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Project Manual

for

**FIRST COVENANT CHURCH
LOBBY & FELLOWSHIP ADDITION
Salina, Kansas**

November 26, 2025

Project No. 25-3518

FIRST COVENANT CHURCH
LOBBY & FELLOWSHIP ADDITION
SALINA, KANSAS

Project No. 25-3518

DATE OF DRAWINGS AND SPECIFICATIONS

November 26, 2025

OWNER

FIRST COVENANT CHURCH
2625 E. Magnolia Rd
Salina, KS 67401
785-823-3792

ARCHITECT

JONES GILLAM RENZ ARCHITECTS, INC
Charles A. Renz, Project Architect
730 N. 9th Street Salina, KS 67401
785 827 0386

STRUCTURAL ENGINEERS

BOB D. CAMPBELL COMPANY
Chris Beverlin, P. E.
4338 Belleview Ave, Kansas City, MO 64111
816 531 4144

MECHANICAL/ELECTRICAL

LST CONSULTING ENGINEERS, INC.
John Lewis Smith, P.E
4809 Vue Du Lac Pl, Ste 201, Manhattan, KS 66503
785 587 8042

CIVIL

KAW VALLEY ENGINEERING
Matthew Rowe, P.E.
1627 Sunflower Lane, Salina, KS 67401
785-823-3400

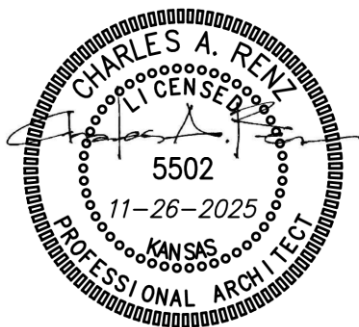


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First Covenant Church
Lobby & Fellowship Addition
Salina, Kansas

Jones Gillam Renz Architects, Inc
730 N. 9th St.
Salina, Kansas 67401
785-827-0386

Project No. 25-3518

INVITATION TO BID

Sealed Bids, will be received by First Covenant Church, for the furnishing of all labor and materials as hereinafter specified for the construction of Lobby & Fellowship Addition. **Bids shall be delivered to the office of JGR Architects, 730 N. Ninth Street, Salina, KS before Thursday, January 8, 2026 at 3:00 p.m.** Bids received after this time will not be accepted. Bids will be opened in private session with the owner the same day.

1. PROJECT SCOPE

- a. Building: New Addition – 1,700 s.f. Infill at existing outdoor plaza space.
- b. Footing/Foundation: Concrete footings and foundations.
- c. Floor Structure: Cast-in-place concrete slab on grade.
- d. Wall/Roof Structure: Structural Steel Framing. Metal stud wall infill, Acoustical structural metal roof deck.
- e. Exterior Finishes: Brick Veneer, Shingle roof, Aluminum windows and storefront openings.
- f. Floor Finishes: LVT resilient flooring, Carpet tile., Minor patch and infill ceramic tile to match existing.
- g. Ceiling Finishes: Painted acoustical metal roof deck, drywall ceilings, soffits, and bulkheads.
- h. Custom Cabinetry: Plastic Laminate, Stain & Finished wood.
- i. Wall Finishes: Painted gypsum board, Wood panel accents.
- j. Roof Membrane: Shingle roofing system over cover board and rigid insulation; Single ply roof at roof edge.
- k. Paving: 6" Concrete paving. Curb and gutter, new sidewalk.
- l. Mechanical: HVAC system with ground mounted equipment. Fresh-air unit on roof. Exhaust fans for restroom exhaust.
- m. Plumbing: Waste, Vent Piping, equipment, and plumbing fixtures. Domestic water, equipment, and fixtures.
- n. Extend piping for installation of new sprinkler piping and heads.
- o. Electrical: New Lighting and site lighting.
Fire alarm system modification and integration of new devices.
Conduit & cabling for owner's data systems.
- p. Site Utilities: Modification of existing Gas line to feed new HVAC Unit.
New electrical conduit and cable for new and relocated light fixtures, and outdoor signs.

2. PRE-BID CONFERENCE

Pre-Bid Conference will be held on **Thursday, December 18th, 2025 at 2:00 p.m. at building site, 2625 E. Magnolia, Salina, KS.** Failure to attend may be grounds for rejection of bid.

3. COMPLETION TIME

Completion date for the project is to be bid in calendar days: To be Bid by Contractor and stated on the Bid Form.

4. The GENERAL CONSTRUCTION CONTRACT will include General Construction, Mechanical, and Electrical Work combined into one Contract.

5. As a condition precedent to Contract Award, type of work completed and proposed Subcontractors will be carefully considered. Owner is not obligated to accept lowest or any other bid.

6. The Owner has identified a Select Bidders List for the General Construction.

7. The Drawings, Specifications, and Contract Documents may be obtained by bona fide Prime Bidders (Mechanical and Electrical, and Subcontractors) from Jones Gillam Renz Architect, 730 N. Ninth Street, Salina, Kansas 67401, 785-827-0386 upon deposit of \$200.00 for one (1) set of General Construction, Mechanical and Electrical Drawings and Specifications.

Electronic Drawings and specifications will be available for review on the website at www.jgrarchitects.com.
Mechanical, Plumbing and Electrical Subcontractors who are bidding from documents via website or plan room must contact the office of Jones Gillam Renz Architects, 785.827.0386 to register as an official Plan Holder.

Those who submit prime bids may obtain refund by returning sets in good condition no more than one (1) week after bids have been opened. No refund of deposit will be made to Contractors not submitting a bid, unless all documents are returned in good condition five (5) days prior to time of receiving bids.

CONTRACT DOCUMENTS will be on file and may be examined at the following locations:

Jones Gillam Renz Architects, 730 North 9th Street, Salina, KS 67401, ph. 785-827-0386, www.jgrarchitects.com

Associated General Contractors of Kansas, ph. 316-928-8635, www.agcks.org

Dodge Construction Network, ph. 877-784-9556, www.construction.com

Construct Connect, ph. 877-969-2909, www.constructconnect.com

Salina Blueprint, 209 S. Santa Fe Ave., Salina, KS 67401, ph. 785-827-6182, www.salinablue.com

Salina Area Chamber of Commerce Plan Room, 120 West Ash, Salina, KS 67401, ph. 785-827-9301, www.salinakansas.org

8. BID SECURITY in the amount of 5% of the bid must accompany each bid in accordance with INFORMATION FOR BIDDERS.

BY ORDER OF:

First Covenant Church
Salina, Kansas

INFORMATION FOR BIDDERS

1. EXAMINATION

Before submitting their bid, each Bidder shall carefully examine all documents pertaining to the work, visit the site of the work, and inform themselves as to all existing conditions under which the work will be performed. Submission of a bid will be considered presumptive evidence that the Bidder is fully aware of the conditions of the work, requirements of the Contract Documents, pertinent State and Local codes, conditions of labor and material markets, and has made allowances in their bid for all work and all contingencies. Contractors will not be given extra payments for conditions which can be determined by examining the site and documents.

2. QUESTIONS AND INTERPRETATION OF DOCUMENTS

Should a Bidder be in doubt as to the meaning of any part of the Drawings, Specifications or other proposed Contract Documents and/or find discrepancies in or omissions from the Drawings, Specifications and Contract Documents, he shall contact the Architect immediately per Article 3, Subparagraph 3.2.1 of the AIA General Conditions. Any interpretation of the proposed documents will be made only by Addendum duly issued and copy of such Addendum will be emailed to each person receiving a set of such documents. The Architect and Owner will not be responsible for any other explanation or interpretation of the proposed documents.

3. GENERAL CONSTRUCTION BID

- a. The General Construction bid shall incorporate all of the departments of Work (General Construction, Electrical, and Mechanical Work) into one (1) bid.
It is preferred that General Contractors work with Prime subcontractors with whom they have previous working relationships, including at least three previous projects of similar scope. Contractor/Subcontractor experience and relationship may be considered by the owner in the evaluation of bids and acceptance of bids.
- b. The General Contractor shall assume all responsibility for supervision and coordination of the Work.
- c. The General Contractor shall furnish Performance and Payment Bonds in the full amount of the Work (Total of General Construction, Electrical, and Mechanical Work).
- d. The General Contractor shall carry and pay the premium covering the General Construction Work, for Contractors and Subcontractors Insurance as specified in Supplementary Conditions of the Contract.

4. BID PROCEDURE

- a. Bids will be received at the time and place stated in the INVITATION TO BID. Bids received after the time stated will be returned unopened.
- b. No oral or telephonic bids will be considered, but modifications by email of bids already submitted will be considered if received prior to time set for bid opening.
- c. Any addenda issued during the time of preparation of bids are to be acknowledged on the Bid Form and in closing a Contract, they will become a part thereof.
- d. Each Bidder is required to bid all alternates included in the Bid Form, except that should they desire not to bid an Alternate, they may insert the words "No Bid" in the space provided for such Alternates. In such case, if it is determined to use such Alternate, the fact that the cost of the material, type, or method bid may be lower than that chosen shall not constitute the basis of a claim by the Bidder that the Contract be awarded to him. If an Alternate Price called for involves no change in price, Bidder shall so indicate by writing the words, "No Change" in the space provided. Refer to Section 01019 - SPECIAL PROVISIONS. Each Bidder is required to fill in all unit cost items shown on the Bid Form. Failure to comply may be cause for rejection.
- e. Bids shall be submitted on the forms provided. All blank spaces on the forms shall be fully completed in words as well as figures. Bid Forms must be signed in longhand, with name typed below signature. Where Bidder is a corporation, Bid Forms must be signed with legal name of corporation, followed by the name of the State of Incorporation, the legal signature of an officer authorized to bind the corporation to a contract, Attest and Seal Impression. A copy of the Bid Form is bound herein for the convenience of the Bidders and is not to be detached or filled out. Separate Bid Forms, in triplicate, will be furnished to all Bidders.

- f. Submittals of Bids shall be as follows:
- 1) Bids, together with Bid Security, shall be sealed in an opaque envelope, labeled "FIRST COVENANT CHURCH, LOBBY & FELLOWSHIP ADDITION, SEALED BID, DO NOT OPEN" addressed to: FIRST COVENANT CHURCH. **Bids shall be delivered to the office of JGR Architects, 730 N. Ninth St., Salina, KS before 2:00p.m. on Thursday, December 11, 2025. Bids will be opened in private session with the owner the same day.**

5. CONTRACT GUARANTEE

Successful Bidder must deliver to the Owner the following Bonds in an amount no less than 100% of the accepted bid, as security for the faithful performance of the Contract.

- a. Performance and Payment Bond as per General Conditions.
- b. Statutory Bond, as required in Section 01019 - SPECIAL PROVISIONS.

6. WITHDRAWAL OF BIDS

A bid may be withdrawn on written or faxed request and by request of Contractor personally, received or made prior to time fixed for bid opening. No bid may be withdrawn after opening of bids.

7. INTERPRETATION OF QUOTED PRICES

In case of a difference in written words and figures in a bid, the amount stated in written words shall govern.

8. TIME OF CONSTRUCTION AND LIQUIDATED DAMAGES

Refer to Section 01019 - SPECIAL PROVISIONS.

9. DISQUALIFICATION

The Owner reserves the right to disqualify bids, before or after opening upon evidence of collusion with intent to defraud or illegal practices upon part of the Bidder. Bids will be opened as stated in the Invitation to Bid.

10. SALES TAX EXEMPTION

Refer to Section 01019 - SPECIAL PROVISIONS.

First Covenant Church, Lobby & Fellowship Addition, Salina, Kansas

BID FORM

Bid of _____
(Firm Name)
Date _____

BID FORM FOR:
First Covenant Church
Lobby & Fellowship Addition, Salina, Kansas

TO: **First Covenant Church**
2625 E. Magnolia
Salina, KS 67401

In compliance with your INVITATION TO BID, the undersigned proposes to furnish all labor and materials and perform all work for the General Construction, including Mechanical and Electrical Work, incidental for the construction and equipping of First Covenant Church, Lobby & Fellowship Addition, Salina, Kansas, in strict accordance with the Specifications and the Drawings dated November 26, 2025 mentioned therein for the consideration of the following:

BASE BID _____ **Dollars**

\$ _____

The Base Bid includes all allowances as outlined in Section 01019 – Special Provisions.

Number of consecutive Calendar Days to complete this project in accordance with Drawings and Specifications, to be coordinated with General Contractor and subject to Liquidated Damages,

Section 01019 - SPECIAL PROVISIONS -- _____ **DAYS**

The Undersigned acknowledges receipt of the following addenda:

Addendum #1 _____ Addendum #2 _____ Addendum #3 _____ Addendum #4 _____ Addendum #5 _____

ALTERNATE PRICES: For the Alternates as described in the Specifications and/or Drawings, the undersigned agrees to ADD or DEDUCT the following amounts to or from the BASE BID as hereinafter itemized:

<u>ALTERNATE NO.</u>	<u>ADD/DEDUCT</u>
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<u>Alternate No. 1</u> Expanded patio area	\$ _____
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<u>Alternate No. 2</u> Site driveway approach and parking lot expansion.	\$ _____
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<u>Alternate No. 3</u> Interior wood wall paneling at fireplace.	\$ _____
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<u>Alternate No. 4</u> Drop-off canopy footings.	\$ _____
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<u>Alternate No. 5</u> Concrete curb repairs..	\$ _____
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Alternate No. 6
If added by addendum.

\$ _____

Unit Prices

Unit Price No. 1 Removal, haul-off, and replacement of unsuitable soil \$ _____ **per C.Y.**

I (or WE) FURTHER AGREE AS FOLLOWS:

1. To furnish labor and materials for additional work (except Mechanical and Electrical) ordered by the Owner and for which no pre-agreed upon amount has been determined for the cost of the labor and materials involved plus 10% for overhead and profit.
2. To furnish supervision and coordination for 10% of the cost of additional Mechanical and Electrical work ordered by the Owner.
3. To accept the provisions of Section 01019 - SPECIAL PROVISIONS regarding the date of completion of the Project and Liquidated Damages.
4. If written notice of the acceptance of the Bid is mailed, telegraphed or delivered to the Undersigned within 30 days after the date of the opening of the Bids, or anytime thereafter before this Bid is withdrawn, the Undersigned will, within ten (10) days after the date of such mailing, telegraphing or delivery of such notice, execute and deliver a contract in accordance with AIA Document A101, Standard Form of Agreement Between Owner and Contractor, and give Performance Bond in accordance with the Specifications and bid as accepted.
5. That upon failure or refusal to execute and deliver the contract and bonds required within ten (10) days after receipt of notice of acceptance of the Bid, that security deposited with Bid shall be forfeited to the Owner as liquidated damages for such failure or refusal.

DECLARATION:

1. The Undersigned hereby declares that he has carefully examined the Invitation and Information for Bidders, the Drawings and Specifications, has visited the actual location of the Work and has consulted his sources of supply, and has satisfied himself as to all quantities and conditions, and understands that in signing this Bid, he waives all rights to plead any misunderstanding regarding the same.
2. The Undersigned understands that his competence and responsibility and that of his proposed subcontractors, time of completion, as well as any other factors of interest to the Owner will be considered in making the award. The Owner reserves the right to reject any or all bids, to accept or reject alternate bids and unit prices and to waive technicalities concerning the bids received, as it may be in his interest to do so.

(Legal Name of Bidder)

(SEAL, if bid is by a corporation)

(Address of Bidder)

BY _____ in longhand

(Title) Typewritten

AIA[®] Document A201[™] – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

First Covenant Church
Lobby & Fellowship Addition, Salina, KS
JGR Project #25-3518

THE OWNER:

(Name, legal status and address)

First Covenant Church
2625 E. Magnolia Rd, Salina, KS 67401
785-823-3792

THE ARCHITECT:

(Name, legal status and address)

Jones Gillam Renz Architects, Inc.
730 N. 9th St., Salina, KS 67401
785-827-0386

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ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503[™], Guide for Supplementary Conditions.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document

G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and

delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely

upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will

promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or

expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during

that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;

- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

SUPPLEMENTARY CONDITIONS OF THE CONTRACT

1. DEFINITIONS - Supplement Paragraph 1.1 as follows:
 - a. When words such as approved, proper, satisfactory, equal, and as directed are used, they imply such reference to the Architect's specific approval and directions.
 - b. Provide means to furnish and install.
 - c. The provisions of the Agreement take precedence over all other Contract Documents.
2. WARRANTY - Supplement Paragraph 3.5.1 as follows:
 - a. Contractor warrants to Owner and Architect that on receipt of notice from either of them, within the period of one (1) year following date of Substantial Completion, that defects in materials and/or workmanship have appeared in the Work, Contractor will promptly correct such defects to the state of condition originally required by the Contract Documents at Contractor's expense.
3. SHOP DRAWINGS - Supplement Paragraph 3.12 as follows:
 - a. The Contractor shall submit **one (1) electronic copy** of all Shop or Setting Drawings and Schedules required for the work of the various trades, after same have been checked and compared with the Contract Document Requirements, and after checking with field conditions at the job and so certified on the Drawings by the Contractor. Above Drawings will not be checked by Architect unless same bear certification.
 - b. Architect's approval is subject to notations on Drawings, Compliance with Drawings and Specifications, and conditions and measurements at project. Measurements and quantity not checked or approved.
4. SAMPLES - Supplement Subparagraph 3.12.3 as follows:
 - a. All samples as called for in the various Sections of this Specification and any other samples, as directed, shall be furnished by the Contractor for approval.
 - b. All samples of materials that require approval as to color, texture, finish and type shall be furnished at the same time, so that an intelligent selection of colors and textures may be made by the Architect.
5. COLOR SELECTIONS
 - a. The Contractor shall provide for and coordinate into the project construction schedule, a 6-week time frame for the Architect/Designer to make final color selections from Contractor's submittals, obtain approval from the Owner and to submit a color schedule, indicating what colors go where, to the Contractor. Time frame begins when Architect has received 100% of submittals listed below.
 - b. Submittals, i.e., actual samples, manufacturers' literature, full color line options, etc., shall include as a minimum, but not limited to:

Carpet Types	Paint
Sheet Vinyl Flooring	Corner Guards
Vinyl Composition Tile Flooring	Plastic Laminate (Manufacturer)
Vinyl Base	Wood Stain for Doors and Woodwork
Ceramic Wall Tile	Aluminum Storefront System
Ceiling Types	
6. CLEAN UP - Supplement Paragraph 3.15 as follows:
 - a. Each Contractor shall, at all times, remove any and all of his rubbish from the buildings and grounds and keep the building site clean.
 - b. In addition to the general broom cleaning, the General Contractor shall do the following special cleaning for all trades at the completion of the work:
 - 1) Glass. Remove putty, stains and paint from all glass and wash and polish same. Care shall be taken not to scratch the glass.
 - 2) Painted, Decorated, and Stained Work. Remove all marks, stains, fingerprints and other soil or dirt from all painted, decorated, and stained work.
 - 3) Temporary Protection. Remove all temporary protections; clean and polish all floors at completion.
 - 4) Woodwork. Clean and polish all woodwork upon completion.
 - 5) Hardware. Clean and polish all hardware for all trades. This shall include removal of all stains, dust, dirt, paint, etc., upon completion.
 - 6) Tile Work. Remove all spots, soil, and paint from all tile work, wash same upon completion.
 - 7) Fixtures and Equipment. Clean all fixtures and equipment, removing all stains, paint, dirt and dust.
 - c. All combustible rubbish, and all debris and other rubbish shall be removed entirely from the premises.

7. MUTUAL RESPONSIBILITY OF CONTRACTORS - Supplement Paragraph 6.2 as follows:
- General Contractor shall assume general coordination and direction of the project. General Contractor shall cooperate with Mechanical and Electrical Contractors and other subcontractors and/or suppliers on the Work and install their work in sequence to facilitate and not delay the completion of the project. The Architect is not the coordinator or expeditor of the work of the contractors and/or subcontractors referred to hereinbefore.
8. CHANGES IN THE WORK
Refer to Paragraph 7.2 and insert the following:
- Whenever a Change Order involves net cost decrease, the CREDIT to the Owner shall be such net cost decrease. Whenever a Change Order involves a summary net increase, the Contract shall be increased by the amount of such net cost increase plus 10% of such net cost for overhead and profit. The General Contractor will furnish supervision and coordination for 10% of the cost of additional Mechanical and Electrical work ordered by the Owner.
 - The Contractor shall furnish the Owner an itemized accounting with supporting data used in computing the value of any change that might be ordered.
 - Change Orders must state a number of added days or days to be deleted from completion time. If no change in days is required by the change order, write NONE. Failure to comply with above voids any later request for extra time.
9. APPLICATION FOR PROGRESS PAYMENTS AND CERTIFICATION FOR PAYMENT
- Amend Subparagraph 9.3.1 and insert the following: On or before the 25th day of each month, the Contractor shall submit to the Architect an itemized Application for Payment supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require.
 - Amend Subparagraph 9.4.1 and insert: If the Contractor has made application for payment as above, the Architect will, with reasonable promptness and within seven (7) days after receipt of the application, issue an application for payment to the Owner, with a copy to the Contractor in the amount of 90% of the value of the Contract the Architect determines has been completed to the date of application, thus a 10% retainage, less any amount paid to the Contractor, or state in writing his reason for withholding an application as provided in Subparagraph 9.5.1.
 - Date of payment of the Application for Payment by the Owner is hereby defined as the earliest possible date that the Owner can prepare vouchers after receipt of Application for Payment from the Architect and approval of same by any governing body of the Owner and issuance of vouchers to cover Application for Payment.
10. CONTRACTOR'S LIABILITY INSURANCE
- Workers' Compensation and Employers Liability Insurance - Refer to Subparagraph 11.1.1.
 - Bodily Injury and Property Damage - Refer to Subparagraph 11.1.2. Limits shall be as follows:
 - Limits of liability coverage shall be \$2,000,000.00 Combined Single Limit for Bodily Injury and Property Damage.
 - Owner's Protective Liability Insurance - Refer to Paragraph 11.2 - Owner's Option.
11. PERFORMANCE AND PAYMENT BONDS - Supplement Subparagraph 11.4.1 as follows:
- Bond shall be equivalent to AIA Form A311, two part Performance Bond and Labor and Materials Bond with amount shown on each part equal to 100% of the total amount payable by the terms of the Contract. Surety shall be company licensed to do business at the place of building and shall be acceptable to the Owner.
12. PROPERTY INSURANCE MARINE ALL RISK SPECIAL BUILDERS RISK AND TRANSIT FORM
Refer to Paragraph 11.4 Property Insurance and insert the following:
- Until the Work is completed and accepted by the Owner, **the General Contractor shall effect and maintain total Property Insurance (Marine All Risk Special Builders Risk and Transit Form)** upon the Work at the site to 100% of the insurable value thereof (plus 8% of this insured value for Architect's Fee in connection with any loss covered by this insurance) including items of labor and materials connected therewith in or adjacent to the structure insured, materials in place or to be used as a part of the permanent construction, including surplus materials, shanties, protective fences, bridges or temporary structures, miscellaneous materials and supplies incidental to the Work, and such scaffoldings, stagings, towers, forms and equipment as are not owned or rented by the Contractor, the cost of which is included in the cost of the work. EXCLUSIONS: This insurance does not cover any tools owned by mechanics; any tools, equipment, scaffoldings, stagings, towers and forms owned or rented by the Contractor; the capital value of which is not included in the cost of the work, nor loss of equipment, materials, tools, etc., by theft. **Contractor shall not commence construction prior to receipt of policy copy from Owner.**
 - This insurance shall include the interest of the Owner, the Contractor, Subcontractor, and Sub-Subcontractor in the Work.

