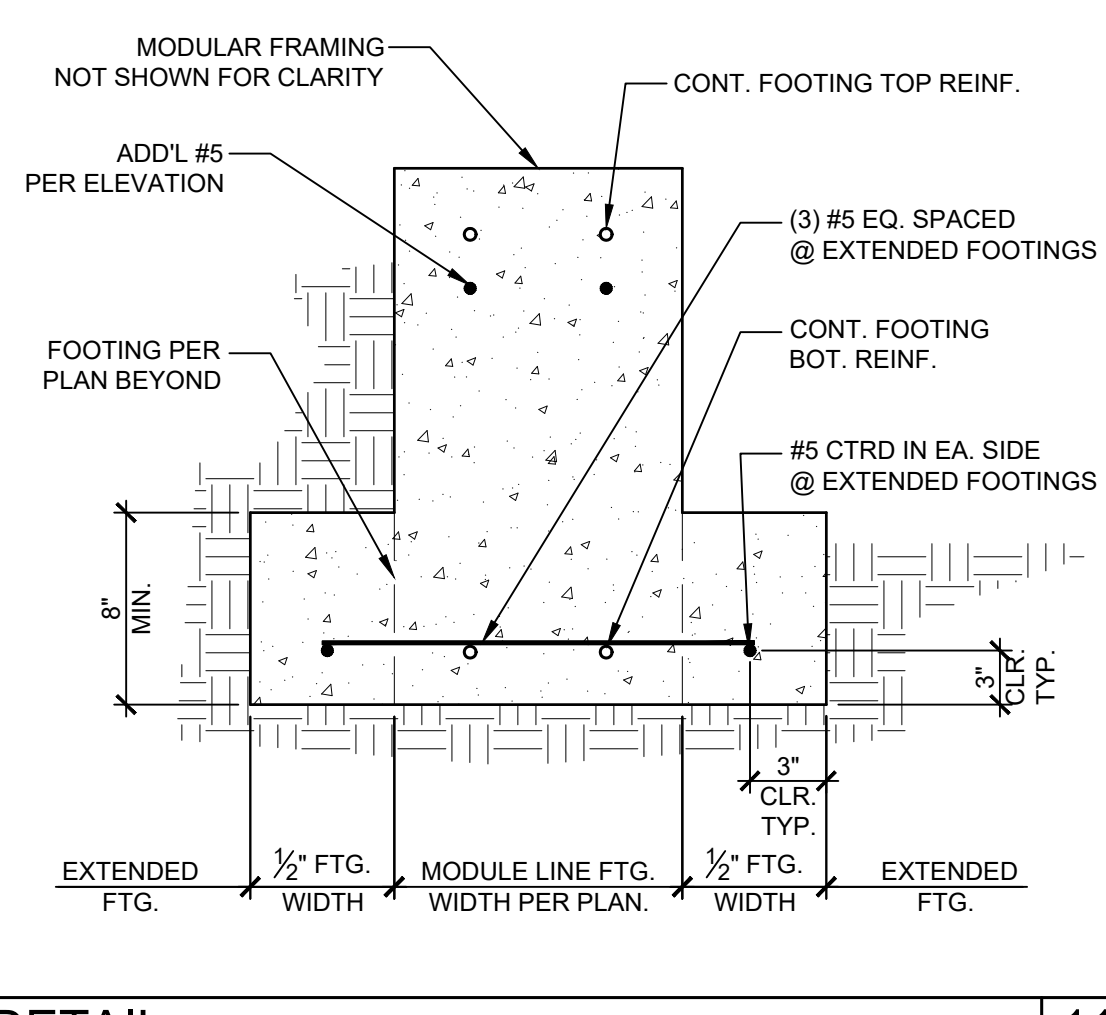
DETAIL SCALE: 1 1/2"=1'-0" 2



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



DETAIL SCALE: 1 1/2"=1'-0" 6



DETAIL SCALE: 1 1/2"=1'-0" 11

NOT USED 7

NOT USED 8

NOT USED 9

NOT USED 10

DETAIL SCALE: 1 1/2"=1'-0" 11