END OF SECTION

LIST OF DRAWINGS

General

	Cover
	Survey
CFP	Code Footprint

Civil

01	Demolition Plan	04	Site Improvements – Alternate #2
02	Site & Dimension Plan	05	Details
03	Grading & Erosion Control Plan	06	Details

Architectural

D1.1	Site Demolition Plan	A3.1	Exterior Elevations
D2.1	Floor Demolition Plan	A3.2	Building Sections
A1.1	Site Plan	A4.1	Wall Sections
A1.2	Canopy Plans	A4.2	Wall Sections
A1.3	Section	A4.3	Wall Sections
A2.0	Alternate #1 Patio Expansion Plan	A5.1	Roof Plan
A2.1	Floor Plan & Base Bid Patio Plan	A6.1	Interior Elevations, casework Elevation & Sections
A2.2	Area B Floor Plan		
A2.3	Reflected Ceiling Plan		

Structural

S0.1	General Notes	S4.0	Sections
S0.2	Schedules & Details	S4.1	Sections
S0.3	Schedules & Details	S4.2	Sections
S2.1	Foundation Plan	S4.3	Sections
S2.2	Roof Framing Plan		

Mechanical/Electrical

ME101	Site Electrical Plan	E-001	Electrical General Notes
M-001	Mechanical General Notes	E-101	Power & Lighting Plan
M-101	Mechanical Plan		

SECTION 01010

GENERAL WORK REQUIREMENTS

1. **GENERAL**
Should conflict occur between these General Work Requirements and the General Conditions, the requirements of this Section take precedence.
2. **INTENT OF DOCUMENTS**
The Contract Drawings are complementary and what is called for by anyone shall be as binding as if called by all. The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work.
3. **MANUFACTURER'S DIRECTIONS**
All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturers, unless herein specified to the contrary.
4. **BUILDING PERMIT**
As stated in Subparagraph 4.7.1, AIA DOCUMENT A201, General Conditions, the General Contractor shall secure and pay for the building permit.
5. **MATERIALS - EQUIPMENT - SUBSTITUTION**
 - A. In general, these Specifications identify the required materials and equipment by naming one or more manufacturers, brand, model, catalog number, and/or other identification; the first-named manufacturer's product used as a basis for design; the other named brands considered equivalent. Equivalent brand manufacturers named must furnish products consistent with the Specifications for the first-named product, as determined by the Architect. Base Bid shall include only those brands named and must be used on the project, except as hereinafter provided.
 - B. Materials or equipment specified exclusively, Base Bid shall be based on same and used on project, except as hereinafter provided.
 - C. Prior to receipt of bids, should Contractor wish to incorporate in Base Bid, brands or products other than those named in the Specifications, he shall submit written request for substitution to Architect not later than seven (7) days prior to date bids are due. Architect will consider request and items approved will be listed in an addendum issued to all bidders.
 - D. After execution of Contract, substitution of product brands for those named in the Specifications will be considered, only if request is received within thirty (30) days after Contract Date and request includes showing credit due Owner.
 - E. Materials specified equivalent and those proposed for substitution must be equal or better than first-named material in construction, efficiency, utility, aesthetic design, and physical size shall not be larger than space provided for it. Request for substitution by full description and technical data in two (2) copies, including manufacturer's name, model, catalog number, photographs or cuts, physical dimensions, operating characteristics, and any other information for comparison.
 - F. Owner reserves the right:
 - 1) To require any or all bidders, before execution of Contract, to state what materials they will use.
 - 2) To require "if bound with the Bid Form," the Contractor to fill out a BID SUPPLEMENT listing the BASE BID and "ADD" or "DEDUCT" for other materials he proposes to use.
6. **APPROVAL OF SUBCONTRACTORS - MATERIALS**
 - A. The Contractor, if requested, must submit for approval before signing Agreement, list of Subcontractors and material suppliers enumerating items of work to be performed, name of materials, equipment, etc., to be furnished and/or installed. Refer to Paragraph - MATERIALS - EQUIPMENT - SUBSTITUTION.
 - B. If the list is not requested prior to signing of Agreement, list, as described in previous paragraph, shall be furnished within ten (10) days of signing Agreement.
7. **PROTECTION - Supplement, ARTICLE 10, AIA GENERAL CONDITIONS**
 - A. Refer to Paragraph - WEATHER CONDITIONS.
 - B. Each Contractor shall assume responsibility for his materials stored on the premises.
 - C. General Contractor shall take charge and assume general responsibility for proper protection of project during construction.

- D. The General Contractor shall protect trees, shrubs, lawns, and all landscape from damage, providing guards and covering. Damaged work shall be repaired or replaced at his expense. Protect streets and sidewalks and make repairs at his expense.
- 1) Water Protection. The General Contractor shall, at all times, protect the excavation, trenches, and/or the building from damage by rain water, spring water, ground water, backing up of drains or sewers and all other water. He shall provide all pumps and equipment and enclosures to provide this protection.
 - 2) Bracing, Shoring, and Sheeting. The General Contractor shall provide all shoring, bracing and sheeting as required for safety and for the proper execution of the work and have same removed when the work is completed.
 - 3) Guard Lights. The General Contractor shall provide and maintain guard lights at all barricades, railings, obstructions in the streets, roads or sidewalks and at all trenches or pits adjacent to public walks or roads.
 - 4) Weather Conditions. The General Contractor shall, at all times, provide protection against weather; rain, winds, storms, frost, or heat, so as to maintain all work, materials, apparatus, and fixtures, free from injury or damage. At the end of the day's work, all new work likely to be damaged shall be covered.

8. WEATHER CONDITIONS

The Contractor shall protect all portions of his work and all materials, at all times from damage by water, freezing, frost and is to repair, replace and make good to the satisfaction of the Architect, any portion of same which may in the Architect's opinion, have been damaged by the elements.

9. GRADES, LINES, LEVELS, AND SURVEYS

The Owner will establish the lot lines, restrictions and a bench mark. All other grades, lines, levels, and bench marks shall be established and maintained by the General Contractor, who shall be responsible for same. The General Contractor shall verify all grades, lines, levels, and dimensions as shown on the Drawings and he shall report all errors or inconsistencies in the above to the Architect before commencing work.

- A. The General Contractor shall provide and maintain well-built batter boards at all corners. He shall establish bench marks in not less than two (2) widely separated places. As the work progresses, he shall establish bench marks at each floor, giving exact levels of the various floors.
- B. As the work progresses, the General Contractor shall lay out in the forms and the rough flooring the exact location of all partitions as a guide to all trades.
- C. The General Contractor shall verify all grades, lines, levels, and dimensions as shown on the Drawings and he shall report any errors or inconsistencies in the above to the Architect before commencing work.

12. REQUIREMENTS IMMEDIATELY AFTER EXECUTION OF CONTRACT

Immediately after execution of the Contract, the Contractor shall deliver to the Architect the following items which are described more fully in following Articles:

Schedule of Values
Schedule of Operations
Progress Charts
Samples
Superintendent's name and resume of experience
List of Subcontractors and Material Suppliers

- A. Schedule of Values on AIA Form G702, or other form approved by the Architect, a detailed breakdown of the Contract Sum indicating the amounts allotted to the various divisions of the work for labor and material. The schedule will serve as a guide to the Architect in determining the amounts due each month as the work progresses. The schedule shall be broken down as directed by the Architect.
- B. Schedule of Operations based on the above Schedule of Values and indicating the progress of the work up to the first day of each month shall be prepared by the Contractor in a form approved by the Architect and shall be delivered to the Architect in duplicate with each application for payment.
- C. Progress Charts based on the above specified schedule of operations and indicating the progress of the work up to the first day of each month shall be prepared by the Contractor in a form approved by the Architect and shall be delivered to the Architect in duplicate with each application for payment. Progress charts shall be in the form of a bar graph. Along with progress charts the Contractor shall provide an estimated monthly cash flow chart.

13. CONSTRUCTION PROCEDURE

- A. Each Contractor shall schedule his work so as to cause a minimum of interference with business operations during all of the construction work.
- B. Precautions and Cooperation
 - 1) Notify the Owner 7 days in advance before any utility (natural gas, water, electricity, or sewer) is to be interrupted.
 - 2) With proper notification, interruption in utilities up to 4 hours will be permitted without special provisions by the Contractor. *If any interruption of a utility exceeds 4 hours the Contractor must make arrangements for temporary alternate utility service.
 - 3) Interruption of utilities must be coordinated with the Owner with changeovers and out of service at night. Weekend and evening changeovers of utilities shall occur with no additional cost to the Owner.
 - 4) Openings to be cut in existing exterior walls must be saw cut. No jackhammer work will be permitted. Notify the Owner 7 days in advance of cutting of exterior walls.

14. TIME EXTENSIONS ADVERSE WEATHER

- A. The Contractor shall comply with all provisions of the General Conditions in submitting any request for extension of Contract Time due to unusually severe weather.
- B. Definitions:
 - 1. Adverse Weather - Atmospheric conditions at a definite time and place which are unfavorable to construction activities.
 - 2. Unusually Severe Weather - Weather which is more severe than the adverse weather anticipated for the season, location, or activity involved.
- C. In order for any request of time extension due to unusually severe weather to be valid, the Contractor must document both of the following conditions.
 - 1. The weather experienced at the project site during the Contract period is more severe than the adverse weather anticipated for the project location during any given month.
 - 2. The unusually severe weather actually caused a delay to the completion of the project. The delay must be beyond the control and without fault or negligence by the Contractor.
- D. The following schedule of monthly anticipated adverse weather delays will constitute the baseline for monthly weather time evaluations. The Contractor's Progress Schedule must reflect these anticipated adverse weather delays in all weather-affected activities:
MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS BASED ON FIVE (5) DAY WORK WEEK.

<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
10	8	7	6	7	7	5	5	5	4	5	9

END OF SECTION 01010

SECTION 01019

SPECIAL PROVISIONS

1. GENERAL

Should conflict occur between these Special Provisions and the General Conditions, the requirements of the Special Provisions shall take precedence.

2. TIME OF CONSTRUCTION – PENALTY CLAUSE

- a. Time of Construction - The Contractor will commence the work within ten (10) days after the Architect shall have given the Contractor written notice to commence construction to the satisfaction of the Owner within the calendar days as stated in Paragraph 3, below. The time for completion herein set forth shall be extended for the period of any reasonable delay which is due exclusively to causes beyond the control and without the fault of the Contractor, including acts of God, fires, floods, and direction by the Architect. It is impractical to perform any operation of construction and acts of omissions of the Owner with respect to matters for which Owner is solely responsible; provided, however, that no such extension of time for completion shall be granted the Contractor, unless within ten (10) days after the happening of any event relied upon by the Contractor for such extension of time, the Contractor shall have made a request, therefore, in writing to the Architect. Extended time will be submitted with pay request for Owner's approval.
- b. Penalty Clause - The time of completion of the construction of the project is of the essence of this Contract. Should the Contractor neglect, refuse, or fail to complete the project (100%) within the time herein agreed upon, after giving effect to extensions of time, if any, herein provided; the Owner shall have the right to deduct from and retain out of such money, which may then be due or which may become due and payable to the Contractor, the sum of TWO HUNDRED DOLLARS (\$200.00) per day for each and every day that such construction is delayed in its completion beyond the specified time. If the amount due and to become due from the Contractor to the Owner is insufficient to pay in full any such penalties, the Contractor shall pay to the Owner the amount necessary to effect such payment in full; provided, however, that the Owner shall promptly notify the Contractor in writing of the manner in which the amount retained, deducted or claimed. No award is given to the Contractor for early completion.
- c. Joint Responsibility - The General Contractor and/or Subcontractors causing the delay in completion of the project shall be responsible for payment of the penalty. In no case shall the total penalty for all contracts exceed the sum of daily penalty multiplied by the number of days of delay in completion.

3. WORK SEQUENCE, SCHEDULE FOR COMPLETION AND LIQUIDATED DAMAGES

- a. Schedule requirements for each area are outlined as follows.

Work	Available Start	Substantial Completion	Liquidated Damages
Lobby & Fellowship Addition	January 2, 2025	To be bid	\$200/Calendar Day

- b. Schedule requirements for final completion – 30 days following substantial completion with liquidated damages equivalent to those identified for substantial completion.

4. ALTERNATES - Refer to Alternate Schedule, Section 01030

- a. Alternates specified are not a part of Base Bid, but are Alternates to same, their acceptance being at option of Owner.

5. CASH ALLOWANCES

- a. Costs included in Allowances: Cost of Product to Contractor or Subcontractor, less applicable trade discounts, delivery to site, except those taxes saved by use of Owner's tax exemption.
- b. Costs Not Included in the Allowance: Fees for overhead and profit, product handling at the site, including unloading, uncrating, and storage; protection of Products from elements and from damage and labor for installation and finishing.
- c. Architect Responsibilities:
 1. Consult with Contractor in consideration and selection of Products, suppliers and installers.
 2. Select Products in consultation with Owner and transmit decision to Contractor.
 3. Prepare Proposal Requests and Change Orders.
- d. Contractor Responsibilities:
 1. Assist Architect/Engineer in selection of Products, suppliers and installers.
 2. Obtain proposals from suppliers and installers and offer recommendations.
 3. On notification of selection by Architect, execute purchase agreement with designated supplier and installer.
 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.

5. Promptly inspect Products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
6. Product handling at the site, including unloading, uncrating and storage, protection of Products from elements and from damage and labor for installation and finishing.
7. The Contractor shall include in his Bid all fees for all cash allowances.
- e. Funds will be drawn from Cash Allowances only by written authorization from Owner (District).
- f. Cash Allowances:
 1. Section 08710 Door Hardware. Note this allowance is to include hardware for doors and frames, excluding overhead doors. **Amount \$5,000.00.**
 2. Inspection and Testing Allowance – The contractor shall include in his bid, an allowance of **\$10,000.00** for direct cost of testing by the approved testing companies. The contractor shall bear all costs associated with coordination, administration scheduling, and supervision of testing companies, and include those costs in his bid.
 3. Section 09688 Carpet Tile. Carpet Allowance. This allowance to include purchase and delivery of carpet only. **Amount \$32/sq. yard.**
 4. Contingency Allowance – In addition to the specification sections listed above, include an allowance of **\$20,000.00** in the general bid and contract amount to be included in the contractors base bid. This allowance shall be used at the sole discretion of the Architect and/or Owner specifically for hidden conditions discovered in the field or on site, the addition of labor, parts and/or materials required for timely completion in conjunction with the general scope of work.

6. ENUMERATION OF DRAWINGS AND SPECIFICATIONS

- a. Correlation. Accompanying these Specifications are the Drawings, which jointly with these Specifications, are intended to explain each other and describe and coordinate the work to be performed under the Contract.
- b. Verification of Documents. Before submitting his bid, each Bidder shall check his set(s) of Drawings and Specifications and advise the Architect if any sheets are missing.
- c. Specifications Explanations. For convenience of reference, the Specifications are separated into Titled Divisions and Sections. Such separation shall not, however, operate to make the Architect an arbiter to establish limits between the Contractor and Subcontractor or Sub-Subcontractor.
- d. Drawings. Refer to LIST OF DRAWINGS.
- e. Specifications. Refer to TABLE OF CONTENTS.

7. WARRANTIES

Before being eligible for final payment, Contractor shall deliver to Owner, through Architect, all special warranties specified for materials, equipment and installation.

8. OPERATING INSTRUCTIONS

Before being eligible for final payment, Contractor shall deliver to Owner, through Architect, three (3) copies of manufacturer's operating and maintenance instructions, and one (1) CD/DVD containing complete set or manufacturers operating instructions, a complete set of shop drawings on each piece of equipment. Electronic files shall be in PDF format with files organized into single documents for Architectural, Mechanical, and Electrical divisions.

9. AS-BUILT DRAWINGS

Before being eligible for final payment, the Electrical and Mechanical Contractors shall prepare and deliver to Owner, through Architect, One (1) CD/DVD containing AS-BUILT DRAWINGS in PDF format. These drawings shall consist of marked-up prints, and shall show the correct location of every item of equipment, piping, conduit, panel boards, ductwork, switches, valves, etc. If marked-up prints are used, and scanned, they shall be new white prints without miscellaneous markings. All markings shall be clearly legible and identified.

10. CERTIFICATE OF COMPLIANCE

Upon completion of project, Contractor is to furnish written Certification to the Architect that he has complied with every paragraph of the Specifications and Drawings.

11. CONTRACTOR'S AFFIDAVIT OF RELEASE OF LIENS

Upon completion of project, Contractor shall submit to Owner a signed Contractor's Affidavit of Release of Liens prior to final payment.

12. CONTRACTOR'S MONTHLY APPLICATION FOR PAYMENT FORM

Contractor's monthly Application for Payment shall be submitted as per General Conditions. AIA Document G702, Application and Certificate for Payment is approved and acceptable.

13. FILING AND RECORDING OF BONDS

In addition to furnishing the number of combination Performance Bond and Labor and Materials Payment Bond, and Statutory Bond, if required, the Contractor shall file copies of such bonds with Clerk of the District Court and furnish Architect with receipt furnished by Clerk of the District Court, covering charges for filing and recording of said bonds.

14. STATUTORY BONDS

In addition to furnishing the combination Performance and Labor and Materials Payment Bond specified in General Conditions, the Contractor shall furnish Statutory Bond in an amount not less than 100% of the Agreement in such numbers and form stated in Sample Copy bound in the Specifications. Statutory Bond shall be filed and recorded with Clerk of the District Court, as specified in Paragraph - FILING AND RECORDING OF BONDS.

15. DOCUMENTS FURNISHED CONTRACTORS

The General Contractor will be furnished, free of charge, the following working drawings and specifications, including modifications for construction of the project - 20 sets. The General Contractor will be responsible for distribution of these sets to the Subcontractors and suppliers. The Contractor shall pay the actual cost of reproduction and postage for all additional sets requested by him.

16. TESTING AND INSPECTIONS

- a. The General Contractor shall be responsible for coordination and scheduling of all inspections and testing as required by the Contract documents. The Contractor shall include a testing and inspection allowance in his bid as described in paragraph 5.f.3 of this section. The Contractor shall pay all costs associated with testing and all direct costs from the testing/inspection company and shall be deducted from the testing and inspection allowance. Re-testing/ inspection costs associated with incorrect or defective work shall be paid by the Contractor and such costs are not to be deducted from the allowance.
- b. All sampling and testing procedures shall be performed by the inspection company responsible for inspection and testing.

17. SALES TAX EXEMPTIONS

- a. Materials and equipment incorporated into this project **are exempt** from the payment of sales tax under the laws of the State of Kansas and such **sales tax shall not be included** in the Bid of the Bidder.
- b. The Owner will provide the Contractor with a proper exemption certificate within twenty (20) days of the Contract date.
 - 1) Should the Owner fail to provide an exemption certificate within the required time period, the Contractor shall be reimbursed monthly for all sales tax amounts for which he becomes liable until such certificate is provided.
 - 2) To minimize the Contractor's record keeping expense, the Owner shall provide an exemption certificate within sixty (60) days or it shall be presumed that the project will proceed on a non-exempt basis, and the Contract amount shall be equitably adjusted in writing in a lump sum amount sufficient to cover the Contractor's sales tax expense.
 - 3) Upon issuance of a proper exemption certificate to the Contractor, the Contractor shall assume full responsibility for his own proper use of the certificate, and shall pay all costs of any legally assessed penalties relating to the Contractor's use of the exemption certificate.

END OF SECTION 01019

SECTION 01030

ALTERNATES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for alternates.

1.3 GENERAL

- 1. The General Contractor shall state in his Bid Form the amount of dollars to be ADDED or DEDUCTED from his Base Bid for the following Alternates.
- 2. Alternates are not in order of acceptance.
- 3. It shall be the responsibility of the General Contractor to advise all necessary personnel and suppliers as to the nature and extent of all alternates selected by the owner.
- 4. Circle Add or Deduct to indicate that the alternate price is to be added or subtracted from the base bid.

1.4 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.5 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. ALTERNATE NO. 1

The Contractor shall state the amount of dollars to be added or deducted to the Base Bid to provide all labor and materials associated with the construction of the expanded patio area, including all sitework, paving, electrical, etc.

Add/Deduct \$ _____

2. ALTERNATE NO. 2

The Contractor shall state the amount of dollars to be added or deducted to the Base Bid to provide all labor and materials associated with the construction of the expanded driveway, entrance driveway revision, new electrical associated with the relocate sign and new/relocated lights.

Add/Deduct \$ _____

3. ALTERNATE NO. 3

The Contractor shall state the amount of dollars to be added or deducted to the Base Bid to provide all labor and materials associated with the installation of wood wall panel over the fireplace.

Add/Deduct \$ _____

4. ALTERNATE NO. 4

The Contractor shall state the amount of dollars to be added to the Base Bid to provide all labor and materials associated with the installation of the six (6) concrete footings for a future covered canopy structure at the new south drive and drop-off area. Footings shall each be 6'-9" x 6'-9" x 3'-0"d. Each concrete footing shall be reinforced with (9) #6's each way, top and bottom.

Added \$ _____

5. ALTERNATE NO. 5

The Contractor shall state the amount of dollars to be added or deducted to the Base Bid to provide all labor and materials associated with the repair of existing damaged curb/gutter at the East parking lot. Reference Civil drawings per locations and quantity.

Add/Deduct \$ _____

6. ALTERNATE NO. 6

If added by addendum.

Add/Deduct \$ _____

END OF SECTION 01030

SECTION 013516

ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, **General Contractor will conduct** conference at **Project site**.
 - 1. Attendees: In addition to representatives of Owner, **General Contractor**, Architect, and Contractor, shall be represented at the meeting.
 - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Fire-prevention plan.
 - b. Governing regulations.
 - c. Areas where existing construction is to remain and the required protection.
 - d. Hauling routes.
 - e. Sequence of alteration work operations.
 - f. Storage, protection, and accounting for salvaged and specially fabricated items.
 - g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - 3. Reporting: **General Contractor** will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at **bi-weekly** intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.
 - 1. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - 2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1.5 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.6 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area **designated by Owner**.
 - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
 - 1. Repair and clean items for reuse as indicated.
 - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
 - 1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 - 2. Secure stored materials to protect from theft.
 - 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
 - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
 - 1. Comply with NFPA 241 requirements unless otherwise indicated.
 - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
 - 1. Obtain Owner's approval for operations involving use of **open-flame** or welding or other high-heat equipment. Notify Owner **at least 72 hours** before each occurrence, indicating location of such work.
 - 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 - 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 - 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 - 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 - 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than **30 minutes** after conclusion of work **in each area** to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at **each area of** Project site until **60 minutes** after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
 - 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation **photographs**. Comply with requirements in Section 013233 "Photographic Documentation."
- B. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- C. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- 1.3 DEFINITIONS
 - A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.
- 1.4 USE CHARGES
 - A. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
 - B. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- 1.5 SUBMITTALS
 - A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- 1.6 QUALITY ASSURANCE
 - A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
 - B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- 1.7 PROJECT CONDITIONS
 - A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails.
 - B. Lumber and Plywood: Comply with requirements in Division 6 Section.
 - C. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
 - D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
 - E. Paint: Comply with requirements in Division 9 painting Sections.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and ~~4-foot-~~ (1.2-m-) square tack board.
 - 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of ~~68 to 72 deg F~~ (20 to 22 deg C).
 - 4. Lighting fixtures capable of maintaining average illumination of ~~20 fc~~ (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filters at air grille in system. Before Substantial Completion, all units and ductwork shall be thoroughly cleaned and restored to new condition.

2.4 SIGN AND ADVERTISING

- A. The General Contractor shall furnish and erect one (1) painted sign, 8 x 12 in size, as shown on the last page of this Section and placed where directed. Sign shall show the following:
 - 1. Name of Project
 - 2. Name, Logo and Address of Architect
 - 3. Name, Logo and Address of General Contractor
 - 4. Name of Mechanical Subcontractor
 - 5. Name of Electrical Subcontractor
- B. Post entire construction area with DANGER and NO TRESPASSING signs to comply with safety and insurance regulations.
- C. Keep premises clear and free from other signs or posters.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Use of Owner's existing electric power service will be permitted, Coordination is required to provide power when new service is installed.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.
 - a. Principal subcontractors' field and home offices.
 - 2. Provide superintendent with cellular telephone for use when away from field office.
- I. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail. Cellular e-mail service is acceptable.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within **30 feet (9 m)** of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- E. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
 - 1. Provide temporary, directional signs for construction personnel and visitors.
 - 2. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- J. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 1 Section "Summary."

- B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 2 Section "Site Clearing" and Erosion Control drawings.
 - C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - 1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 2. Reference erosion control drawings for additional requirement.
 - D. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
 - E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
 - F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
 - G. Site Enclosure Fence: **Before construction operations begin**, furnish, and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As indicated on Drawings.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. **Provide Owner with one set of keys.**
 - H. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
 - I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
 - J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
 - K. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 - 2. Insulate partitions to provide noise protection to occupied areas.
 - 3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - 4. Protect air-handling equipment.
 - 5. Weather strip openings.
 - 6. Provide walk-off mats at each entrance through temporary partition.
 - L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses.
 - 1. Prohibit smoking in completed facilities.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
- 3.5 OPERATION, TERMINATION, AND REMOVAL
- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
 - B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 - C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of

interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Reference General Conditions.

END OF SECTION 01500

SECTION 02110

SITE CLEARING

PART 1 – GENERAL

1.01 SECTION INCLUDES

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

1.02 REGULATORY REQUIREMENTS

- A. Conform to applicable local codes and ordinances for disposal of debris, burning debris on site, use of herbicides, etc.
- B. Coordinate clearing Work with utility companies as required.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.

3.02 PROTECTION

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

3.03 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove paving, curbs, and improvements designated.
- C. Remove trees and shrubs indicated. Remove stumps, root system surface rock and other areas indicated or implied for completion of the project.
- D. Clear undergrowth and deadwood, without disturbing subsoil. Strip and clear vegetation from areas designated to be filled, excavated, regraded, or landscaped.

3.04 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.

3.05 TOPSOIL EXCAVATION

- A. Excavate clean topsoil from areas to be further excavated, filled, re-landscaped, or regraded.
- B. Stockpile in area designated on site to depth not exceeding 8 feet. Protect from erosion. Remove excess topsoil not being reused, from site.

END OF SECTION 02110

SECTION 02205
SOIL MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Subsoil and topsoil materials.

1.2 RELATED SECTIONS

- A. Document: N/A

1.3 REFERENCES

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
B. ASTM D2487 - Classification of Soils for Engineering Purposes.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. **Note the Contractor shall over excavate new addition area at South entry. Minimum 18" below existing grade.**
B. Fill Material: Under slabs and within the zone of influence of foundation elements must be a material approved by the geotechnical engineer and as indicated in the geotechnical report.
C. Fill and Backfill Material: Other areas, foundation backfill, site grading, and pavement, should be clean site material or similar borrow material, approved by the geotechnical Engineer. Foreign matter shall be limited in size to 1 ½" in greatest dimension, and be limited to no more than 5% by volume or weight.
D. Topsoil: Incorporate topsoil into subsoil 3"- 4". Topsoil should be blended and contain the following components by percentage:
- | | |
|--|----------|
| Organic Matter: | 4 - 6 % |
| Sand (ASTM - 300 and 75% between .25mm and .75mm): | 40 - 50% |
| Silt: | 20 - 25% |
| Clay: | 25 - 40% |

2.2 SOURCE QUALITY CONTROL

- A. Inspection and testing will be performed by an independent laboratory, Contractor shall bear all related costs under provisions of General Requirements.
B. Tests and analysis of soil material will be performed in accordance with ANSI/ASTM D698.
C. If tests indicate materials do not meet specified requirements, change material and retest at no cost to Owner.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials on site at locations indicated or in areas that will not impact project completion.
B. Stockpile in sufficient quantities to meet project schedule and requirements.
C. Separate differing materials with dividers or stockpile apart to prevent mixing.
D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 02205

SECTION 02211

ROUGH GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling, and rough contouring the site for site structures, building pads and paving.

1.2 RELATED SECTIONS

- A. Document: N/A

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil, Fill and Structural Fill: As specified in Section 02205.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities. Locate, identify, and protect utilities that remain, from damage. Notify utility company to remove and relocate utilities.
- C. Protect above and below grade utilities that remain.
- D. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- E. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Stockpile in area designated on site to depth not exceeding 8 feet. Protect from erosion. Remove subsoil not being reused, from site.
- C. When excavating through roots, perform work by hand and cut roots with sharp axe.

3.4 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill materials on continuous layers and compact in accordance with Schedule at end of Section.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 inches in 10 ft. unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Remove surplus fill materials from site.

3.5 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the General Requirements.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D698.
- C. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no additional cost to the Owner.

3.7 SCHEDULES

- A. Reference Soils Report, 4.2.3 Compaction Requirements Topsoil Fill:

END OF SECTION 02211

SECTION 02222

EXCAVATING

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Excavating for building foundations and footings.
 - B. Excavating for slabs-on-grade, paving, landscaping.
 - C. Excavating for site structures and utilities.
- 1.2 RELATED SECTIONS
 - A. Document: N/A

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

- 3.1 PREPARATION
 - A. Identify required lines, levels, contours, and datum.
 - B. Locate, identify, and protect utilities that remain, from damage.
 - C. Notify utility company to remove and relocate utilities.
 - D. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
 - E. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavation equipment and vehicular traffic.
- 3.2 EXCAVATION
 - A. Underpin adjacent structures which may be damaged by excavation work.
 - B. Excavate subsoil required to accommodate building foundations, slabs-on-grade, paving and site structures, construction operations.
 - C. Machine slope banks to angle of repose or less, until shored.
 - D. Do not interfere with 45 degree bearing splay of foundation unless shoring has been installed.
 - E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
 - F. Hand trim excavation. Remove loose matter.
 - G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
 - H. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
 - I. Correct areas over-excavated in accordance with Section 02223.
 - J. Stockpile excavated material in area designated on site and remove excess material not being reused, from site.
 - K. Shoring or Bracing will be required on the north and east wall of the new structure adjacent to the existing building. See the Geotechnical Report for recommendations.
- 3.3 FIELD QUALITY CONTROL
 - A. Field inspection will be performed under provisions of the General Requirements.
 - B. Provide for visual inspection of bearing surfaces.
- 3.4 PROTECTION
 - A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
 - B. Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.

END OF SECTION 02222

SECTION 02223

BACKFILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building perimeter and site structure backfilling to subgrade elevations.
- B. Site filling and backfilling.
- C. Fill under slabs-on-grade, paving.
- D. Consolidation and compaction as scheduled.
- E. Fill for over-excavation.

1.2 RELATED SECTIONS

- A. Document: N/A

1.3 REFERENCES

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Fill: As specified in Section 02205.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify subdrainage, dampproofing or waterproofing installation has been inspected and completed.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify and proof roll subgrade surface to a depth of 8 to 12 inches to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Fill, Place and compact materials in continuous layers not exceeding 8 inches in compacted depth.
- D. Employ a placement method that does not disturb or damage other work.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
- F. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- G. Slope grade away from building minimum 2 inches in 10 ft. unless noted otherwise.
- H. Make gradual grade changes. Blend slope into level areas.
- I. Remove surplus backfill materials from site.
- J. Leave fill material stockpile areas free of excess fill materials.

- 3.4 TOLERANCES
 - A. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.
 - B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
- 3.5 FIELD QUALITY CONTROL
 - A. Field inspection and testing will be performed under provisions of the General Requirements.
 - B. Compaction testing will be performed in accordance with ANSI/ASTM D698.
 - C. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest at no additional cost to the Owner.
 - D. Proof roll compacted fill surfaces under slabs-on-grade, and paving.
- 3.6 PROTECTION OF FINISHED WORK
 - A. Protect finished Work under provisions of the General Requirements.
 - B. Reshape and re-compact fills subjected to vehicular traffic.
- 3.7 SCHEDULE
 - A. Interior Slab-On-Grade:
 - 1. Fill compacted to 98 percent of standard Proctor.
 - 2. Cover with Sand Fill 2 inches thick, compacted to 95 percent.
 - B. Exterior Side of Foundation Walls Retaining Walls and Over Granular Filter Material and Foundation Perimeter Drainage:
 - 1. Fill to subgrade elevation, each lift, compacted to 90 percent (minimum) of standard Proctor.
 - C. Fill Under Grass Areas:
 - 1. Fill to 4 inches below finish grade.
 - D. Fill Under Asphalt or Concrete Paving:
 - 1. Compact subsoil to 95 percent of its maximum dry density.
 - E. Fill to Correct Overexcavation:
 - 1. Lean concrete to minimum compressive strength of 1000 psi.
 - 2. Compact approved fill to 95 percent of its maximum dry density.

END OF SECTION 02223

SECTION 02225

TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating trenches for utilities from 5 feet outside building to municipal utilities.
- B. Compacted fill from top of utility bedding to subgrade elevations.
- C. Backfilling and compaction.

1.02 RELATED SECTIONS

- A. Document: N/A

1.03 REFERENCES

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

1.04 FIELD MEASUREMENTS

- A. Verify that survey bench mark and intended elevations for the Work are as shown on drawings.

1.05 COORDINATION

- A. Coordinate all work as required.
- B. Verify work associated with lower elevation utilities are complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Fill: As specified in Section 02205.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities which are to remain.
- E. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with fill and compact to density equal to or greater than requirements for subsequent backfill material.

3.02 EXCAVATION

- A. Excavate subsoil required for utilities to municipal utilities.
- B. Cut trenches sufficiently wide to enable installation and allow inspection.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Hand trim excavation. Remove loose matter.
- E. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- F. Correct areas over excavated in accordance with Section 02222.
- G. Stockpile excavated material in area designated on site and remove excess material not being used, from site.

3.03 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

- C. Granular Fill: Place and compact materials in continuous layers not exceeding 8 inches compacted depth.
 - D. Soil Fill: Place and compact material in continuous layers not exceeding 8 inches compacted depth.
 - E. Employ a placement method that does not disturb or damage foundation perimeter drainage, conduit or pipes in trench.
 - F. Maintain optimum moisture content of fill materials to attain required compaction density.
 - G. Remove surplus fill materials from site.
 - H. Leave fill material stockpile areas completely free of excess fill materials.
 - I. **When backfilling exterior utilities, contractor shall place warning tape a minimum of 12" above any pipe or conduit.**
- 3.04 TOLERANCES
- A. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.
- 3.05 FIELD QUALITY CONTROL
- A. Field inspection and testing will be performed under provisions of the General Requirements.
 - B. Compaction testing will be performed in accordance with ANSI/ASTM D698.
 - C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to the owner.
- 3.06 PROTECTION OF FINISHED WORK
- A. Protect or reshape and recompact fills subjected to vehicular traffic during construction.

END OF SECTION 02225

SECTION 02260

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems. **Contractor is responsible for all excavation support and protection systems as required by local, state, and OSHA regulations.**
- B. Related Sections:
 - 1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.

1.3 PERFORMANCE REQUIREMENTS

- A. Furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 2. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 3. Monitor vibrations, settlements, and movements.
- B. Excavation support and protection must comply with ASHA, state and local requirements.

1.4 QUALITY ASSURANCE

- A. Preinstallation:
 - 1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
 - a. Existing utilities and subsurface conditions.
 - b. Proposed excavations.
 - c. Proposed equipment.
 - d. Monitoring of excavation support and protection system.
 - e. Working area location and stability.
 - f. Coordination with waterproofing.
 - g. Abandonment or removal of excavation support and protection system.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is referenced elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Shotcrete: Comply with Division 3 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- C. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

END OF SECTION 02260

SECTION 02520
PORTLAND CEMENT CONCRETE PAVING

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Concrete sidewalks, parking lot, ramps, stairs, curbs, and curb cuts.
- 1.2 PERFORMANCE REQUIREMENTS
 - A. Paving: Designed for parking and light duty commercial vehicles.
- 1.3 QUALITY ASSURANCE
 - A. Perform work in accordance with ACI 301, requirements of Sections 03100, 03200 and 03300.
 - B. Obtain cementitious materials from same source throughout.
- 1.4 ENVIRONMENTAL REQUIREMENTS
 - A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

- 2.1 FORM MATERIALS
 - A. Wood or Steel form material, profiled to suit conditions.
 - B. Joint Filler: ANSI/ASTM D1751 type; 3/4 inch thick.
- 2.2 REINFORCEMENT
 - A. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; 6x6-W2.9 x W2.9 in flat sheets or coiled rolls; unfinished.
 - B. Reinforcing Steel: ASTM A615; 40 or 60 ksi yield grade; deformed billet steel bars; unfinished.
- 2.3 CONCRETE MATERIALS
 - A. Cement: ASTM C150 Air Entraining - Type IA Portland type, natural color.
 - B. Fine and Coarse Mix Aggregates: ASTM C33.
 - C. Water: Potable, not detrimental to concrete.
 - D. Air Entrainment: ASTM C260.
 - E. Chemical Admixture: ASTM C494, as approved by Architect.
- 2.4 CONCRETE MIX - BY PERFORMANCE CRITERIA
 - A. Mix concrete in accordance with, ACI 304. Deliver concrete in accordance with ASTM C94.
 - B. Provide concrete to the following criteria:
 - 1. Compressive Strength: Reference schedule below.
 - 2. Slump: 3 to 4 inches.
 - 3. Air Entrained: 5 percent.
 - C. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
 - D. Use calcium chloride only when approved by Architect/Engineer.
 - E. Use set retarding admixtures during hot weather only when approved by Architect/Engineer.
- 2.5 SOURCE QUALITY CONTROL
 - A. Submit proposed mix design of each class of concrete to the architect and appointed testing laboratory firm for review prior to commencement of work.
 - B. Tests on cement and aggregates shall be performed to ensure conformance with specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade, granular base and stabilized soil is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manholes, catch basins, and frames with oil to prevent bond with concrete pavement.
- C. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

- A. Place and secure forms to correct location, dimension, and profile.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

- A. Place reinforcement at mid-height of slabs-on-grade.
- B. Interrupt reinforcement at expansion joints.
- C. Place dowels and reinforcement to achieve pavement and curb alignment as detailed.
- D. Provide doweled joints 12 inch o.c. at interruptions of concrete.

3.5 PLACING CONCRETE

- A. Place concrete in accordance with ACI301.
- B. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.
- C. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- D. Place concrete to indicated pattern.

3.6 JOINTS

- A. Place ½" inch expansion joints at 60 foot intervals. Align curb, gutter, and sidewalk joints.
- B. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/4 inch for sealant placement by Section 07900.
- C. Provide scored or sawn joints at 6 feet intervals U.N.O. at sidewalks and curbs and 150 square feet at all pavement.
- D. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.7 FINISHING

- A. Sidewalk Paving: Light broom, radius to 1/4 inch and trowel joint edges.
- B. Handicapped Ramps: Reference ADA.
- C. Curbs and Gutters: Trowel finish.
- D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
- E. Parking: Light Broom.

3.8 FIELD QUALITY CONTROL

- A. Three concrete test cylinders shall be taken for every 100 or less cu yds of each class of concrete placed each day.
- B. One additional test cylinder shall be taken during cold weather and cured on site under same conditions as concrete it represents.
- C. One slump test shall be taken for each set of test cylinders taken.

3.9 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

3.10 SCHEDULES

- A. Concrete sidewalks and integral curb and gutter: 4,000 psi 28 day concrete, 4 inches thick, 6x6 – W1.4 x W1.4 W.W.F. reinforced, natural color Portland cement, broom finish, detectable warnings per ADA at ramps and curb cuts.
- B. Concrete Parking and Drive: 4,000 psi 28 day concrete, 6 inches thick, 6x6 – W2.9 x W2.9 W.W.F. reinforced, natural color Portland cement, broom finish.
- C. Concrete thickness, reinforcing, and subgrades may vary. Reference requirements of Civil Drawings for clarification and requirements at paving areas. Civil Drawing notes shall override this requirements of this schedule.

END OF SECTION 02520

SECTION 02764

PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in ~~1/2-inch-~~ (13-mm-) wide joints formed between two ~~6-inch-~~ (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below ~~40 deg F~~ (4.4 deg C).
 - 3. When joint substrates are wet or covered with frost.
 - 4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
 - 1. Products:
 - a. Sonneborn, Div. of ChemRex, Inc.; Sonomeric 1.
- B. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
 - 1. Products:
 - a. Crafcro Inc.; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
- C. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
 - 1. Products:
 - a. Crafcro Inc.; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 02764

SECTION 02830

GALVANIZED CHAIN LINK FENCE AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fence framework, fabric, and accessories. Height approximately 8'-0", match existing.
- B. Concrete anchorage for posts and center drop for gates.
- C. Manual gates and related hardware.

1.02 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in commercial quality chain link fencing with two years experience.
- B. Installation: ANSI/ASTM F567.

1.03 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit shop drawings and product data for approval.
- B. Include plan layout, grid, and spacing of components, accessories, fittings, hardware, anchorages, and schedule of components.
- C. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Framework: ASTM A120; Schedule 40 steel pipe, standard weight, one piece without joints, or to match existing.
- B. Fabric: FS RR-F-91 Type I – zinc coated steel. 2.0-inch diamond mesh steel wire, interwoven, 9-gage thick, top selvage twisted tight, bottom selvage knuckle and closed. Fabric will be installed at entire perimeter.
- C. Line Posts: 2 3/8" diameter steel pipe. Posts shall be approximately 11'-0" in overall length. Posts shall be spaced at 10' maximum on center.
- D. Terminal Posts: 2 7/8" diameter pipe. Posts shall be approximately 11'-0" in overall length.
- E. Top Rail, Mid Rail, Bottom Rail, and Knee Brace: 1 5/8" diameter pipe.
- F. Top, Roof and Brace Rail: 3.5-inch diameter, plain end, sleeve coupled steel pipe.
- G. Gate Frame and Track: 2 7/8" diameter steel pipe for welded fittings. Provide commercial grade rolling gate with hard rubberized wheels. Provide all heavy duty hardware and track capable of supporting gate. Concrete base for roller type carrier.
- H. Caps: Cast steel or malleable iron, galvanized sized to post dimension, set screw retained.
- I. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings: Steel.
- J. Tension Wire: 6 gage steel, single strand.
- I. Gate Hardware: Latch with gravity drop, type required for rolling gate assembly, hardware for padlock. Provide heavy duty rolling castors to support 10'-12' wide rolling gate.

2.02 FINISHES

- A. Galvanized: ANSI/ASTM A123; 1.8 oz/sq.ft. coating.
- B. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories, and gates in accordance with ANSI/ASTM F567.
- B. Set posts minimum 30" deep in concrete (3000 psi) footing (\pm 10" dia x 3'-0" deep).
- C. Provide top rail through line post tops and splice with 7-inch long rail sleeves.
- D. Brace each gate and corner post back to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.

- E. Install center and bottom brace rail on corner and gate leaves.
- F. Stretch fabric between terminal posts.
- G. Position bottom of fabric 2 inches above finished floor.
- H. Fasten fabric to top rail, line posts, braces, and bottom tension wire (and roof) with wire ties maximum 15 inches on center.
- I. Attach fabric to end, top, corner, and gateposts with tension bars and tension bar clips.
- J. Install gates with fabric to match fence. Install heavy duty rolling gate hardware and wheeled carrier.

END OF SECTION 02830

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Formwork for cast-in place concrete, with shoring, bracing, and anchorage.
 - B. Openings for other work.
 - C. Form accessories.
 - D. Form stripping.
- 1.2 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store, protect, and handle products to site per the suppliers and/or manufacturer's recommendations.
 - B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.
- 1.3 COORDINATION
 - A. Coordinate this Section with other Sections of work which require attachment of components to formwork.
 - B. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

PART 2 PRODUCTS

- 2.1 WOOD FORM MATERIALS
 - A. Form Materials: At the discretion of the Contractor.
- 2.2 PREFABRICATED FORMS
 - A. Preformed Steel Forms: Minimum gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- 2.3 FORMWORK ACCESSORIES
 - A. Form Ties: Removable or Snap-off type, metal, size, and shape to minimize filling, waterproofing, and refinishing concrete surfaces.
 - B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
 - C. Corners: Chamfer, exposed edges 1/2 inch unless otherwise noted or detailed on the drawings.
 - D. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, release tape sealed slots, anchors for securing to concrete formwork.
 - E. Flashing Reglets: Galvanized steel 22 gage thick, longest possible lengths, with alignment splines for joints, release tape sealed slots, anchors for securing to concrete formwork.
 - F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
 - G. Waterstops: Rubber Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, maximum possible lengths, ribbed profile, preformed corner sections, and heat welded jointing.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with drawings.
- 3.2 EARTH FORMS
 - A. Earth forms if permitted, hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.3 ERECTION – FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over stressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members which are not indicated on Drawings.
- F. Provide chamfer strips on external corners of beams joists columns and exposed decorative concrete edges.
- G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

3.4 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Position recessed reglets for brick veneer masonry anchors to spacing and intervals specified in Section 04300.
- E. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301. Construct and align formwork for elevator hoistway in accordance with ANSI/ASME A17.1.

3.8 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.9 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION 03100

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.2 SUBMITTALS

- A. Submit under provisions of the General Requirements.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI - Manual of Standard Practice ACI 301 – Specifications for Structural Concrete for Buildings, and ACI 318 – Building Code Requirements for Reinforced Concrete.

1.4 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade as indicated on the drawings; deformed billet steel bars, unfinished.
- B. Reinforcing Steel Plain Bar and Rod Mats: ASTM A704, ASTM A615, Grade 60 as indicated on the drawings; steel bars or rods, unfinished.
- C. Welded Steel Wire Fabric: ASTM A815; in flat sheets or coiled rolls; unfinished.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.3 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice. Locate reinforcing splices not indicated on drawings, at point of minimum stress.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as indicated on the drawings or if not indicated as follows:

E. Item	Coverage
Beams	1 1/2 inch
Column Ties	1 1/2 inch
Walls (exposed to weather or backfill)	2 inch
Footings and Concrete Formed Against Earth	3 inch
Slabs on Fill	3/4 inch

END OF SECTION 03200

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Cast-in-place concrete floors, foundation walls, and footings.
 - B. Floors and slabs on grade.
 - C. Control, expansion, and contraction joint devices associated with concrete work, including joint sealants.
 - D. Equipment pads.
- 1.2 SUBMITTALS
 - A. Submit under provisions of the General Requirements.
 - B. Product Data:
 - 1. Provide data on joint devices, attachment accessories.
 - 2. Product data on nonshrink grout.
 - C. Samples: Submit 2-inch long samples of expansion/contraction joint.
 - D. Manufacturer's Installation Instructions: Indicate installation procedures and interfacer required with adjacent Work.
 - E. Concrete Mix Design Proportions.
 - 1. Submit as specified in Part 2, Paragraph 2.05 H. Mix Proportions, this section, before placing concrete.
 - 2. Submit for each mix design.
 - 3. Resubmit for any change in mix design.
 - 4. Submit back-up test data for each mix design
- 1.3 PROJECT RECORD DOCUMENTS
 - A. Accurately record actual locations of embedded utilities and components which are concealed from view.
- 1.4 QUALITY ASSURANCE
 - A. Perform Work in accordance with ACI301.
 - B. Acquire cement and aggregate from same source for all work.
 - C. Conform to ACI 305R when concreting during hot weather.
 - D. Conform to ACI 306R when concreting during cold weather.
- 1.5 COORDINATION
 - A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

- 2.1 CONCRETE MATERIALS
 - A. Cement: ASTM C150, Type I - Normal or Type III - High Early Strength.
 - B. Fine and Coarse Aggregates: ASTM C33.
 - C. Water: Clean, potable, and not detrimental to concrete.
- 2.2 ADMIXTURES
 - A. Air Entrainment: ASTM C260.
 - B. Chemical: ASTM C494 Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating.

2.3 ACCESSORIES

- A. Bonding Agent: Polymer resin emulsion, polyvinyl acetate, Latex emulsion, two component modified epoxy resin, non-solvent two component polysulfide epoxy, mineral filled polysulfidepolymer epoxy, mineral filled polysulfide polymer epoxy resin, or Polyamid cured epoxy as approved.
- B. Vapor Barrier: 15 mil. thick clear polyethylene film, type recommended for below grade.
- C. Non-Shrink Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.
- D. Curing Compound: Liquid membrane-forming compound conforming to ASTM C 309, Type 1. Curing compound used on floors to be sealed, painted, tiled, or covered with resilient floor covering shall be guaranteed not to interfere with application of sealers, paint, tile mortar, or tile adhesive after 28-day curing period.

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler:
 - 1. Joint Filler Type A: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick.
 - 2. Joint Filler Type B: ASTM D1752; Closed cell polyvinyl chloride foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.
- B. Expansion and Contraction Joint Devices: ASTM B221 alloy, extruded aluminum; resilient elastomeric, vinyl, or neoprene, filler strip with a Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; extruded aluminum or vinyl cover plate, of longest manufactured length at each location, recess mounted; color as selected.
- C. Sealant: Rubber or synthetic rubber compound.

2.5 CONCRETE MIX

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301.
- C. Provide concrete with compressive strength of 3,500 psi at 28 days.
- D. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
- E. Use calcium chloride only when approved by Architect/Engineer.
- F. Use set retarding admixtures during hot weather only when approved by Architect/Engineer.
- G. Add air entraining agent to normal weight concrete mix for work exposed to exterior.
- H. Mix Proportions.
 - 1. Concrete shall be homogeneous, readily placeable, and uniformly workable; proportioned to conform to ACI 211.1.
 - 2. Mix proportions for all concrete shall be selected preferably on the basis of field experience, but in the case where sufficient or suitable strength test data is not available, concrete shall be proportioned on the basis of laboratory trial mix design. Designs shall conform to ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

- B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Use forms for all concrete except footings may be earth formed. Adequately brace and stiffen forms to prevent deflection and settlement.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301 and ACI 304.
- B. Notify Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion, and contraction joints are not disturbed during concrete placement.
- D. Install vapor barrier under interior slabs on grade. Lap joints minimum 6 inches and seal watertight by sealant applied between overlapping edges and ends or taping edges and ends.
- E. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; lap over damaged areas minimum 6 inches and seal watertight.
- F. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler.
- G. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- H. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Conform to Section 07900 for finish joint sealer requirements.
- I. Install joint devices in accordance with manufacturer's instructions.
- J. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- K. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish.
- L. Install joint covers in longest practical length, when adjacent construction activity is complete.
- M. Apply sealants in joint devices in accordance with Section 07900.
- N. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- O. Place concrete continuously between predetermined expansion, contraction, and construction joints.
- P. Do not interrupt successive placement; do not permit cold joints to occur where possible.
- Q. Place floor slabs in saw cut pattern indicated, not to exceed areas larger than 200 sf. Cut joints with power blade as soon as concrete surface is firm enough to resist tearing or damage by the blade and before random shrinkage cracks can occur (Usually required 4 to 12 hours after finishing).
- R. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 ft.
- S. Place concrete on properly prepared and unfrozen subgrade and only in dewatered excavations.

3.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed concrete walls columns beams joists with smooth rubbed finish.
- B. Finish concrete floor surfaces in accordance with ACI 301.
- C. Wood float surfaces which will receive quarry tile, ceramic tile, or terrazzo with full bed setting system.
- D. Steel trowel surfaces, which will receive carpeting, resilient flooring, seamless flooring, thin set quarry tile, or thin set ceramic tile.
- E. Steel trowel surfaces which are scheduled to be exposed.
- F. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/4 inch per foot or as indicated on drawings.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces in accordance with ACI 308.

- D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 4 days.
- E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
- F. Curing Compound: Cure with liquid membrane-forming compound conforming to ASTM C 309, Type I. Apply immediately after removal of forms (which have been continuously wet); or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk on. Apply curing compound to all exposed surfaces immediately after removing form or after finishing concrete.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of the General Requirements.
- B. Provide free access to Work and cooperate with appointed firm.
- C. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
- D. **Three 6"x12" or four 4"x8" concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed. Test the additional 4"x8" cylinders at 28 days.**
- E. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. One slump test will be taken for each set of test cylinders taken.
- G. Water added to concrete having a slump below the specified minimum shall be at Contractor's risk. If the water added produces a slump greater than the specified maximum, the concrete will be rejected. If water is added, the concrete shall be remixed for a minimum of 25 revolutions. Three concrete test cylinders will be taken from every truck that water is added to at the jobsite.

3.7 PATCHING

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections as directed or in accordance with ACI 301.

3.8 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

END OF SECTION 03300

SECTION 04300
UNIT MASONRY SYSTEM

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Concrete masonry and brick units.
 - B. Reinforcement, anchorage, and accessories.
- 1.2 SUBMITTALS
 - A. Submit under provisions of the General Requirements.
 - B. Product Data: Provide data for masonry and brick units and fabricated wire reinforcement.
- 1.4 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store, protect and handle products to site under provisions of the General Requirements.
 - B. Accept units on site. Inspect for damage.
- 1.6 ENVIRONMENTAL REQUIREMENTS
 - A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
 - B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.
 - C. Hot Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot or Cold Weather Masonry Construction.

PART 2 PRODUCTS

- 2.1 CONCRETE MASONRY UNITS
 - A. Hollow Non-Load Bearing Block Units (CMU): All exterior exposed concrete masonry units and mortar shall contain integral water repellent. Units shall comply with ASTM C 33 and ASTM C 90, grade N water permanence per ASTM E 514 test. Wind driven protection per ASTM E 514-74, Class E. Full wall flexural bond strength per ASTM E 72-74 all interior concrete masonry shall be grade S, Type I, moisture controlled units.
 - B. Size and Shape: Nominal modular size of 4, 6, 8 x 16 x 8 inches.
- 2.2 BRICK UNITS
 - A. Sioux City Brick:
 - 1. Badlands Velour (field brick).
 - A. Size and Shape: Nominal modular size of 4 x 8 x 2 2/3 inches.
- 2.3 REINFORCEMENT AND ANCHORAGE
 - A. Single and Multiple Wythe Joint Reinforcement: Truss type; steel wire, hot dip galvanized to ASTM A641 after fabrication, No. 9 side rods with No. 9 cross ties.
 - Manufacturers:
 - a) DUR-O-WALL
 - b) TRU-MESH
 - c) BET-R-WALL
 - B. Reinforcing Steel: ASTM A615, 40 or 60 ksi yield grade, deformed billet bars, uncoated finish.
 - C. Wall Ties: Corrugated wall ties, 22 ga., hot dip galvanized to ASTM A123 steel finish,

HB-213 Dur-O-Wall Anchor or Equal.

Manufacturers:

- a) DUR-O-WALL
- b) TRU-MESH
- c) BET-R-WALL

2.4 MORTAR AND GROUT

- A. Mortar and Grout: As specified in Section 04100.

2.5 FLASHINGS

- A. Thru-Wall Flashings: Asphalt fabric backed copper, 3-5 oz.
- B. Lap Sealant: Butyl type as specified in Section 07900.

2.6 ACCESSORIES

- A. Preformed Control Joints: Rubber, Neoprene, Polyvinyl chloride material. Provide with corner and tee accessories, heat or cement fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride, polyethylene, polyurethane or rubber; oversized 50 percent to joint width; self-expanding.
- C. Building Paper: TYVEK Commercial wrap.
- D. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- E. Weeps: Locate at 32" o.c.
- F. Weep Vent: Open weave polyester mesh; insect resistant, hold back from face 1/4".
- G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
- H. Cavity wall Mortar Net: 90% open area, 10" H, 1" wide, 18" minimum density PVC or nylon material set behind bottom brick courses between brick and flashing around all exterior veneer walls.

2.7 LINTELS

- A. As detailed on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running unless otherwise indicated.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave, unless noted otherwise.
- D. Brick Units:
 - 1. Bond: Running, unless noted otherwise.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave, unless noted otherwise.

3.4 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or bitumen damp proofing is applied.
- I. Isolate masonry partitions from vertical structural framing members with a control joint.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.5 WEEPS

- A. Install weeps in veneer at 32 inches o.c. horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and under precast concrete window sills. Hold weep screens back from face 1/4 “.

3.6 CAVITY WALL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weeps.
- B. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor barrier adhesive.
- C. Install 10” High x 1” Thick x continuous “Mortar Net” cavity drainage fabric.
- D. Install 90% open weave polyester weep vents at 32” o.c. and at weep locations above windows and doors.

3.7 REINFORCEMENT AND ANCHORAGE

- A. Install horizontal joint reinforcement 16 inches o.c.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place joint reinforcement continuous in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- F. At masonry veneer, attach wall ties to metal studs at back-up wall at maximum 24 inches o.c. vertically and 16 inches o.c. horizontally. Place at maximum 3 inches o.c. each way around perimeter of openings, and within 12 inches of openings.
 - 1. At top of CMU veneer, field bend and extend galvanized tie minimum 1” into CMU cavity and grout solid. Space at 16” o.c. Provide appropriate length of wall tie to extend into CMU

3.8 MASONRY FLASHINGS

- A. Extend flashings horizontally at foundation walls, above ledge or shelf angles and lintels, under parapet caps, and at bottom of walls.
- B. Turn flashing up minimum 8 inches and bed into mortar joint of masonry, seal to concrete, seal or underlap at sheathing over framed back-up.
- C. Lap end joints minimum 6 inches and seal watertight.
- D. Turn flashing, fold, and seal at corners, bends, and interruptions.

3.9 LINTELS

- A. Install loose steel or precast concrete lintels over openings as indicated or detailed on the Structural.

- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
- C. Maintain minimum 8 inch bearing on each side of opening.

3.10 GROUTED COMPONENTS

- A. Reinforce bond beam as indicated or detailed.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.11 ENGINEERED MASONRY

- A. Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
- B. Place mortar in masonry unit bed joints back 1/4 inch (6 mm) from edge of unit grout spaces, bevel back and upward. Permit mortar to cure 7 days before placing grout.
- C. Reinforce masonry unit cores and cavities with reinforcement bars and grout as indicated.
- D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters. Splice reinforcement in accordance with Section 03200.
- E. Wet masonry unit surfaces in contact with grout just prior to grout placement.
- F. Grout spaces less than 2 inches in width with fine grout using low lift grouting techniques. Grout spaces 2 inches or greater in width with course grout using high or low lift grouting techniques.
- G. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.
- H. Low Lift Grouting: Place first lift of grout to a height of 16 inches to three CMU courses and rod for grout consolidation. Place subsequent lifts in 8 inch increments and rod for grout consolidation.
- I. High Lift Grouting:
 - 1. Provide cleanout opening no less than 4 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit.
 - 2. In double wythe walls, omit every second masonry unit in one of the wythes for clean out and cell inspection purposes.
 - 3. In double wythe walls, construct vertical grout barriers or dams between the masonry wythes, with masonry units every 30 feet maximum.
 - 4. Clean out masonry cells and cavities with high pressure water spray. Permit complete water drainage.
 - 5. Request inspection of the cells and cavities. Allow 3 days advance notice of inspection.
 - 6. After cleaning and cell inspection, seal openings with masonry units.
 - 7. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
 - 8. Limit grout lift to 60 inches and rod for grout consolidation or mechanically vibrate. Wait 60 minutes before placing next lift.

3.12 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- D. Size control joint in accordance with Section 07900 for sealant performance.
- E. Form expansion joint as detailed.

3.13 BUILT-IN WORK

- A. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, fireplace accessories, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build in organic materials subject to deterioration.

3.14 TOLERANCES

- A. Maximum Variation From Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/32 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.15 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.16 MOCK-UP

- A. Provide a 4 ft. by 4 ft. mock-up panel on the job site to be used as a standard for similar masonry construction on the project.

3.17 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.18 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION 04300

SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Structural steel framing members and support members.
 - B. Base plates.
 - C. Grouting under base plates.
- 1.2 GENERAL
 - A. All notes or specifications on structural drawings shall override any discrepancies listed.
- 1.3 SUBMITTALS
 - A. Submit under provisions of the General Requirements.
 - B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
 - 2. Connections and Connections not detailed.
 - 3. Cambers, and loads.
 - 4. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.
 - 5. The Engineer prepared Contract Drawings cannot be used as Erection Drawings.
 - C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- 1.4 QUALITY ASSURANCE
 - A. Fabricate and erect structural steel members in accordance with AISC - Manual of Steel Construction, Allowable Stress Design, Ninth Edition.
 - B. Perform Work in accordance with AISC - Specification for Architectural Exposed Structural Steel.
 - C. High strength bolts shall comply with Specification for Structural Forms using ASTM A 325.
- 1.5 QUALIFICATIONS
 - A. Fabricator: Company specializing in performing the work of this Section with minimum 5 years' documented experience.
 - B. Erector: Company specializing in performing the work of this Section with minimum 5 years' documented experience.
 - C. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Kansas.
- 1.6 FIELD MEASUREMENTS
 - A. Verify that field measurements are as shown on shop drawings and/or as instructed by the manufacturer.

PART 2 PRODUCTS

- 2.1 MATERIALS
 - A. Reference drawings and notes on the drawings.
- 2.2 FINISH
 - A. Prepare structural component surfaces in accordance with SSPC SP 2.
 - B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete or high strength bolts.

2.3 SHOP CONNECTIONS

- A. Weld or bolt at Contractor's option except when otherwise indicated or specified.
- B. Shop portions of connections may be welded equivalent to any bolted connection specified if Engineer concurs.
- C. Welded connections shall be as indicated or in accordance with acceptable alternative designs.
 - 1. Welds of connection angles to beam webs shall conform with AISC Manual, Part 4, Tables III and IV, with particular regard for minimum web thickness. Provide longer connection angles or reinforce web as required.
 - 2. All butt-joint groove welds shall be complete penetration welds unless otherwise indicated and shall conform to the applicable standards in AISC Manual, Part 4, with special emphasis on maintaining root opening.
- D. Bolted connections shall conform with AISC Manual, Part 4:
 - 1. All bolted connections shall be made with $\frac{3}{4}$ -inch bolts, nuts, and washers unless otherwise indicated or specified.
 - 2. Connections must be selected to support one-half the total uniform load capacity shown in the Allowable Uniform Load Tables, Part 2 of the AISC Manual, for the given beam, span and grade of steel specified.
 - 3. Use the minimum number of rows of bolts for beam connections so that the bottom row is at or below the centerline of the beam.

2.4 FIELD CONNECTIONS

- A. Provide with bolted connections unless otherwise indicated or specified.
- B. Provide for field welding only when so indicated or when detail clearances make bolting impractical.
- C. Bolted connections shall comply with Part 2.03 Paragraph D, this specification.

2.5 STAIRS

- A. Fabricator shall design and detail stair stringers, pans, landings, and their connections to meet the criteria specified in this specification and the design drawings.
- B. The stringers and pans specified are the minimum acceptable sizes.

2.6 CONCRETE ANCHORS

- A. Manually expanded and adhesive anchor types.
- B. Furnish sizes indicated and install to conform to manufacturer's printed instruction.
- C. Carbon steel grades and surface plating (or galvanizing) shall be manufacturer's standard.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing and decking.
- B. Field weld components indicated on Drawings and/or shop drawings.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.
- D. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
- E. Grout under base plates as indicated. Cut off exposed edges of grout at 45 degrees along the edges of the base plates after grout has acquired its initial set.
- F. Frame floor, roof openings greater than 12 inches with supplementary framing.

3.3 CONNECTIONS

- A. All bracing connections shall be bolted slip critical type. All other connections shall be pretensioned.
- B. Where required for connection fit-up, bolt holes may be adjusted in one of the following manners: (flame cutting or flame enlargement of holes is not allowed):
 - 1. Reamed to AISC allowable maximum size for oversized holes.
 - 2. Holes may be filled with weld metal, ground smooth, and field-drilled.
 - 3. Other Engineer-approved methods.
- C. Make welded connections as indicated and leave all erection bolts in place after completion of welding unless otherwise indicated. Reinforce connections when members requiring fillet welds are not in contact. Use backup bars or spacer bars on all butt welds where root opening exceeds 3/16-inch. Remove all run-out tabs.

3.4 CONCRETE ANCHORS

- A. Install anchors to conform to manufacturer's printed instructions.
- B. The hole tolerances, drill bits, and anchor installation torque shall be as per manufacturer's printed recommendations.

3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 05120

SECTION 05311

STEEL FLOOR DECK

PART 1 GENERAL

- 1.01 SECTION INCLUDES
- A. Steel floor deck and accessories.
 - B. Framing for openings up to and including 12 inches.
- 1.02 RELATED SECTIONS
- A. Section 05120 - Structural Steel: Structural framed openings larger than 12 inches.
- 1.03 PERFORMANCE REQUIREMENTS
- A. Design metal decking in accordance with SDI Design Manual for Composite Decks, Form Deck, and Roof Decks.
 - B. Calculate to structural working stress design and maximum vertical deck deflection of 1/180.
- 1.04 SUBMITTALS
- A. Shop Drawings: Indicate decking plan, support locations, projections, openings and reinforcement, pertinent details, and accessories. Accessories to include as a minimum, all flashings required to close deck units at columns, walls, and penetrations through the deck. Also include deck support at columns.
 - B. Product Data: Provide deck profile characteristics and dimensions, structural properties, and finishes.
 - C. Manufacturer's Installation Instructions: Indicate specific installation sequence, and special instructions.
- 1.05 QUALIFICATIONS
- A. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.
- 1.06 STORAGE AND HANDLING
- A. Store and protect products.
 - B. Cut plastic wrap to encourage ventilation.
 - C. Separate sheets and store decking on dry wood sleepers; slope for positive drainage.
- 1.07 FIELD MEASUREMENTS
- A. Verify that field measurements are as shown on shop drawings.

PART 2 PRODUCTS

- 2.01 MATERIAL
- A. Sheet Steel: ASTM A446, Grade A Structural Quality; precoated with prime coating of gray color as selected from manufacturer's standard range.
 - B. Welding Materials: AWS D1.1.
 - C. Touch-Up Primer: Red oxide type.
- 2.02 FABRICATION
- A. Stair Landing: Sheet steel, configured as follows:

<u>Span Design:</u>	<u>Multiple</u>
Minimum Metal Thickness (Excluding Finish):	28 Gage.
Nominal Height:	0.6 inches
Formed Sheet Width:	24, 30, or 36 inches
Side Joints:	Lapped
Flute Sides:	Plain vertical face

- B. Floor Metal Decking Above Data Center: Sheet steel, configured as follows:
 - Span Design: Multiple
 - Minimum Metal Thickness (Excluding Finish): 16 Gage.
 - Nominal Height: 3 inches
 - Formed Sheet Width: 24, 30, or 36 inches
 - Side Joints: Lapped
 - Flute Sides: Plain vertical face
- C. Floor Metal Decking at Mezzanine, configured as follows:
 - Span Design: Multiple
 - Minimum Metal Thickness (Excluding Finish): 26 Gage.
 - Nominal Height: 0.6 inches
 - Formed Sheet Width: 24, 30, or 36 inches
 - Side Joints: Lapped
 - Flute Sides: Plain vertical face
- D. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.

3.02 INSTALLATION

- A. Erect metal decking in accordance with manufacturer's instructions.
- B. Bear decking on masonry support surfaces with 4-inch minimum bearing. Align and level.
- C. Bear decking on steel supports with 2 inch minimum bearing. Align and level.
- D. Fasten ribbed deck to steel support members at ends and intermediate supports with fusion welds through weld washers as required on the structural drawings.
- E. Weld in accordance with AWS D1.1.

END OF SECTION 05311

SECTION 05312
STEEL ROOF DECK

PART 1 GENERAL

- 1.01 SECTION INCLUDES
 - A. Steel roof deck and accessories.
 - B. Framing for openings up to and including 12 inches.
- 1.02 RELATED SECTIONS
 - A. Section 05120 - Structural Steel: Structural framed openings larger than 12 inches.
- 1.03 PERFORMANCE REQUIREMENTS
 - A. Design metal decking in accordance with SDI Design Manual for Composite Decks, Form Deck, and Roof Decks.
 - B. Calculate to structural working stress design and maximum vertical deck deflection of 1/180.
 - C. Verify attachments required on the structural drawings are adequate to safely resist uplift loads.
- 1.04 SUBMITTALS
 - A. Shop Drawings: Indicate decking plan, support locations, projections, openings and reinforcement, pertinent details, and accessories.
 - B. Product Data: Provide deck profile characteristics and dimensions, structural properties, and finishes.
 - C. Manufacturer's Installation Instructions: Indicate specific installation sequence, and special instructions.
- 1.05 QUALIFICATIONS
 - A. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.
- 1.06 STORAGE AND HANDLING
 - A. Store and protect products.
 - B. Cut plastic wrap to encourage ventilation.
 - C. Separate sheets and store decking on dry wood sleepers; slope for positive drainage.
- 1.07 FIELD MEASUREMENTS
 - A. Verify that field measurements are as shown on shop drawings.

PART 2 PRODUCTS

- 2.01 MATERIAL
 - A. Sheet Steel: ASTM A446
 - B. Welding Materials: AWS D1.1.
 - C. Touch-Up Primer: Red oxide type.
- 2.02 FABRICATION
 - A. Metal Decking: Sheet steel, configured as follows:

<u>Span Design:</u>	<u>Multiple</u>
<u>Rib Design</u>	Type B, Wide Rib
Minimum Metal Thickness (Excluding Finish):	Reference Structural Drawings
Nominal Height:	1-1/2 inches
Formed Sheet Width:	24, 30, or 36 inches
Side Joints:	Lapped
Flute Sides:	Plain vertical face

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.

3.02 INSTALLATION

- A. Erect metal decking in accordance with manufacturer's instructions.
- B. Bear decking on masonry support surfaces with 4-inch minimum bearing. Align and level.
- C. Bear decking on steel supports with 2 inch minimum bearing. Align and level.
- C. Fasten ribbed deck to steel support members at ends and intermediate supports with fusion welds through weld washers as required on the structural drawings.
- D. Weld in accordance with AWS D1.1.

END OF SECTION 05312

SECTION 05400

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Ceiling joist framing.
- B. Related Sections include the following:
 - 1. Division 05 Section "Cold-Formed Metal Trusses."
 - 2. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 3. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
 - 4. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of **1 inch**.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 - 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- B. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
 - 1. Allied Studco.
 - 2. AllSteel Products, Inc.
 - 3. California Expanded Metal Products Company.
 - 4. Clark Steel Framing.
 - 5. Consolidated Fabricators Corp.; Building Products Division.
 - 6. Craco Metals Manufacturing, LLC.
 - 7. Custom Stud, Inc.
 - 8. Dale/Incor.
 - 9. Design Shapes in Steel.
 - 10. Dietrich Metal Framing; a Worthington Industries Company.
 - 11. Formetal Co. Inc. (The).
 - 12. Innovative Steel Systems.
 - 13. MarinoWare; a division of Ware Industries.
 - 14. Quail Run Building Materials, Inc.
 - 15. SCAFCO Corporation.
 - 16. Southeastern Stud & Components, Inc.
 - 17. Steel Construction Systems.
 - 18. Steeler, Inc.
 - 19. Super Stud Building Products, Inc.
 - 20. United Metal Products, Inc.

2.2 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: 50 KSI.
 - 2. Coating: **G60**.
- B. Steel Sheet for **Vertical Deflection** Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: **50 (340), Class 1 or 2**.
 - 2. Coating: **G60**.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As noted on Design Drawings.
 - 2. Flange Width: **1-5/8 inches (41 mm)**.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: **Matching steel studs**.
 - 2. Flange Width: **1-1/4 inches (32 mm)**.
- C. Vertical Deflection Clips: Manufacturer's standard **bypass** clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dietrich Metal Framing; a Worthington Industries Company.
 - b. MarinoWare, a division of Ware Industries.
 - c. SCAFCO Corporation
 - d. The Steel Network, Inc.

- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Minimum Base-Metal Thickness: **0.0428 inch (1.09 mm)**.
 3. Flange Width: 2 ½”.
- 2.4 CEILING JOIST FRAMING
- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, **unpunched**, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: **0.0329 inch (0.84 mm)**.
 2. Flange Width: **1-5/8 inches (41 mm)**.
- 2.5 FRAMING ACCESSORIES
- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers, knee braces, and girts.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.
- 2.6 ANCHORS, CLIPS, AND FASTENERS
- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade **36** threaded carbon-steel **hex-headed bolts headless, hooked bolts** and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by **mechanically deposition according to ASTM B 695, Class 50**.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.
- 2.7 MISCELLANEOUS MATERIALS
- A. Galvanizing Repair Paint: **ASTM A 780**.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching.
- E. Sealer Gaskets: Closed-cell neoprene foam, **1/4 inch (6.4 mm)** thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet (1:960)** and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of **1/8 inch (3 mm)**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding **1/16 inch (1.6 mm)**.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
 - E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
 - F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
 - G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
 - H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
 - I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
 - J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet (1:960)** and as follows:
 - 1. Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- 3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION
- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
 - B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: **16 inches (406 mm)**.
 - C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
 - D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to **infill** studs and anchor to building structure.
 - E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than **48 inches (1220 mm)** apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within [**12 inches (305 mm)**] of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking at **96-inch centers**.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
 - F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.
- 3.5 FIELD QUALITY CONTROL
- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Field and shop welds will be subject to testing and inspecting.
 - C. Testing agency will report test results promptly and in writing to Contractor and Architect.
 - D. Remove and replace work where test results indicate that it does not comply with specified requirements.
 - E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Metal ladders.
4. Metal floor plate [**and supports**].
5. Miscellaneous steel trim.
6. Metal bollards.
7. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Manufactured metal ladders.
6. Ladder safety cages.
7. Metal bollards.
8. Abrasive metal [**nosings**] [**treads**] [**and**] [**thresholds**].

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication and installation details. [**Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.**]

D. Samples: For each type and finish of extruded [**nosings**] [**and**] [**tread**].

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes. B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide [**Type 304**] stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening [aluminum] [stainless steel] [or] [nickel silver].
2. Provide bronze fasteners for fastening bronze.
- B. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- C. Post-Installed Anchors: [Torque-controlled expansion anchors] [or] [chemical anchors].
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 1 (A1)] [Group 2 (A4)] stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.3 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with [Section 099113 "Exterior Painting."] [Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."] [Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal weight, air-entrained concrete with a minimum 28-day compressive strength of 3500 psi.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing [**and contour of welded surface matches that of adjacent surface**].
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than **8 inches (200 mm)** from ends and corners of units and **24 inches (600 mm)** o.c.
- 2.5 MISCELLANEOUS FRAMING AND SUPPORTS
- A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fire-Resistance Rating: [**As indicated**].
- 2.6 SHELF ANGLES
- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive **3/4-inch (19-mm)** bolts, spaced not more than **6 inches (150 mm)** from ends and **24 inches (600 mm)** o.c., unless otherwise indicated.
1. Provide mitered and welded units at corners.
 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately **2 inches (50 mm)** larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize [**and prime**] shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with [**zinc-rich primer**].
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.
- 2.7 METAL LADDERS
- A. General:
1. Comply with ANSI A14.3 [, **except for elevator pit ladders**].
 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
1. Space siderails [**16 inches (406 mm)**] apart unless otherwise indicated.
 2. Siderails: Continuous, [**3/8-by-2-1/2-inch (9.5-by-64-mm)** steel flat bars, with eased edges.
 3. Rungs: [**3/4-inch- (19-mm-) diameter**] [**3/4-inch- (19-mm-) square**] [**1-inch- (25-mm-) diameter**] [**1-inch- (25-mm-) square**], steel bars.
 4. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
- 2.8 METAL FLOOR PLATE
- A. Fabricate from [**abrasive-surface floor**] plate of thickness indicated below:
1. Thickness: [**1/4 inch (6.4 mm)**].
- B. Provide [**steel**] angle supports as indicated.
- C. Provide flush [**steel**] bar drop handles for lifting removable sections, one at each end of each section.

2.9 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize [**exterior**] miscellaneous steel trim.
- D. Prime [**exterior**] miscellaneous steel trim with [**zinc-rich primer.**]

2.10 METAL BOLLARDS

- A. Fabricate metal bollards from [**Schedule 80 steel pipe**] Retain subparagraph below if required; delete if bollards are concrete filled.
 - 1. Cap bollards with **1/4-inch- (6.4-mm-)** thick steel.
- B. Fabricate bollards with **3/8-inch- (9.5-mm-)** thick, [**steel**] [**stainless steel, ASTM A480/A480M, No. 4 finish**] baseplates for bolting to concrete slab. Drill baseplates at all four corners for **3/4-inch (19-mm)** anchor bolts.
- C. Fabricate sleeves for bollard anchorage from steel or stainless steel [**pipe**] with **1/4-inch- (6.4mm-)** thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than **8 inches (200 mm)** deep and **3/4 inch (19 mm)** larger than OD of bollard.
- D. Prime steel bollards with [**zinc-rich primer.**]

2.11 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with [**zinc-rich primer.**] [**primer specified in Section 099600 "High Performance Coatings."**]

2.12 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize [**and prime**] loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with [**zinc-rich primer.**]

2.13 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.

2.15 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

- B. Shop prime iron and steel items [**not indicated to be galvanized**] unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with [**universal shop primer**]
- C. Preparation for Shop Priming: Prepare surfaces to comply with [**requirements indicated below:**]
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections. C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for [**ceiling hung toilet partitions**] [**operable partitions**] [**overhead doors**] [**and**] [**overhead grilles**] securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to existing construction with [**expansion anchors**] [**anchor bolts**] [**through bolts**].
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

3.3 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, "Specifications for Structural Steel Buildings," and with requirements applicable to listing and labeling for fire resistance rating indicated.

3.4 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete [**with pipe sleeves preset and anchored into concrete**] [**in formed or core-drilled holes not less than 42 inches (1050 mm) deep and 3/4 inch (19 mm) larger than OD of bollard**]. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately **1/8 inch (3 mm)** toward bollard.
- C. Anchor bollards in place with concrete footings. Center and align bollards in holes **3 inches (75 mm)** above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- D. Fill bollards solidly with concrete, mounding top surface to shed water.

3.5 INSTALLATION OF VEHICULAR BARRIER CABLE SYSTEMS

- A. Install vehicular barrier cable systems at locations indicated, mounted at heights indicated on Drawings above the parking surface. Anchor [**wire ropes**] [**steel prestressing strand**] to structural columns and walls and tension to withstand vehicle loading as specified in "Performance Requirements" Article with no cable tensioned less than **3000 lbf (13.3 kN)**. Do not displace supporting components.

3.6 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05500

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood blocking, cants, and nailers.
 - 2. Wood furring.
 - 3. Plywood backing panels.
 - 4. Building vapor barrier.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.
- C. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
 - 5. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
 - 6. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
 - 7. All plywood blocking shall be fire retardant treated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Wood Structural Panels:
 - 1. Plywood: DOC PS 1.
 - 2. Oriented Strand Board: DOC PS 2.
 - 3. Thickness: As needed to comply with requirements specified but not less than thickness indicated.

4. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
5. Factory mark panels according to indicated standard.
6. All plywood sheathing shall be fire retardant treated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 lumber except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:
 - a. Chromated copper arsenate (CCA).
 - b. Ammoniacal copper zinc arsenate (ACZA).
 - c. Ammoniacal, or amine, copper quat (ACQ).
 - d. Copper bis (dimethyldithiocarbamate) (CDDC).
 - e. Ammoniacal copper citrate (CC).
 - f. Copper azole, Type A (CBA-A).
 - g. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing members less than 18 inches above grade.
 4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 lumber and AWPA C27 plywood. Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood
 2. Use treatment that does not promote corrosion of metal fasteners.
 3. Use Exterior type for exterior locations and where indicated.
 4. Use Interior Type A High Temperature (HT), unless otherwise indicated.
- B. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
 1. Rooftop equipment bases and support curbs.
 2. Blocking.
 3. Cants.
 4. Nailers.
 5. Furring.
 6. Grounds.

- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent maximum moisture content.
 - C. For exposed boards, provide lumber with 15 percent maximum moisture content.
 - D. For concealed boards, provide lumber with 15 percent maximum moisture content.
 - E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.
- 2.5 SHEATHING
- A. Reference specification Section 06112. a
- 2.6 PLYWOOD BACKING PANELS
- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire- retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.
- 2.7 FASTENERS
- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - B. Nails, Brads, and Staples: ASTM F 1667.
 - C. Power-Driven Fasteners: CABO NER-272.
 - D. Wood Screws: ASME B18.6.1.
 - E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - F. Lag Bolts: ASME B18.2.1.
 - G. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.
 - H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.
- 2.8 METAL FRAMING ANCHORS
- A. General: Provide framing anchors made from metal indicated, of structural capacity, type, and size indicated, and as follows:
 - 1. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
 - 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
 - B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - C. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Use for exterior locations and where indicated.
 - D. Joist Hangers: U-shaped joist hangers with **2-inch-** long seat and **1-1/4-inch-** wide nailing flanges at least 85 percent of joist depth.
 - 1. Thickness: **0.050 inch.**

- E. I-Joist Hangers: U-shaped joist hangers with **2-inch-** long seat and **1-1/4-inch-** wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
 - 1. Thickness: **0.050 inch.**
 - F. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
 - 1. Strap Width: **1-1/2 inches.**
 - 2. Thickness: **0.050 inch.**
 - G. Bridging: Rigid, V-section, nailless type, **0.062 inch** thick, length to suit joist size and spacing.
 - H. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post **1 inch** above base and with **2-inch-** minimum side cover, socket **0.062 inch** thick, and standoff and adjustment plates **0.108 inch** thick.
 - I. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
 - 1. Width: **3/4 inch.**
 - 2. Thickness: **0.050 inch.**
 - 3. Length: **16 inches.**
 - J. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, **1-1/2 inches** wide by **0.050 inch** thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.
 - K. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, **2-1/4 inches** wide by **0.062 inch** thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.
 - L. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, **1-1/4 inches** wide by **0.050 inch** thick by **36 inches** long.
 - M. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
 - N. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, **1-1/8 inches** wide by **9/16 inch** deep by **0.034 inch** thick with hemmed edges.
 - O. Wall Bracing: Angle bracing made for letting into studs in saw kerf, **15/16 by 15/16 by 0.040 inch** thick with hemmed edges.
- 2.9 MISCELLANEOUS MATERIALS
- A. Building Vapor Barrier: Fluid-applied membrane.
 - B. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing and recommended by sheathing manufacturer for use with type of sheathing required.
 - C. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; **1- inch** nominal thickness, compressible to **1/32 inch** ; selected from manufacturer's standard widths to suit width of sill members indicated.
 - D. Sill-Sealer Gaskets: Closed-cell neoprene foam, **1/4 inch** thick, selected from manufacturer's standard widths to suit width of sill members indicated.
 - E. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.
 - F. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2- propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply field treatment complying with AWWPA M4 to cut surfaces of preservative-treated lumber and plywood.

- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the Uniform Building Code.
 - 4. Table 2305.2, "Fastening Schedule," in the BOCA National Building Code.
 - 5. Table 2306.1, "Fastening Schedule," in the Standard Building Code.
 - 6. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in the International One- and Two-Family Dwelling Code.
 - E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
 - F. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
- 3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION
- A. Install where indicated and where required for screening or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 - B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.
 - C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than **1-1/2 inches** wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.
- 3.3 BUILDING PAPER APPLICATION
- A. Apply building paper horizontally with **2-inch** overlap and **6-inch** end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with **4-inch** overlap.
- 3.4 BUILDING WRAP APPLICATION
- A. Cover wall sheathing with building wrap as indicated.
 - 1. Comply with manufacturer's written instructions.
 - 2. Cover upstanding flashing with **4-inch** overlap.
 - 3. Seal seams, edges, and penetrations with tape.
 - 4. Extend into jambs of openings and seal corners with tape.

END OF SECTION 06100

SECTION 06112

SHEATHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gypsum wall sheathing.
- B. APA rated (fire retardant treated) plywood at sloped metal accent roofs
- C. Telephone and electrical panel boards.

1.02 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of the General Requirements.
- B. Protect sheathing from warping or other distortion by stacking.

PART 2 PRODUCTS

2.01 SHEATHING MATERIALS

- A. Wall Sheathing
 - 1. Gypsum (typical) Fiberglass Mat Faced
 - a) Fire resistant, 5/8 inch, glass mat, Type "X" core.
 - b) Manufacturer – Georgia Pacific Dens Glass Gold

2.02 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing, and galvanized. Reference requirements of Section 05400 Cold-Formed Framing.
 - 2. Anchors: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.
- B. Sill Gasket on Top of Foundation Wall: Contractor submit for approval by Architect.
- C. Building Paper: Tyvek Commercial Wrap at Plywood sheathed walls.

PART 3 EXECUTION

3.01 FRAMING

- A. Set structural members level and plumb, in correct position.
- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Place horizontal members flat, crown side up.
- D. Construct load bearing framing and curb members full length without splices.

3.02 SHEATHING

- A. Secure wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered.
- B. Place building paper horizontally over wall sheathing, weather lap edges and ends.
- C. Install telephone and electrical panel boards with plywood sheathing material where required. Over size the panel by 12 on all sides.

3.03 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum, and 1/2 inch maximum in 30 feet.

END OF SECTION 06112

SECTION 06114

WOOD BLOCKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Blocking in wall and roof openings.
- B. Wood furring and grounds.
- C. Concealed wood blocking for support of toilet and bath accessories, wall cabinets, and wood trim.
- D. Telephone and electrical panel boards.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Miscellaneous Blocking: Minimum stud grade.
- B. Plywood: APA Rated Sheathing, Grade C-D; Exposure Durability 1; sanded.
- C. Roof Curbs and Cants: Treated lumber.

2.2 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Hot-dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 - 2. Anchors: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

PART 3 EXECUTION

3.1 FRAMING

- A. Set members level and plumb, in correct position.
- B. Place horizontal members flat, crown side up.
- C. Construct curb members of single pieces.
- D. Space framing and furring 16 inches o.c.
- E. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- F. Coordinate curb installation with installation of decking and support of deck openings, roofing vapor retardant, and parapet construction.

3.2 SHEATHING

- A. Secure sheathing to framing members with ends over firm bearing and staggered.
- B. Install telephone and electrical panel boards with plywood sheathing material where required. Over size the panel by 12 inches on all sides.

END OF SECTION 06114

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Finish carpentry items, other than shop prefabricated casework.
 - B. Hardware and attachment accessories.
- 1.2 QUALITY ASSURANCE
 - A. Perform work in accordance with AWI Custom.
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store, protect, and handle products to site under provisions of the General Requirements.
 - B. Protect work from moisture damage.
- 1.4 FIELD MEASUREMENTS
 - A. Verify that field measurements are as indicated on shop drawings and as instructed by the manufacturer.
- 1.5 COORDINATION
 - A. Coordinate the work with plumbing and electrical rough-in, and installation of associated and adjacent components.

PART 2 PRODUCTS

- 2.1 LUMBER MATERIALS
 - A. Softwood Lumber: Graded in accordance with AWI Custom; Reference schedule at the end of this section; **Select White Birch**, maximum moisture content of 6 percent; suitable for transparent finish.
- 2.2 SHEET MATERIALS
 - A. Exterior Plywood: Exposed to weather shall be group 1, Exterior type, Grade A-B or A-C as required for exposure.
 - B. Interior Plywood: Interior or Exterior type, Group 1 or 2, Grade B-D where concealed, Grade A-C one side exposed and Grade A-A two sides exposed.
 - C. Wood Particleboard: ANSI A208.1 Type 1; AWI standard, composed of wood chips, medium density, made with high waterproof resin binders; of grade to suit application; sanded faces.
 - D. Exterior Hardie Panel; fiber cement panels.
- 2.3 FASTENERS
 - A. Fasteners: Of size and type to suit application; Galvanized finish in concealed locations and Brass or Chrome finish in exposed locations.
- 2.4 FABRICATION
 - A. Fabricate to AWI Custom standards.
 - B. Shop assemble work for delivery to site, permitting passage through building openings.
 - C. Fit exposed sheet material edges with 3/8 inch matching hardwood edging. Use one piece for full length only.
 - D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.5 SHOP FINISHING

- E. Sand work smooth and set exposed nails and screws.
- F. Apply wood filler in exposed nail and screw indentations.
- G. On items to receive transparent finishes, use wood filler which matches surrounding surfaces and of types recommended for applied finishes.
- H. Seal, stain, and varnish exposed to view surfaces. Brush apply only.
 - 1. Prime paint. Seal surfaces in contact with cementitious materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

- A. Install work in accordance with AWI Custom Quality Standard.
- B. Set and secure materials and components in place, plumb, and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. Install components trim with nails, screws, bolts with blind fasteners or wall adhesive by gun application.
- E. Install hardware in accordance with manufacturer's instructions.

3.3 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Brush apply two coats of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.4 PREPARATION FOR SITE FINISHING

- A. Site Finishing: Refer to Section 09900.
- B. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.5 SCHEDULE

- A. Interior: Wood base, wood wall trim, wood door trim, 3/4" thick material with varying widths (reference drawings). **Select White Birch** stained and finished.

END OF SECTION 06200

SECTION 06410

CUSTOM CASEWORK

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Countertops, base and wall cabinets.
 - B. Cabinet hardware.
 - C. Prefinished surfaces and preparation for site finishing.
 - D. Preparation for installing utilities.
- 1.2 SUBMITTALS
 - A. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, and schedule of finishes.
- 1.3 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store and handle products to site.
 - B. Protect units from moisture damage.
- 1.5 FIELD MEASUREMENTS
 - A. Verify that field measurements are as on shop drawings.
- 1.6 COORDINATION
 - A. Coordinate the work with plumbing and electrical rough-in.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Salina Planning Mill.
 - B. Crestwood Inc.
 - C. Kitchens, Inc.
 - D. Technique Manufacturing
 - E. Substitutions: Under provisions of the General Requirements.
 - 2.2 WOOD MATERIALS
 - A. Softwood Lumber: FS MM-L-736; graded in accordance with AWI Premium Grade; average moisture content of 6 percent; species and grade as follows: **Select White Birch, to match.** Edging & trim where indicated and detailed.
 - 2.3 SHEET MATERIALS
 - A. Hardwood Plywood: S 51; graded in accordance with AWI, core materials of veneer, and lumber, type of glue recommended for application; face veneer and cuts as follows:

ITEM	FACE SPECIES
Drawer 'Box' Construction	Melamine (unless noted otherwise) - Per AWI Premium Grade.
Door Construction	Plastic Laminate (u.n.o.) - Per AWI Premium Grade.
Cabinet 'Body' Construction	Plastic Laminate at exposed (u.n.o.). Melamine at unexposed (u.n.o.) - Per AWI Premium Grade.
Backs	Plastic Laminate at exposed (u.n.o.). Melamine at unexposed (u.n.o.) - Per AWI Premium Grade.
Shelving	Melamine (u.n.o.) - Per AWI Premium Grade.
- (Note: Full line of colors for all melamine selected by architect.)**

- B. High Performance particleboard Core:
 - 1. Particleboard to be ¾" thick of 45 lb. Density, and balanced construction with moisture Content not to exceed 8%. All particleboards shall meet or exceed the requirements for its type and classification under Commercial Standard CS-236-66, Federal Specifications LLL-B-800A, and ASTM D 1037-78.
 - 2. Particleboard shall meet the following performance requirements. Submit compliance data from the manufacturer prior to fabrication:

Screw Holding, Face	471 lbs.
Modulus of Rupture	2,400 psi.
Modulus of Elasticity	450,000 psi.
Internal Bond	90 psi.
Surface Hardness	900 lbs.
 - C. Hardboard: Hardboard shall meet or exceed Commercial Standards CS-251 and Federal Specifications LLL-B-00810. Tempered hardboard ¼" thick, smooth both sides.
- 2.4 MANUFACTURERS - PLASTIC LAMINATE
- A. Wilsonart, Formica, Pionite or Nevamar. (Full Line of all manufacturers including premium grade)
- 2.5 SOLID SURFACE MATERIALS
- A. LG Solid Surface
 - 1. ¾" or 1" standard thickness with 1-1/2" thick eased edges.
 - 2. Color to be selected from full line of manufacturer's colors, price category (D) and below.
 - B. Equivalent product by Corian – color to be selected including all colors to price category 5.
- 2.6 LAMINATE MATERIALS
- A. Plastic Laminate: AWI, 0.040 inch Post Forming 0.050 inch General Purpose quality; color, pattern, and surface texture as selected.
 - B. Laminate Backing Sheet: 0.020 inch Backing Sheet grade, undecorated plastic laminate.
- 2.7 ACCESSORIES
- A. Adhesive: FS MMM-A-130 contact adhesive, type recommended by AWI and laminate manufacturer to suit application.
 - B. Fasteners: Size and type to suit application.
 - C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; approved finish in exposed locations.
 - D. Concealed Joint Fasteners: Threaded steel.
 - E. PVC Edge Band: 3mm Color and Pattern matched to plastic laminated face. Typical at all doors, drawers, and open cabinet edges.
- 2.8 HARDWARE
- A. Hinges: Grass #3803 120° – nickel finish.
 - B. Pulls: Hafele, Amerock Allison, satin nickel, item no. 133.50.160
 - C. Drawer Slides: Hafele, Accuride #3832SC.
 - D. Adjustable shelf clips: Knap & Vogt, 3256 zinc finish.
 - E. Cushion Bumpers: Hafele #356.21.428 – clear. Two on each door & drawer.
 - F. "Recessed" Adjustable shelf standards: Knap & Vogt, #255, zinc finish.
 - G. Grommets: Hafele, Series #429, full range colors. Quantity (22). Locate per shop drawings review.
 - H. Catches: Amerock, #9783 magnetic.
 - I. Floating Shelf Brackets: Hafele T-LOC Innovashelf, or equivalent concealed shelf support for floating shelves.
- 2.9 FINISHING MATERIALS
- A. Stain, Varnish and Finishing Materials: As specified in Section 09900.
- 2.10 FABRICATION
- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
 - B. Fit shelves, doors, and exposed edges with .3mm pvc. Pattern and color match to laminate cabinets. Use one piece for full length only.

- C. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- D. Door and Drawer Fronts: 3/4 inch thick; overlay style.
- E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and sitecutting.
- F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arrises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- G. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- H. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges.

2.11 FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler, which matches surrounding surfaces and of types recommended for applied finishes.
- D. Seal, stain and varnish exposed to view surfaces.
- E. Seal, stain and varnish internal exposed to view and semi-concealed surfaces.
Seal surfaces in contact with cementitious materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

- A. Set and secure casework in place; rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.3 ADJUSTING

- A. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings and fixtures.

3.5 SCHEDULE

- A. Adjustable shelving longer than 34" to be 1" thick.

END OF SECTION 06410

SECTION 07213

BATT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Batt insulation at exterior wall and roof locations.
- B. Batt insulation for filling perimeter window and door shim spaces, crevices in exterior wall and roof.
- C. Sound batt insulation at interior walls.
- D. Vapor retarder.

1.2 REFERENCES

- A. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.3 SYSTEM DESCRIPTION

- A. Materials of This Section: Provide continuity of thermal barrier at building enclosure in conjunction with thermal insulating materials in Section 07212. Overlap insulations to ensure complete thermal envelope at all exterior surfaces.

1.4 COORDINATION

- A. Coordinate the work with all related Sections for installation of vapor retarder and other forms of insulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

- A. OWENS-CORNING FIBERGLASS Product - thermal batt insulation. Class A rated.
- B. Substitutions: Under provisions of the General Requirements.

2.2 MATERIALS

- A. Batt Insulation: ASTM C665; preformed glass fiber batts; loose laid and taped, conforming to the following:
 - 1. Thermal Resistance: R-19 at walls.
 - 2. Batt Size: 6" and 8" per exterior wall thickness.
 - 3. Facing: FSK
- B. Sound Batt Insulation:
 - 1. Batt size: 3" and 6".
 - 2. Facing: Unfaced.
- C. Tape: Self-adhering type as recommended by the manufacturer, mesh reinforced, 2 inches wide.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify that substrate, adjacent materials, and insulation are dry and ready to be installed.

3.2 INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- C. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
- D. Install with applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane, caulk, or tape.
- E. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

END OF SECTION 07213

SECTION 072419
OUTSULATION® PLUS MD SYSTEM
EXTERIOR INSULATION AND FINISH SYSTEM WITH MOISTURE DRAINAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. This document is to be used in preparing specifications for an Exterior Insulation and Finish System (EIFS) with Moisture Drainage including:
 - a. An integral fluid applied air and water-resistive membrane barrier compatible with the substrate surface and adhesive application of the EIF system.
 - b. Accessory materials required for treating sheathing joints, fasteners, penetrations, rough openings, and material transitions compatible with substrate surfaces and the adhesive application of the EIFS.
 - c. Joint sealants compatible with specified EIFS for use in all exterior envelope joint waterproofing.
 - d. **Existing EIFS installation is to remain. Work associated with this project is minor, however, all existing warranties shall remain in place. Contractor shall coordinate with installer and Manufacturer to confirm all work is compliant with existing warranty requirements.**

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Construction Meetings

The warranty shall require a pre-construction meeting including representatives of the Manufacturer, the Applicator, the Owner, and the Consultant (if applicable) prior to installation of the Products. Work in this section requires coordination with related sections and trades.) The EIFS installer shall coordinate with the General Contractor to schedule, invite and administer a pre-construction meeting including but not limited to the architect of record, consultant(s), EIFS, sheathing board, accessory materials and sealant manufacturer's representatives and the owner to assure required integration of products selected as specified herein and for proper sequencing and installation detailing.

B. Coordinate for related specification and integration of Selected Materials as referenced in Section 2.02.B.1, 2.02.B.2 and 2.02.C herein below.

C. Sequencing

1. Provide jobsite grading prior to installation of Exterior Insulation and Finish System with Moisture Drainage so that the system may be terminated at 8 in above grade or as required by code.
2. Coordinate installation of sheathing board and accessory materials, flashing, foundation waterproofing, roofing membrane, windows, doors, and other penetrations of the exterior walls to provide a continuous air and water-resistive membrane barrier.
3. Provide protection of rough openings before installing windows, doors, and other penetrations of the exterior walls.
4. Coordinate installation of windows and doors so air and water-resistive membrane barrier accessory materials, transitions, flashings, etc. are connected to them to provide a continuous barrier.
5. Install window and door head flashings immediately after windows and doors are installed.
6. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.
7. Install copings and sealants immediately after installation of the Exterior Insulation and Finish System with Moisture Drainage and when EIFS coatings are dry.
8. Attach penetrations through Exterior Insulation and Finish System to structural support and provide water-tight seals at penetrations.

1.03 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

- A. Submit product data as required by Section 01 33 00, Administrative Requirements.
- B. Submit shop drawings for panelized EIFS with Moisture Drainage showing wall layout, connections, details, expansion joints, and installation sequence.

- C. Submit two (2) samples of the Exterior Insulation and Finish System with Moisture Drainage for each finish, texture, and color to be used on the project. Use the same tools and techniques proposed for the actual installation. Make the samples of sufficient size to accurately represent each color and texture being utilized on the project.
- D. Submit a current copy of the manufacturer's Trained Contractor Certificate for the EIF system specified. Submit Owner/Architect-requested test results verifying the performance of the Exterior Insulation and Finish System with Moisture Drainage.
- E. Submit a copy of the manufacturer's installation details and application instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Submit a copy of the manufacturer's recommended maintenance and repair manual.
- B. Submit a copy of the Exterior Insulation and Finish System with Moisture Drainage manufacturer's comprehensive single source limited warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. A member in good standing of the EIFS Industry Members Association (EIMA).
 - 2. Manufacture Exterior Insulation and Finish System with Moisture Drainage materials at a facility covered by a current ISO 9001:2015 and ISO 14001:2015 certification. Certification of the facility is done by a registrar accredited by the American National Standards Institute, Registrar Accreditation Board (ANSI- RAB).
- B. Contractor Qualifications:
 - 1. Knowledgeable in the proper installation of the Exterior Insulation and Finish System with Moisture Drainage.
 - 2. Possess a current copy of the manufacturer's Trained Contractor Certificate for the EIF system specified.
 - 3. Successfully complete a minimum of three (3) projects of similar scope and scale to the specified project.
- C. Insulation Board Manufacturer Qualifications:
 - 1. Listed by EIFS Manufacturer, and capable of producing the Expanded Polystyrene (EPS) in accordance with the current EIFS Manufacturer's Specification for Insulation Board.
 - 2. Subscribe to the Dryvit Third Party Certification and Quality Assurance Program.
- D. Panel Fabricator Qualifications:
 - 1. Experienced and competent in the fabrication of architectural wall panels.
 - 2. Possess a current Outsulation Plus MD System Trained Contractor Certificate* issued by Dryvit Systems, Inc.
- E. Panel Erector Qualifications:
 - 1. Experienced and competent in the installation of architectural wall panel EIF systems.
 - 2. Shall be:
 - a. The panel fabricator or
 - b. An erector approved by the panel fabricator or
 - c. An erector under the direct supervision of the panel fabricator.
- F. Mock-Up:
 - 1. Provide the owner/architect with a mock-up for approval.
 - a. Of suitable size as required to accurately represent the products being installed, as well as each color and texture to be utilized on the project.
 - b. Prepared with the same products, tools, equipment and techniques required for the actual applications. Use finish from the same batch that is being used on the project.
 - c. Available and maintained at the jobsite.
 - 2. Regulatory Requirements: Separate the EPS insulation board from the interior of the building by a minimum 15-minute thermal barrier.
 - 3. Comply with local building codes for the use and maximum thickness of EPS insulation board.
- G. Inspections:
 - 1. Cooperate with independent, third-party inspectors when required by code or by contract documents.

1.06 DELIVERY, STORAGE AND HANDLING

1. Deliver all Exterior Insulation and Finish System with Moisture Drainage components and materials to the job site in the original, unopened packages with labels intact.
2. Inspect all Exterior Insulation and Finish System with Moisture Drainage components and materials upon arrival for physical damage, freezing or overheating. Do not use questionable materials.
3. Store all Exterior Insulation and Finish System with Moisture Drainage components and materials at the jobsite in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Maintain minimum and maximum storage temperature as stated in the product data sheets or specifications for the materials selected. NOTE: Minimize exposure of materials to temperatures over 90 °F (32 °C). Finishes exposed to temperatures over the published maximum storage temperature for even short periods may exhibit skinning and increased viscosity and should be inspected prior to use.
4. Protect all products from inclement weather and direct sunlight.

1.07 SITE CONDITIONS

A. Ambient Conditions

1. Do not apply wet materials during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
2. Verify the minimum air and wall surface temperatures at the time of application as stated in the product data sheets or specifications for the materials selected.
3. Maintain these temperatures with adequate air ventilation and circulation for a minimum of 24 hours (48 hours for specific Specialty Finishes) thereafter, or until the products are completely dry. (Note to Specifier: The use of dark colors must be considered in relation to wall surface temperature as a function of local climatic conditions. Use of dark colors in high temperature climates can affect the performance of the EIF system.)

1.08 WARRANTY

A. Manufacturers' Limited EIF System Warranty

1. Existing 20 year warranty shall remain in effect. Contractor shall provide all manufacturer inspection and documentation stating warranty completion.

B. Installer Warranty

1. EIF system Installer shall provide a separate minimum 1-year warranty for all workmanship related to the proper installation and drainage performance of the EIFS application. Manufacturer shall not be responsible for workmanship associated with the installation of Exterior Insulation and Finish System with Moisture Drainage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers List:

1. Dryvit Systems, Inc., One Energy Way, West Warwick, RI 02893, 800-556-7752, www.dryvit.com.
2. Tremco, Inc., 3735 Green Road Beachwood, OH 44122 [800.321.7906](tel:800.321.7906), www.tremco.com.

B. Substitution Limitations:

1. All components of the Outsulation® Plus MD System® including EPS Insulation Board shall be supplied or obtained from Dryvit Systems, Inc., Tremco, Inc. or their authorized distributors. Substitutions or additions of materials manufactured or supplied by others will void the EIF system warranty.

2.02 DESCRIPTION

- A. System Description: The Dryvit Outsulation Plus MD System is an Exterior Insulation and Finish System (EIFS) with Moisture Drainage, consisting of:
 - a. An Air and Water-Resistive Membrane Barrier

- b. Accessory Materials
- c. Adhesive – installed in vertical ribbons to facilitate egress of incidental moisture
- d. Expanded Polystyrene (EPS) insulation board
- e. Base Coat
- f. Reinforcing Mesh
- g. Finish Coat
- h. Joint Sealants as specified herein below

B. Materials:

1. Fluid-Applied Air and Water-Resistive Barrier:

a. Permeable:

- 1) Dryvit Backstop® NTX: A standard film vapor permeable, low-temperature, flexible, polymer-based non-cementitious water-resistive and air barrier coating available in Texture and Smooth versions. Backstop NTX can be installed in ambient air and substrate surface temperatures of 25 °F (3.88 °C) and rising for a minimum 24 hours and exposed for up to 6 months during the construction process.
- 2) Alternate #1, 20 yr, Tremco ExoAir® 230: A thick film synthetic, permeable, elastomeric air/water-resistive membrane barrier designed to be roller or spray applied. ExoAir 230 can be installed in ambient air and substrate surface temperatures of 40 °F (5 °C) and rising, shall be protected from rain and washout prior to drying and can be exposed for up to 12 months during the construction process. ExoAir is specialty formulated for design options requiring assemblies that have been evaluated for NFPA 285.

(Note to Specifier: Coordinate item above for 20-year EIF system warranty as referenced in Section 1.09.A.2. Delete section 2.02.B.1.a.1 above and section 2.02.B.1.b below. Retain only section 2.02.B.a.2) above.)

b. Non-Permeable – Vapor Retarder / Barrier:

- 1) Dryvit Backstop® NT-VB (Vapor Barrier): A standard film non-permeable, Class I, low-temperature, flexible, polymer-based non-cementitious water-resistive and air barrier coating available in Texture and Smooth versions. Backstop NT-VB can be installed in ambient air and substrate surface temperatures of 40 °F (5 °C) and rising for a minimum 24 hours and exposed for up to 6 months during the construction process. Backstop NT-VB Texture is additionally used for treatment of sheathing board joints, inside / outside corners and spotting of fastener heads.

2. Accessory Materials for Fluid Applied Air and Water-Resistive Barrier (AWRB):

- a. Provide compatible accessory materials as required by project conditions for substrate, rough opening and penetration preparation, bridge expansion joints in substrate, material transitions and flashing integration to produce a complete air and water-resistant assembly.
 - 1) Dryvit Grid Tape™: An open weave fiberglass mesh tape with pressure sensitive adhesive. Used in combination with Backstop NTX Texture for treating sheathing board joints and inside / outside corners and preparing rough openings and penetrations. Backstop NTX Texture is used alone for spotting fastener heads.
 - 2) Dryvit AquaFlash®: Fluid-applied, water-based polymer transition membrane. Used in preparing rough openings and penetrations, bridging expansion joints in substrate, material transitions and flashing integration. AquaFlash can be installed in ambient air and substrate surface temperatures of 40 °F (5 °C) and rising for 24 hours.
 - i. Dryvit AquaFlash Mesh and Corners: Polyester reinforcing mesh for use with AquaFlash.
 - 3) Dryvit Backstop Flash and Fill: A flexible, waterproof, low temperature gun applied material. Used in substrate preparation, treating sheathing board joints, inside/outside corners and fastener heads, preparing rough openings and penetrations, bridging expansion joints in substrate material transitions and flashing integration. Backstop Flash and Fill can be installed in ambient air and substrate surface temperatures of 32 °F (0 °C) and rising for 24 hours. Note: Dryvit Backstop Flash and Fill may only be used with Dryvit Backstop NTX air/water-resistive barrier.
 - 4) 20 yr, Tremco Dymonic 100: A high-performance, high-movement, single-component,

medium- modulus, low-VOC, UV-stable, non-sag, gun applied polyurethane sealant. Used in substrate preparation, treating sheathing board joints and inside/outside corners and fastener heads, preparing rough openings and penetrations, bridging expansion joints in substrate, material transitions and flashing integration. Dymonic 100 can be installed in ambient air and substrate surface temperatures of 40 °F (5 °C) and rising. Where Dymonic 100 must be applied in temperatures below 40 °F, (5 °C), please refer to the Tremco Technical Bulletin for Applying Sealants in Cold Conditions (No. S-08-44 rev 1) that can be found at www.tremcosealants.com.

3. Drainage Components:

- a. Drainage Track UV treated PVC “J” channel perforated with weep holes, complying with ASTM D 1784 and ASTM C 1063. The use of Dryvit Drainage Track is limited to the base of the EIF system at finished grade level. Use Dryvit Drainage Strip at all other horizontal terminations.
- b. Acceptable manufacturers of Drainage Track:
 - 1) Starter Trac STWP – without drip edge by Plastic Components, Inc.
 - 2) Starter Trac STDE – with drip edge by Plastic Components, Inc.
 - 3) Universal Starter Track by Wind-lock Corporation
 - 4) Sloped Starter Strip with Drip by Vinyl Corp.
- c. Dryvit Drainage Strip™ corrugated plastic strip.
- d. TREMPRO CHEM X PRO™ adhesive used to attach Drainage Track and Dryvit Drainage Strip to the sheathing.

4. Adhesives:

- a. Liquid polymer-based adhesive field mixed with Portland cement.
 - 1) Dryvit Primus®
 - 2) Dryvit Genesis®
- b. Ready mixed dry blend cementitious, copolymer-based adhesive field mixed with water.
 - 1) Dryvit Primus® DM
 - 2) Dryvit Genesis® DM
 - 3) Dryvit Genesis® DMS
 - 4) Rapidry DM™ 35-50
 - 5) Rapidry DM™ 50-75

5. Insulation Board:

- a. Expanded Polystyrene; minimum thickness 25 mm (1 in); meeting Dryvit Specification [DS131](#) and ASTM E 2430.

6. Pre-Coated Insulation Starter Boards, Corners and Shapes:

Pre-Base Coated Insulation Starter Boards, Corners and Shapes provide for properly back wrapped and encapsulated EIF system termination edges typically scheduled to receive primers and sealants and are recommended. Non-Machine coated starter boards and shapes must be produced with Dryvit materials to be covered under the EIF system warranty.

- a. Machine Coated Starter Boards, Corners and Shapes: Shall be produced by Tremco CPG. The term of the warranty may be extended for an additional 2 years with the use of Tremco-produced Machine Coated Starter Boards.

7. Base Coat:

- a. Liquid polymer-based base coat field mixed with Portland cement.
 - 1) Dryvit Primus
 - 2) Dryvit Genesis
 - 3) Dryvit Dryflex
- b. Ready mixed dry blend cementitious, copolymer-based base coat field mixed with water.
 - 1) Dryvit Primus DM
 - 2) Dryvit Genesis DM
 - 3) Dryvit Genesis DMS
 - 4) Rapidry DM 35-50
 - 5) Rapidry DM 50-75
 - 6) Dryvit NCB – Non-cementitious
- c. Liquid polymer-based base coat field mixed with Portland cement when specified.
 - 1) ShieldIt™

8. Reinforcing Mesh:

- a. Open-weave, glass fiber fabric treated for compatibility with other EIF system materials.
- b. Provide for ultra high impact mesh assembly including [Panzer 15 mesh] [Panzer 20 mesh] for all EIFS clad wall areas within 8'-0" of grade and where additionally indicated on contract drawings.

Reinforcing Mesh ¹ /Weight oz/yd ² (g/m ²)	Minimum Tensile Strengths	EIMA Impact Classification	EIMA Impact Range in-lbs (Joules)		Impact Test Results in-lbs (Joules)	
Standard - 4.3 (146)	150 lbs/in (27 g/cm)	Standard	25-49	(3-6)	36	(4)
Standard Plus - 6 (203)	200 lbs/in (36 g/cm)	Medium	50-89	(6-10)	56	(6)
Intermediate TM - 12 (407)	300 lbs/in (54 g/cm)	High	90-150	(10-17)	108	(12)
Panzer [□] 15 ¹ - 15 (509)	400 lbs/in (71 g/cm)	Ultra High	>150	(>17)	162	(18)
Panzer 20 ¹ - 20.5 (695)	550 lbs/in (98 g/cm)	Ultra High	>150	(>17)	352	(40)
Detail Mesh [□] Short Rolls - 4.3 (146)	150 lbs/in (27 g/cm)	n/a	n/a	n/a	n/a	n/a
Corner Mesh TM - 7.2 (244)	274 lbs/in (49 g/cm)	n/a	n/a	n/a	n/a	n/a
* It shall be colored blue and bear the Dryvit logo for product identification						
1. Shall be used in conjunction with Standard Mesh (recommended for areas exposed to high traffic)						

9. Finish:

- a. Hydrophobic (HDPTM) Finishes: 100% acrylic coating with integral color and texture and formulated with hydrophobic properties:
 - 1) Available textures:
 - a) LimestoneTM HDP, custom color as selected by Architect – Owner.

C. Joint Sealants:

Base Bid 12 Year, and Alternate #1 20 year Warranty Where the additional 2-year EIF System warranty extension for use of Tremco(Company) Joinery and Sealants is desired, retain below section 2.03.C.1. and delete section 2.03.C.2)

1. Silicone Sealant:

- a. Tremco Spectrem 1: An ultra low modulus, high-performance, one-part, moisture-curing silicone jointsealant with physical properties making it an ideal sealant for sealing dynamic joints.
- b. Tremco Spectrem 3: A general-purpose, low-modulus, high performance, one-part, neutral-cure, non-staining, low dirt pickup, construction-grade silicone sealant.
- c. Tremco Spectrem 4-TS: A multi-component, neutral-curing, non-staining, low dirt pick up, low-modulus silicone sealant specially formulated for use in dynamically moving building joints. Spectrem 4-TS offers color flexibility with the opportunity to tint the material on site.
 - a. Coordination for custom sealant colors is required.
- d. Where deemed necessary, use TREMprime Silicone Porous Primer.
- e. See related specification section or consult with Tremco, Inc. for more information.

2. Polyurethane Sealant:

- a. Tremco Dymonic FC: A one component hybrid polyurethane sealant. Where deemed necessary, use TREMprime Silicone Porous Primer for porous surfaces and TREMprime Silicone Metal Primer for metals or plastics. Coordinate for primer use as indicated.

D. Jobsite-Mixed Materials:

1. Portland cement: verify is Type I, II or 1L, meeting ASTM C 150, white or gray in color, fresh and free of lumps.

E. Water: verify is clean and free of foreign matter. Reference Documentation for Outsulation Plus MD System:

1. Data Sheet – DS929
2. Details – DS944
3. Application Instructions – DS934

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Verify access to electric power, clean water and a clean work area at the location where the Dryvit

- materials are to be applied.
2. Verify the deflection of the substrate does not exceed 1/240 times the span. Verify substrate is flat within 1/4 in (6.4 mm) in a 4 ft (1.2 m) radius.
 3. Verify substrate is sound, dry, connections are tight; has no surface voids, projections, or other conditions that may interfere with the Exterior Insulation and Finish System with moisture drainage installation or performance.
 4. Verify the slope of inclined surfaces are not less than 6:12 (27 °) where the length of the slope does not exceed 12 in (305 mm) or 3:12 (14 °) where the length of the slope does not exceed 4 in (102 mm).
 5. Verify metal roof flashings have been installed in accordance with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards.
 6. Verify all rough openings are flashed in accordance with the Exterior Insulation and Finish System with Moisture Drainage manufacturer's installation details, or as otherwise necessary to prevent water penetration. Verify chimneys, balconies and decks have been properly flashed as necessary to prevent water penetration.
 7. Verify windows and doors are installed and flashed per manufacturer's requirements and installation details.
 8. Notify general contractor of all discrepancies prior to the installation of the Exterior Insulation and Finish System with moisture drainage.
(Note to Specifier: Design and location of expansion joints in the Exterior Insulation and Finish System with Moisture Drainage is the responsibility of the project designer and as designated on contract drawings.)
 9. Verify that expansion joints are installed:
 - a. Where expansion joints occur in the substrate system.
 - b. Where building expansion joints occur.
 - c. At floor lines in wood frame construction.
 - d. At floor lines of non-wood framed buildings where significant movement is expected.
 - e. Where the Exterior Insulation and Finish System with moisture drainage abuts dissimilar materials.
 - f. Where the substrate type changes.
 - g. Where prefabricated panels abut one another.
 - h. In continuous elevations at intervals not exceeding 75 ft (23 m).
 - i. Where significant structural movement occurs, such as changes in roof line, building shape or structural system.
 10. Vapor Retarders: The use and location of vapor retarders within a wall assembly is the responsibility of the project designer and shall comply with local building code requirements. The type and location shall be noted on the project drawings and specifications. Vapor retarders may be inappropriate in certain climates and can result in condensation within the wall assembly.

3.02 PREPARATION

- A. Protect the Exterior Insulation and Finish System with Moisture Drainage materials by permanent or temporary means from inclement weather and other sources of damage prior to, during, and following application until completely dry.
- B. Protect adjoining work and property during installation of the Exterior Insulation and Finish System with Moisture Drainage.
- C. Prepare the substrate to be free of foreign materials, such as oil, dust, dirt, form-release agents, efflorescence, paint, wax, water repellants, moisture, frost, and any other condition that may inhibit adhesion.

3.03 INSTALLATION

- A. Install the EIF system in accordance with ASTM C1397 and the Dryvit Outsulation Plus MD System Application Instructions, DS934. Apply base coat sufficient to fully embed the reinforcing mesh. The recommended method is to apply the base coat in two (2) passes.
- B. Apply sealant to base coat surface prepared in accordance with [DS153](#).
- C. Install high impact reinforcing mesh as specified at ground level, high traffic areas and other areas exposed to or susceptible to impact damage as designated on contract drawings.
- D. Install Machine Coated Dryvit EPS Shapes in accordance with Dryvit Publication [DS854](#).

3.04 SITE QUALITY CONTROL

- A. Exterior Insulation and Finish System with Moisture Drainage manufacturer assumes no responsibility for on-site inspections or application of its products.
- B. EIFS sub-contractor to certify in writing the quality of work performed relative to the substrate system, details, installation procedures, and as to the specific products used.
- C. EPS supplier, if requested, to certify in writing that the EPS meets the Exterior Insulation and Finish System with Moisture Drainage manufacturer's specifications.
- D. The sealant contractor, if requested, to certify in writing that the sealant application is in accordance with the sealant manufacturer's and the Exterior Insulation and Finish System with Moisture Drainage manufacturer's recommendations.

3.05 CLEANING

- A. Remove all excess Exterior Insulation and Finish System materials from the job site by the contractor in accordance with contract provisions and as required by applicable law.
- B. Leave all surrounding areas, where the Exterior Insulation and Finish System with Moisture Drainage has been applied, free of debris and foreign substances resulting from the EIFS sub-contractor's work.

END OF SECTION 072419

SECTION 072726

FLUID-APPLIED, VAPOR-PERMEABLE MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. A 40 mil thickness fluid-applied vapor-permeable membrane of synthetic polymer, fire retardant composition for use as an air and water resistive barrier in exterior walls.
- B. Monolithic, fully-adhered membrane and accessory products installed as a continuous air and water resistive barrier assembly over substrates of the Project's opaque walls as indicated on Drawings
- C. Air and water resistive barrier assembly providing air and water tight coverage over these conditions
 1. Joints between building materials such as sheathing joints, mortar joints and dissimilar materials.
 2. Joints around windows, curtain walls, louvers, door frames and other service openings
 3. Junctions between walls and floors, between walls at building corners and between walls, roofs and ceilings.
 4. Mechanical and electrical penetrations
 5. Fastener and hardware penetrations used to attach insulation, cladding, trim or other overburden
 6. Termination at footing, roof deck and existing construction
 7. Junction to air & water barrier in roof, below grade or other adjacent systems
- D. Air and water resistive barrier assembly providing air and water tight coverage while accommodating designed movement at expansion and control joints.

1.02 REFERENCES

- A. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
- B. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- C. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials.
- D. ASTM E 2178 Standard Test Method for Air Permeance of Building Materials
- E. ASTM E 2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- F. International Code Council Evaluation Services (ICC-ES) Acceptance Criteria for Water Resistive Coatings used as Water Resistive Barriers over Exterior Sheathing AC-212, Approved February 2015
- G. National Fire Protection Association (NFPA) 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.03 PERFORMANCE REQUIREMENTS

- A. Installed product and accessories shall exhibit an air leakage rate, infiltration and exfiltration modes, measured after pressure cycling, not to exceed 0.2 L/s*m² at 75 Pa [0.040 CFM/ft² at 1.57 PSF] according to ASTM E 2357.
- B. Product shall meet the water vapor transmission requirement water resistive coatings used as water resistive barriers: minimum 35 g/m²/24h (5 perms), tested to ASTM E 96 water method (B), ICC-ES AC-212, Section 4.4
- C. For Type I, II, III and IV construction: Installed product and accessories shall be tested to NFPA 285 and pass in wall assemblies of the Project or shall pass by engineering judgement.
- D. Installed product and accessories shall be recommended by manufacturer for at least 180 days of outdoor exposure.
- E. Installed product and accessories shall have an upper service temperature limit of 180°F or higher.
- F. Manufacturer shall provide product and accessories which have a minimum installation temperature of 25°F or lower.
- G. Product shall be of fire-retardant, non-asphalt synthetic polymer composition.

- H. Product shall be minimum 0.040 inch (40 mils) dry thickness membrane. Dry membrane thickness shall be calculated based on field-measured wet mil thickness using a comb gauge and volume % solids of the product. [Example 66% solids membrane applied at minimum 60 wet mils yields a minimum 40 mil thickness membrane].

1.04 SUBMITTALS

- A. Shop drawings showing locations and extent of air barrier and details of all typical conditions.
- B. Manufacturer's technical data sheets and safety data sheets for product and accessories.
- C. Manufacturer's installation instructions.
- D. Certification of compatibility by manufacturer, listing all materials on the project with which the product and accessories may come into contact.
- E. Free film sample of product at representative cured thickness, minimum 2 inch by 3 inch size.
- F. Sample of sheet detail flashing and transition membrane, minimum 2 inch by 3 inch size.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Shall be experienced in applying the same or similar materials and shall be specifically approved in writing by Manufacturer.
- B. Single-Source Responsibility: Obtain product and accessories from single manufacturer.
- C. Product and Accessories shall comply with all state and local regulations controlling use of volatile organic compounds (VOCs).
- D. Field-Constructed Mock-Ups: Prior to installation on Project, apply product and accessories on mock-up to verify details under shop drawing submittals, to demonstrate tie-ins with adjoining construction and other termination conditions and to become familiar with properties of materials in application:
 - 1. Apply in field-constructed mockups of assemblies as specified in [\[Section 01 43 39 – Mockups\]](#)

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, lot number and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by manufacturer.
- C. During cold weather, protect product in containers and spray equipment from freezing. Maintain product temperature within acceptable range for spray application, as required by air barrier manufacturer.
- D. Avoid spillage. Immediately notify Owner, [\[Architect\]](#) [\[Consultant\]](#) if spillage occurs and start clean up procedures. Clean spills and leave area as it was prior to spill.

1.07 PROJECT CONDITIONS

- A. Do not apply product or accessories during rain or accumulating snowfall.
- B. Apply product and accessories within approved ambient and substrate temperature range stated in manufacturer's literature.
- C. Do not apply product or accessories over incompatible materials.
- D. Observe safety and environmental measures indicated in manufacturer's SDS, and mandated by federal, state and local regulations.

1.08 WARRANTIES: Provide the manufacturer's minimum five year material warranty.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS :

- A. Carlisle Coatings & Waterproofing, Incorporated. 900 Hensley Lane, Wylie, TX 75098. Phone 1-800-527-7092. Website <http://www.carlisleccw.com>
 - 1. Fire Resist Barritech VP, for installation at 40 degrees F and above
 - 2. Fire Resist Barritech VP LT, for installation at 15 degrees F and above

- 2.02 ACCESSORIES: Provide from same manufacturer as air barrier membrane.
- A. Sheet Detail Flashing: Foil composite faced rubberized asphalt flashing, minimum 0.040 inch (40 mils) thickness.
 - 1. Fire-Resist 705 FR-A or Fire-Resist 705 FR-A LT low temperature application formula by Carlisle Coatings & Waterproofing, Incorporated
 - 2. Others as approved by air barrier membrane manufacturer
 - B. Contact Adhesive:
 - 1. Carlisle Coatings & Waterproofing, Incorporated: CCW-702 Solvent-Based, CCW-702 LV VOC Compliant Solvent-Based, CCW-702 WB Water-Based, CAV-GRIP™ Aerosol Spray or Travel-Tack portable aerosol spray cans
 - 2. Others as approved by air barrier membrane manufacturer
 - C. Liquid Detail Flashing. Silane-terminated polyether, minimum 90% solids. ASTM C 920 Type S, Grade NS, Class 25, Use NT. 0.040 inch (40 mil) thickness application
 - 1. Barribond
 - 2. Others as approved by air barrier membrane manufacture
 - D. Detail Sealant:
 - 1. Barribond by Carlisle Coatings & Waterproofing, Incorporated
 - 2. Others as approved by air barrier membrane manufacturer
 - E. Transition Membrane:
 - 1. CCW SURE-SEAL Pressure-Sensitive Elastoform by Carlisle Coatings & Waterproofing, Incorporated
 - 2. Others as approved by air barrier membrane manufacturer
 - F. Transition Membrane Primer:
 - 1. Carlisle Coatings & Waterproofing, Incorporated: SURE-SEAL HP-250 Primer, SURE-SEAL EP-95 Splicing Cement or SURE-SEAL Low VOC EPDM Primer
 - 2. Others as approved by air barrier membrane manufacturer
 - G. Reinforcing Fabric: Woven, synthetic polymer fabric
 - 1. DCH Reinforcing Fabric by Carlisle Coatings & Waterproofing, Incorporated
 - 2. Others as approved by air barrier membrane manufacturer
 - H. Glass Mat: Randomly-oriented glass strands held in binder soluble in wet air barrier membrane. Offered in rolls of various widths
 - 1. LiquiFiber
 - 2. Others as approved by air barrier membrane manufacturer
 - I. Fill Compound: 2-part, non-sag polyurethane sealant
 - 1. Carlisle Coatings & Waterproofing, Incorporated: CCW-703 V or CCW-201
 - 2. Others as approved by air barrier membrane manufacturer

2.03 RELATED MATERIALS BY OTHERS

- A. Silicone Sealant, select any:
 - 1. Dow 758, 790, 791, 795
 - 2. Pecora AVB Silicone, 890, 891, 895
 - 3. GE Silpruf, Silpruf LM
 - 4. Other product approved by air barrier membrane manufacturer
- B. Polyurethane Foam Sealant, select any:
 - 1. TVM Fireblock Foam
 - 2. Fomo Handifoam Fireblock
 - 3. Great Stuff PRO or Froth Pack by Dow Chemical Company
 - 4. Other product approved by air barrier membrane manufacturer
- C. Insulation Adhesive, select any
 - 1. Barribond
 - 2. LM 800 XL
 - 3. QB-300 Multi-Purpose Construction Adhesive by OSI
 - 4. PL-300 VOC Foamboard Adhesive by Loctite
 - 5. Other product approved by air barrier membrane and board foam insulation manufacturer

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions affecting installation of the air & vapor barrier and accessory products for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing Work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that wall assemblies are dried in, such that water intrusion will not occur from above, behind or around the air barrier installation.
- C. Concrete shall be cured for a minimum of seven days. It shall be smooth, with sharp protrusions such as form joints or fins removed and ground flush. Honeycomb and holes/cracks shall be filled with grout or mortar.
- D. Surfaces shall be sound, dry and free of oil, grease, dirt, excess mortar or other contaminants.
- E. Surfaces shall be supported and flush at joints without large voids or sharp protrusions.
- F. Mortar joints shall be struck flush and shall be free of voids. Mortar droppings shall be removed from brick ties and all other surfaces accepting air barrier.
- G. Sheathing boards shall be flush at joints, with gaps between boards according to building code and sheathing manufacturer's requirements. Sheathing boards shall also be securely fastened to the structure with proper fastener type, technique and spacing according to building code and sheathing manufacturer's requirements. Sheathing boards shall be repaired or replaced if inspection reveals moisture damage, mechanical damage or if sheathing boards have exceeded the exposure duration or exposure conditions as required by the sheathing manufacturer.
- H. Plywood, OSB, lumber or pressure-treated wood moisture content, measured with a wood moisture meter in the core of the substrate, shall be below 20%.
- I. Inform Architect in writing of
 - 1. Unsatisfactory substrates
 - 2. Cracks in concrete and masonry.
 - 3. Gaps or obstructions such as steel beams, angles, plates and projections which cannot be spanned or covered by Product or Accessories.
 - 4. Anticipated problems applying product and accessories over substrate.

3.02 SURFACE PREPARATION

- A. Fill cracks, gaps and joints with fill compound, detail sealant or other material approved by air barrier manufacturer.
- B. Fill rough gaps around pipe, conduit and similar penetrations with mortar, non-shrink grout, fill compound or polyurethane foam sealant shaved flush.
- C. Apply a $\frac{3}{4}$ inch cant of fill compound or detail sealant at the intersection of the base of the wall and the footing.

3.03 DETAILING

- A. Additional materials and installation are required at joints, transitions, openings, terminations, penetrations and similar surface irregularities. Perform detailing before or after product installation.
- B. Install product and accessories in details as directed in manufacturer's literature.
- C. Sheathing joints, use one of the following methods:
 - 1. 4 inch reinforcing fabric imbedded in product and centered over joint.
 - 2. 2" width liquid flashing centered over joint.
- D. Sheathing inside and outside corners. Flashing or reinforcement shall bear 3 inches minimum onto either side of angle change. Use any of the following methods:
 - 1. Sheet detail flashing
 - 2. Liquid detail flashing centered over angle change
 - 3. Reinforcing fabric centered over angle change and imbedded in product
 - 4. Glass mat centered over angle change and imbedded in product
- E. Window openings. Flashing or reinforcement shall bear onto wall 3 inches minimum and shall return into window opening according to Project drawings. Use any of the following materials:

1. Sheet detail flashing
 2. Liquid detail flashing
 3. Glass mat imbedded in product
- F. Pipe or duct penetrations. Flashing or reinforcement shall bear onto wall 3 inches minimum and shall bear onto pipe or duct 3 inches, or according to Project drawings. Select any:
1. Sheet detail flashing
 2. Liquid detail flashing
 3. Glass mat imbedded in product
- G. Expansion or deflection joints. Flashing shall bear 3 inches minimum onto either side of joint. Select any:
1. Sheet detail flashing bellows or expansion bulb
 2. Transition membrane expansion bulb
- H. Interface of dissimilar substrates: Flashing or reinforcement shall bear 3 inches minimum onto either side of joint. Select any:
1. Sheet detail flashing
 2. Liquid detail flashing
 3. Reinforcing fabric imbedded in product
 4. Glass mat imbedded in product
- I. Seal all terminations of sheet detail flashing with a 1 inch width X 0.040 inch (40 mils) thick ribbon of detail sealant, centered over termination.

3.04 INSTALLATION

- A. Apply product and accessories over opaque wall surfaces as indicated in Project drawings.
- B. Use the manufacturer's standard or low temperature formula product as required by the project conditions.
- C. Apply product by spray, roller, brush or other method as recommended by air barrier manufacturer. Apply product at specified wet mil thickness in accordance with air barrier manufacturer's requirements.
- D. Verify compliance with air barrier manufacturer's minimum required thickness by documenting product use per area. Perform and document wet mil thickness measurements every 100 square feet, or more frequently if required, to establish uniform and adequate coverage.
- E. Installation shall produce complete coverage of opaque substrates as indicated in Drawings.
- F. Product and accessories shall be fully-adhered to substrates. Defects such as holes, fishmouths, blistering, de-lamination, bridging or thin spots shall be repaired according to air barrier manufacturer's instructions.

3.05 SCHEDULE

- A. Wall substrates and roof or temporary roof shall be in place, effectively enclosing interior space, before proceeding with air barrier installation.
- B. Seal penetrations made through installed product according to manufacturer's instructions and drawings.
- C. Seal fenestration to product with detail membrane, transition membrane, detail sealant, silicone sealant or polyurethane foam sealant according to Project drawings
- D. Through-wall flashing may be installed before or after product. Seal termination of through-wall flashing to product according product manufacturer's instructions.
- E. Exterior cladding shall be installed after product.
- F. Rigid or semi-rigid insulation installed over product shall be attached with mechanical fastening, insulation adhesive or a combination of these techniques, according to insulation manufacturer and air barrier manufacturer's instructions.
- G. Sequence Work to enable air barrier continuity at wall-to-foundation, shelf angle, wall-to-roof, fenestration, different wall assemblies and other conditions as indicated in Project drawings.

3.06 REPAIR AND PROTECTION

- A. Protect from damage during application and remainder of construction period.
- B. Inspect and make necessary repairs before covering. Repair or replace damaged material according to manufacturer's literature.

- C. Product and accessories are not designed for permanent exposure. Cover with insulation or exterior cladding as soon as schedule allows.
- D. Outdoor exposure of installed product and accessories shall not exceed 180 days.

END OF SECTION 072726

SECTION 074113

METAL ROOF PANELS, Shingle Style

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate-coated metal roof panels.
- B. Basis-of-Design Product: Tilcor Roofing Systems, Inc. "CF Shake" aggregate-coated metal roof panels.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry: Wood framing and sheathing.
- B. Section 07 62 00 – Sheet Metal Flashing and Trim: Metal flashing.
- C. Section 07 72 00 – Roof Accessories: Roof ventilators.
- D. Section 07 92 00 – Joint Sealants: Field-applied sealants.

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME) (www.asme.org):
 - 1. ANSI/ASME B18.6.1 – Wood Screws (Inch Series).
 - 2. ANSI/ASME B18.6.4 – Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws, Inch Series.
- B. ASTM International (ASTM) (www.astm.org):
 - 1. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 792/A 792M – Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 3. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM D 226/D 226M – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - 5. ASTM D 1970/D 1970M – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 6. ASTM E 108 – Standard Test Methods for Fire Tests of Roof Coverings.
- C. ICC Evaluation Service (www.icc-es.org):
 - 1. ICC-ES Evaluation Report ESR-1754 – DECRA Villa Tile (Direct-to-Roof Deck Installation).
- D. International Organization for Standardization (ISO) (www.iso.org):
 - 1. ISO 9001:2015 – Quality management systems – Requirements.
 - 2. ISO 14001:2015 – Environmental management systems – Requirements with guidance for use.
- E. UL (www.ul.com):
 - 1. UL 790 – Standard for Standard Test Methods for Fire Tests of Roof Coverings.
 - 2. UL 2218 – Standard for Impact Resistance of Prepared Roof Covering Materials.

1.4 SUBMITTALS

- A. Submittals: Comply with Division 01.
- B. Product Data: Submit manufacturer's product data, including preparation and installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, fabrication, flashing, fasteners, finish, options, and accessories.
- D. Samples: Submit manufacturer's sample of roof panels.
 - 1. Sample Size: Minimum 6 inches by 6 inches.
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

- F. Product Evaluation Reports: Submit manufacturer's product evaluation reports from accredited evaluation service.
 - G. Manufacturer's Project References: Submit manufacturer's list of 10 successfully completed roof panel projects of similar size and scope to this Project, including project names and locations, name of architects, and type and quantity of roof panels furnished.
 - H. Installer's Project References: Submit installer's list of 5 successfully completed roof panel projects of similar size and scope to this Project, including project names and locations, name of architects, and type and quantity of roof panels installed.
 - I. Warranty Documentation: Submit manufacturer's standard warranty.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer's Qualifications:
 - 1. Manufacturer regularly engaged in the manufacturing of roof panels of similar type to that specified for a minimum of 10 years.
 - 2. Certified Company:
 - a. ISO 9001:2015.
 - b. ISO 14001:2015.
 - B. Installer's Qualifications:
 - 1. Installer regularly engaged in installation of roof panels of similar type to that specified for a minimum of 5 years.
 - 2. Use persons trained for installation of roof panels.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
 - B. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.
 - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - 3. Store materials in clean, dry area indoors.
 - 4. Do not store materials directly on floor or ground.
 - 5. Protect materials and finish during storage, handling, and installation to prevent damage.
- 1.7 WARRANTY
- A. Warranty Period:
 - 1. Multi-family Residential, Non-residential: 50-year limited.
 - a. Wind: Resist blow-off in wind speed up to 120 mph.
 - b. Hail: Resist hail stone penetration, cracks, and splits. No hail stone size limit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Basis of Design - Tilcor Roofing Systems, CF Shake style. Address 915 Great Southwest Parkway. Grand Prairie, TX 75051; 916 838-1940.
- B. Approved Equivalent Mfr. – No Substitutions
- C. Single Source: Provide all related roofing materials as approved or from manufacturer.

2.2 MATERIALS

- A. Basis-of-Design Product: Tilcor Roofing Systems, CF Shake style aggregate-coated metal roof panels.
- B. Roof Panels: Tilcor Roofing Systems, CF Shake style interlocking, concealed fastener panels, resembling dimensional shingles.

1. Material: Pre-corrugated, pressure-formed, aluminum-zinc alloy-coated steel, ASTM A 792/A 792M, with multiple vertical barrel tiles in a panel.
2. Thickness: 28 gauge, 0.0179 inch (0.455 mm).
3. Finish: Ceramic-coated, colored-stone chip finish.
4. Color: To Be Selected; [Classic Cobblestone] [Midnight Eclipse] [Natural Slate] [Old Hickory] [Woodland Green].
5. Dimensions:
 - a. Overall Panel Size: 17 inches (432 mm) wide by 44-1/4 inches (1,124 mm) long.
 - b. Installed Panel Exposure: 14-1/8 inches wide by 52-3/8 inches long.
 - c. Side Panel Laps: 2-3/4 inches (121 mm).
 - d. Panel Leading Edges Bent Down: 1/2 inch (25 mm); provides overlap for weather protection and nailing purposes.
6. Installed Weight: 140 pounds per 100 square feet.
7. Recycled Steel Content: Maximum 30 percent.
8. Non-Combustible, ASTM E 108, UL 790: [Class A] [Class B] [Class C].
9. Impact Resistance, UL 2218: Class 4.
10. ICC-ES Evaluation Reports:
 - a. Direct-to-Roof Deck Installation: ESR-1754.
11. Florida Building Code Approval:
 - a. Direct-to-Roof Deck Installation: FL9759-R7.

C. Flashing:

1. Valley: DECRA “Villa Tile Valley” aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed into valley with stone-coated valley cap.
 - b. Thickness: 26 gauge, 0.0179 inch (0.455 mm).
 - c. Finish: Match upper-exposed stone-coated surface of valley cap to shingle material.
2. Side Flashing: DECRA “Side Flashing” aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed to flash vertical roof surface transitions.
 - b. Thickness: 26 gauge, 0.0179 inch (0.455 mm).
 - c. Finish: Ceramic-coated, colored-stone chip finish to match roofing material.
3. Roof-to-Wall Flashing: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed to flash vertical roof surface transitions.
 - b. Thickness: 26 gauge, 0.0179 inch (0.455 mm).
 - c. Finish: Match color to exterior finish.
4. Pipe Jack Flashing:
 - a. Material: Galvanized or aluminum-zinc alloy-coated steel, ASTM A 792/A 792M.
 - b. Thickness: 26 gauge, 0.0179 inch (0.455 mm).
 - c. Finish: Clean, prime, and paint to match roof material.
5. Underpan: DECRA “Decra Shingle XD Underpan” aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed to counter flash roof penetrations matching roof panel material profile.
 - b. Thickness: 26 gauge, 0.0179 inch (0.455 mm).
6. Fascia Metal: DECRA “Decra Shingle XD Bird Stop Fascia Metal” aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.
 - a. Pressure formed angle installed at first course to cover under-tile panel voids.
 - b. Finish: Ceramic-coated, colored-stone chip finish to match roofing material.
7. Ridge Metal: DECRA “Decra Shingle XD Bird Stop Ridge Metal” aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M.

D. Hip and Ridge: Tilcor Roofing Systems, CF Shake style Hip and Ridge covers, fasciae, drips, rakes, and other trim required, matching shingle material, color, and finish.

1. Hips/Ridges and Rakes: Tilcor Roofing Systems, CF Shake matching components

2. Thickness: 26 gauge, 0.0179 inch (0.455 mm).
3. Finish: Color and finish to be applied along hips, ridges, and rakes.

2.3 ACCESSORIES

- A. Sheet Metal Materials: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M, [Class AZ50] [Class AZ150] coating designation; minimum [Grade 37] [Grade 255].
- B. Felt Underlayment: ASTM D 226/D 226M, Type II, No.30, non-perforated, asphalt-saturated organic felt.
- C. Perimeter Underlayment for Ice Dam Protection:
 1. Self-adhering, polymer-modified, bituminous sheet underlayment; 40 mils (1 mm) thick; ASTM D 1970/D 1970M.
 2. Provide primer when recommended by underlayment manufacturer.
- D. Sealant:
 1. One-part elastomeric polyurethane sealant, ASTM C 920.
 2. Exposed Sealant: Color to match roof panels.
- E. Fasteners:
 1. Screws:
 - a. Wood Screws: ANSI/ASME B18.6.1.
 - b. Sheet Metal Screws: ANSI/ASME B18.6.4.
 - c. Corrosion resistant.
 - d. Minimum No. 9.
 - e. Length: Sufficient length to penetrate substrate 1/2 inch (13 mm) minimum.
 - f. Color: Silver or color coordinated to match roof panels.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate to receive roof panels.
- B. Verify surfaces to support roof panels are clean, dry, square, sound, stable, rigid, and capable of supporting the weight.
- C. Notify Architect of conditions that would adversely affect installation or subsequent use.
- D. Do not begin preparation or installation until unacceptable conditions are corrected.

3.2 PREPARATION

- A. Prepare substrate in accordance with manufacturer's instructions.
- B. Clean substrate of projections and substances detrimental to roof panels.
- C. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with roofing nails.
- D. Inspect and verify roof framing spacing and installation is straight, true, and ready for installation of [battens and] roof panels.
- E. Coordinate installation of roof panels with flashing and other adjoining work to ensure proper sequencing.
- F. Do not install roof panels until vent stacks and other penetrations through roof have been installed and are securely fastened.
- G. Do not install roof panels until flashing is in place.

3.3 INSTALLATION

- A. Install roof panels in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install roof panels, weathertight.
- C. Valleys: Install in accordance with manufacturer's instructions with a minimum 6-inch (152-mm) overlap in direction of flow.
- D. Flashing: Install as indicated on the Drawings and in accordance with manufacturer's instructions.

- E. Roof Panels:
 - 1. Install roof panels, accessories, flashing, and hip and ridge level and plumb.
 - 2. Use fasteners as specified and in accordance with manufacturer's instructions.
 - 3. Install each panel using a random stagger pattern in accordance with manufacturer's instructions.
 - 4. Fasten each panel with minimum 8 screws minimum horizontally into back-shelf tabs of each panel.
 - F. Cut roof panels into each side of valleys in accordance with manufacturer's instructions straight and true to the line of the valley.
 - G. Hip and Ridge:
 - 1. Install hip and ridge along hips, ridges, and rakes as indicated on the Drawings and in accordance with manufacturer's instructions.
 - 2. Bend and fold exposed ends of hips and ridges and neatly cap with end cap or piece of similar material.
 - H. Do not install roof panels in a manner that detracts from appearance of roof.
 - 1. Do not rack panels.
 - 2. Do not line panels vertically up the roof.
 - 3. Do not use even panel offsets.
 - 4. Do not make a pattern with panels.
 - I. Do not use the following with roof panel system:
 - 1. Lead.
 - 2. Copper.
 - 3. Pressure-treated lumber containing copper compounds in the treatment solution.
- 3.4 ADJUSTING
- A. Repair minor damages to roof panels in accordance with manufacturer's instructions and as approved by Architect.
 - B. Remove and replace with new material, damaged components that cannot be successfully repaired, as determined by Architect.
- 3.5 CLEANING
- A. Clean roof panels of debris, including metal shavings, promptly after installation.
- 3.6 PROTECTION
- A. Protect Work of this Section to ensure that, except for normal weathering, Work will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 074113

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cap and sill flashings.
- B. Counter flashings at roof mounted equipment and vent stacks.
- C. Miscellaneous flashings and closure pieces.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details and requirements.

1.4 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal flashing work with three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of the General Requirements.
- B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials which may cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Pre-Coated Galvanized Steel: ASTM A446, Grade A, G90 zinc coating; 24 gage core steel, exposed flashings shall be shop prefinished with Signature 300, KYNAR 500 coating of color as selected.

2.2 ACCESSORIES

- A. Fasteners: Galvanized steel with soft neoprene washers.
- B. Underlayment: ASTM D2178, No. 15 asphalt saturated roofing felt.
- C. Slip Sheet: Rosin sized building paper.
- D. Primer: Zinc chromate type.
- E. Sealant: Polyurethane type, specified in Section 07900.
- F. Bedding Compound: Rubber-asphalt type.
- G. Plastic Cement: ASTM D4586, Type II.
- H. Reglets: Recessed type, galvanized steel; face and ends covered with plastic tape.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of metal, same material as sheet, interlockable with sheet.
- C. Form pieces in longest possible lengths. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam and/or solder for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing. Return and brake edges.

2.4 FINISH

- A. Exposed metal shall be pre-finished with Kynar finish color to be selected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

3.3 INSTALLATION

- A. Conform to drawing details included in the SMACNA manual unless otherwise indicated on the drawings.
- B. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.

END OF SECTION 07620

SECTION 07900

JOINT SEALERS

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Preparing substrate surfaces.
 - B. Sealant and joint backing.
- 1.2 QUALITY ASSURANCE
 - A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
 - B. Perform acoustical sealant application work in accordance with ASTM C919.
- 1.3 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
 - B. Applicator: Company specializing in performing the work of this section with minimum years documented experience.
- 1.4 WARRANTY
 - A. Provide five year warranty.
 - B. Warranty: Include coverage for installed sealants and accessories which fail to achieve air tight seal, water tight seal, and exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

- 2.1 SEALANTS
 - A. Acrylic Latex (Interior minor movement): ASTM C920, single component, non-staining, non-bleeding, non-sagging, white color paintable; manufactured by Pecora AC 20 + silicone.
 - B. Butyl Sealant (Interior minor movement): ASTM C920 single component, solvent release, non-skinning, non-sagging, white, paintable; manufactured by Pecora BC 158.
 - C. Silicone Sealant (Exterior, Interior major movement and Water Resistant Areas): Single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding; color as selected or to match adjacent materials; manufactured by Pecora 895 silicone.
 - D. Bituminous Based (Paving): Single component, asphalt compound, elongation capability of 0 to 2 percent of joint width.
- 2.2 ACCESSORIES
 - A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
 - B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
 - C. Joint Backing: ASTM D1056; round, closed or open cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.
 - D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that substrate surfaces and joint openings are ready to receive work.
 - B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter which might impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions.
- D. Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions.
- B. Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
- C. Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.4 SCHEDULE

- A. Interior; Caulk around all frames, windows, doors, openings, trim, etc., as required to seal or fill gaps, cracks, to make material transitions watertight and/or visually tight and finished.
- B. Exterior; Caulk around all frames, windows, doors, openings, trim, material transitions etc., as required to seal or fill gaps, cracks, to make material transitions watertight and/or visually tight finished.
- C. Paving; Caulk as required to seal or fill gaps, expansion joints, and cracks to make transitions watertight and/or visually tight.

END OF SECTION 07900

SECTION 08111

STANDARD STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-rated, fire rated and thermally insulated steel doors and frames.
- B. Interior and exterior glazed light frames.

1.2 REFERENCES

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
- B. ANSI/SDI-100 - Standard Steel Doors and Frames.
- C. Door Hardware Institute (DHI) - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.
- D. NFPA 80 - Fire Doors and Windows.
- E. NFPA 252 - Fire Tests for Door Assemblies.
- F. UL 10B - Fire Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Submit under provisions of the General Requirements.
- B. Shop Drawings: Indicate door and frame elevations, internal reinforcement, closure method, and cut-outs for glazing and finish.
- C. Product Data: Indicate door and frame configurations, anchor types and spacings, location of cut-outs for hardware reinforcement.
- D. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.4 REGULATORY REQUIREMENTS

- A. Fire Rated Door and Frame Construction: Conform to ASTM E152 and NFPA 252.
- B. Installed Door and Panel Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site.
- B. Accept doors and frames on site in manufacturer's packaging. Inspect for damage.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 DOOR MANUFACTURERS

- A. Ceco Door Products
- B. Steel Craft
- C. Curries Co.
- D. Substitutions: Under provisions of the General Requirements.

2.2 DOORS

- A. Exterior Insulated Doors Thermally Broken: SDI-100 Grade III.
- B. Interior Doors (Non-rated and Fire Rated): SDI-100 Grade III.

2.3 DOOR CONSTRUCTION

- A. Face: Steel sheet in accordance with ANSI/SDI-100. Exterior doors to be G60 galvanized.
- B. Core: Polystyrene foam.
- C. Thermal Insulated Door: Total insulation R value of 7.7, measured in accordance with ASTM C236.

2.4 FRAMES

- A. Exterior Frames: 16 gage thick material, base metal thickness. G60 galvanized.
- B. Interior Frames: 16 gage thick material, base metal thickness.

2.5 ACCESSORIES

- A. Removable Stops: Rolled steel channel shape, mitered corners; prepared for countersink style screws.
- B. Primer: Zinc chromate type.
- C. Silencers: Resilient rubber, fitted into drilled hole.

2.6 FABRICATION

- A. Astragals for Double Doors: Steel, T shaped, specifically for double doors.
- B. Fabricate doors with hardware reinforcement welded in place.
- C. Attach fire rated label to each door unit.
- D. Close top and bottom edge of exterior doors with flush end closure. Seal joints watertight.
- E. Configure exterior doors with special profile to receive recessed weather stripping.
- F. Fabricate frames as welded unit.
- G. Mullions for Double Doors: Removable type, of same profiles as jambs.
- H. Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- I. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.
- J. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.
- K. Prepare frame for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.
- L. Configure exterior frames with special profile to receive recessed weather stripping.
- M. Fabricate frames to suit masonry wall coursing with 4 or 2 inch head member.

2.7 FINISH

- A. Steel Sheet: Galvanized to ASTM A525.
- B. Primer: Baked.
- C. Coat inside of frame profile with bituminous coating to a thickness of 1/16 inch.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

- A. Install doors and frames in accordance with ANSI/SDI-100 and DHI.
- B. Coordinate installation of glass and glazing.
- C. Install door louvers, plumb, and level.
- D. Coordinate installation of doors and frames with installation of frames and hardware specified in Section 08710.
- E. Coordinate with masonry and wallboard wall construction for anchor placement.
- F. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.3 ERECTION TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING

- A. Adjust door for smooth and balanced door movement.

END OF SECTION 08111

SECTION 08211

FLUSH WOOD DOORS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated, **pre-finished.**
 - B. **Graham Wood Doors or Equal, Select White Birch, Color to be Selected**
- 1.2 SUBMITTALS
 - A. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, and special blocking for hardware, identify cutouts for glazing, and louvers.
 - B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics; factory machining criteria, and factory finishing criteria.
 - C. Manufacturer's Installation Instructions: Indicate special installation instructions.
- 1.3 QUALITY ASSURANCE
 - A. Perform work in accordance with AWI Quality Standard Section 1300, Custom Grade.
 - B. Finish doors in accordance with AWI Quality Standard, grades identified in schedule.
- 1.4 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- 1.5 REGULATORY REQUIREMENTS
 - A. Fire Door Construction: Conform to NFPA 252, UL 10B.
 - B. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as scheduled.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver, store, protect, and handle products to site.
 - B. Accept doors on site in manufacturer's packaging. Inspect for damage. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges if stored more than one week. Break seal on-site to permit ventilation.
- 1.7 FIELD MEASUREMENTS
 - A. Verify that field measurements are as indicated on shop drawings.
- 1.8 COORDINATION
 - A. Coordinate the work with door opening construction, door frame and door hardware installation.
- 1.9 WARRANTY
 - A. Provide warranty to the following term:
 - 1. Exterior Doors: 5 years.
 - 2. Interior Doors: Life of original installation.
 - B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, telegraphing core construction.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. **VT Industries, Select White Birch, Color to be selected**
 - B. Forte Opening Solutions, Graham.
 - C. Substitutions: Under provisions of the General Requirements.
- 2.2 DOOR TYPES
 - A. Flush Interior Doors: 1-3/4 inches thick; solid core construction, fire rated as indicated.

2.3 DOOR CONSTRUCTION

- A. Core (Solid, Non-Rated): AWI Section 1300, Type PC-Particleboard.
- B. Core (Solid, Fire Rated): AWI Section 1300, Type FP or FM rating as required or indicated.

2.4 FLUSH DOOR FACING

- A. Veneer Facing (Flush Interior Doors): AWI Custom quality **Select White Birch**, uniform grain.

2.5 ACCESSORIES

- A. Glazing Stops: Wood, of same species as door facing Wood with metal clips for rated doors, mitered corners; prepared for countersink style screws.

2.6 FABRICATION

- A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.
- B. Fabricate fire rated doors in accordance with AWI Quality Standards and to UL requirements. Attach fire rating label to door.
- C. Astragals for Fire Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.
- D. Provide lock blocks at lock edge and top of door for closer hardware reinforcement.
- E. Vertical Exposed Edge of Stiles: Of same species as veneer facing. Hardwood for transparent finish.
- F. Fit door edge trim to edge of stiles after applying veneer facing.
- G. Bond edge banding to cores.
- H. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Provide solid blocking for through bolted hardware.
- I. Factory pre-fit doors for frame opening dimensions identified on shop drawings.
- J. Cut and configure exterior door edge to receive recessed weather stripping devices. Provide edge clearances in accordance with AWI1600.

2.7 FINISH

- A. Manufacturer's prefinished doors in accordance with AWI Quality Standard Section 1500 to the following finish designations:
 - 1. Pre-finished Doors: Submit full line of actual samples for selection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable.
- B. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- A. Install fire rated and non-rated doors in accordance with AWI Quality Standard, NFPA 80 and to Warnock Hersey requirements.
- B. Trim non-rated door width by cutting equally on both jamb edges.
- C. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm). Trim fire door height at bottom edge only, in accordance with fire rating requirements.
- D. Pilot drill screw and bolt holes. Use threaded through bolts for half surface hinges.
- E. Machine cut for hardware. Core for handsets and cylinders.
- F. Coordinate installation of glass and glazing.

3.3 STALLATION TOLERANCES

- A. Maximum Diagonal Distortion (Warp): 1/8 inch measured with straight edge or taught string, corner to corner, over an imaginary 36 x 84 inch surface area.
- B. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taught string, top to bottom, over an imaginary 36 x 84 inch surface area.

- C. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taught string, edge to edge, over an imaginary 36 x 84 inch surface area.

3.4 ADJUSTING

- A. Adjust door for smooth and balanced door movement.

END OF SECTION 08211

SECTION 08410

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum doors and frames.
- B. Vision glass and framing.
- C. Door hardware.
- D. Integral air and vapor barrier.
- E. Perimeter sealant.

1.02 SYSTEM DESCRIPTION

- A. Aluminum entrances and storefront system includes tubular aluminum sections with supplementary internal support framing, shop fabricated, factory prefinished, vision glass, related flashings, anchorage, and attachment devices.

1.03 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with codes.
- B. Limit mullion deflection to flexure limit of glass; with full recovery of glazing materials.
- C. System to accommodate, without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.
- D. Limit air leakage through assembly to 0.06 cfm/min/sq. ft. of wall area, measured at a reference differential pressure across assembly of psf as measured in accordance with AAMA 501.
- E. Water Leakage: None, when measured in accordance with AAMA 501 with a test pressure difference of 2.86 lbs/sq. ft.
- F. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- G. System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental affect to system components.
- H. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site.
- B. Protect pre-finished aluminum surfaces. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not install sealants when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.08 WARRANTY

- A. Provide three year warranty.
- B. Warranty: Include coverage for complete system for failure to meet specified requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Storefront System
 - 1. Manko - Product series – 2450 I, Door series - 150 H Wide Style.
 - 2. Other acceptable manufacturers offering equivalent Products.
 - a. Kawneer.
 - b. TRACO
 - c. EFCO.
 - 3. Substitutions: Under provisions of the General Requirements.

2.02 MATERIALS

- A. Extruded Aluminum: ANSI/ASTM B221; 6063 alloy, T5 temper. Color: **Champagne.**
- B. Steel Sections: ANSI/ASTM A36; shaped to suit mullion sections.
- C. Fasteners: Galvanized steel.

2.03 COMPONENTS

- A. Frame: 4 1/2 x 2 inch nominal dimension; glazing stops; drainage holes; internal weep drainage system.
- B. Exterior Doors: 2 inches thick, 5-inch wide top rail, 5-inch wide vertical stiles, 10-inch wide bottom rail; square glazing stops.
- C. Vestibule Doors: Equal to Manko Series 150 H Wide Stile Door
- D. Flashings: Aluminum, finish to match mullion sections where exposed.

2.04 GLASS AND GLAZING MATERIALS

- A. Glass and Glazing Materials: As specified in Section 08800 of types described below:
 - 1. Glass at Exterior Lights: 1-inch insulated type (outer pane of 1/4 inch tinted Gray at exterior, inner pane of 1/4 inch clear). Tempered where required. **Low-E coating on third surface.**

2.05 SEALANT MATERIALS

- A. Sealant and Backing Materials: As specified in Section 07900.

2.06 HARDWARE

- A. Weather Stripping, Sill Sweep Strips, Thresholds, Hinges, Tubular Pull Handles, Panic Device, Closer: Type to suit application, and finish, all provided by storefront manufacturer / supplier.
- B. Door Hardware at exterior and vestibule doors shall include manufacturer's standard heavy duty Rim Panic Devices and Full length Roton Hinges. All finishes to match Door/Storefront color.
- C. Cost of Storefront hardware shall be included in the **BID PRICE** of the storefront system provider. These cost are NOT to be included in the Hardware Allowance.
- D. Cylinder locks by hardware supplier.

2.07 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to conceal from view.
- E. Prepare components with internal reinforcement for door hardware and door operator hinge hardware.
- F. Reinforce framing members for imposed loads.

2.08 FINISHES

- A. Finish coatings to conform to AAMA
- B. Exposed Aluminum Surfaces: **Champagne.**

PART 3 EXECUTION

- 3.01 EXAMINATION
 - A. Verify site opening conditions.
 - B. Verify dimensions, tolerances, and method of attachment with other work.
 - C. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.
- 3.02 INSTALLATION
 - A. Install wall system in accordance with manufacturer's instructions and AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
 - B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
 - C. Provide alignment attachments and shims to permanently fasten system to building structure.
 - D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
 - E. Provide thermal isolation where components penetrate or disrupt building insulation.
 - F. Install sill flashings.
 - G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
 - H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
 - I. Set thresholds in bed of mastic and secure.
 - J. Install hardware using templates provided.
 - K. Install glass in accordance with Section 08800, to glazing method required to achieve performance criteria.
 - L. Install perimeter sealant to method required to achieve performance criteria, backing materials, and installation criteria in accordance with Section 07900.
- 3.03 TOLERANCES
 - A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 feet, whichever is less.
 - B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- 3.04 ADJUSTING
 - A. Adjust operating hardware and sash for smooth operation.
- 3.05 CLEANING
 - A. Remove protective material from prefinished aluminum surfaces.
 - B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
 - C. Remove excess sealant by method acceptable to sealant manufacturer.
- 3.06 PROTECTION OF FINISHED WORK
 - A. Protect finished Work from damage.

END OF SECTION 08410

SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hardware for wood and hollow steel doors.
- B. Thresholds.
- C. Weather stripping, seals, and doorgaskets.

1.2 ALLOWANCES

- A. Cash Allowance: This contractor shall install and furnish all Finish Hardware not specified in other sections, such as millwork. This contractor shall allow the sum of **\$5,000.00** for the purchase and delivery of hardware only.
- B. Allowance includes purchase and delivery of hardware only. Installation is included in the Contractor's Bid price, not the allowance. Any differential in the allowance listed and the original invoices from suppliers will be adjusted in the contract price.

1.3 REFERENCES

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years' documented experience.
- B. Hardware Supplier: To be selected by Architect & Owner.**

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site.
- B. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.
- C. Deliver keys to Owner by security shipment direct from hardware supplier.

1.7 WARRANTY

- A. Provide five year warranty.

1.8 MAINTENANCE MATERIALS

- A. Provide special wrenches and tools applicable to each different or special hardware component.
- B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 PRODUCTS

2.1 KEYING

- A. Door Locks: Master keyed. Include construction keying, and key to existing keying system.
- B. Codes and final keying provided by owner.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions.
- B. Use templates provided by hardware item manufacturer.
- C. Mounting heights for hardware from finished floor to center line of hardware item:
 - 1. Locksets: 40"
 - 2. Push/Pulls: 45"
 - 3. Dead Locks: 48"
 - 4. Exit Devices: 42"
- D. Thresholds not to exceed ½" in height.

END OF SECTION 08710

SECTION 08800

GLAZING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Glass and glazing for Sections referencing this Section for products and installation.

1.02 PERFORMANCE REQUIREMENTS

- A. Glass and glazing materials of this Section shall provide continuity of building enclosure vapor and air barrier:
 - 1. To utilize the inner pane of multiple pane sealed units for the continuity of the air and vapor seal.
 - 2. Maintain continuous air and vapor barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.
- B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with UBC 91 code.
- C. Limit glass deflection to 1/200 flexure limit of glass with full recovery of glazing materials, whichever is less.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.04 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.05 COORDINATION

- A. Coordinate the Work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.

1.06 WARRANTY

- A. Provide five year manufacturer's warranty.
- B. Warranty: Include coverage for sealed glass units from seal failure, interpane dusting, or misting, reflective coating on mirrors, delamination of laminated glass and replacement of same.

PART 2 PRODUCTS

2.01 FLAT GLASS MATERIALS

- A. Float Glass (Type FG): Clear, 1/4 inch thick minimum.
- B. Safety Glass (Type SG): Clear; fully tempered with horizontal tempering 1/4 inch thick minimum at all locations where glass is less than 18 inches above finished floor.
- C. Tinted Glass (Type TG): Float type, heat strengthened, light reducing, color (to be selected); 1/4 inch thick minimum.
- D. Wire Glass (Type WG): Clear, polished both sides diagonal mesh of woven stainless steel wire of 1/2 inch grid size; 1/4 inch thick.
- E. Mirror Glass (Type MG): Clear tempered safety type with copper and silver coating, organic overcoating, rounded, sanded, edges, 1/4 inch thick minimum, sizes as indicated.
- F. Shatter Resistant Glass: (Type SRG): Clear laminated, 5/16 inch composite - 2 - 1/8-inch thick panels laminated with .060 inner layer film, sizes as indicated.

2.02 SEALED INSULATING GLASS MATERIALS

- A. Insulated Glass Units (Type IG): ASTM E774 and E773; double pane with edge seal; outer pane of 1/4 inch glass tinted at exterior, inner pane of 1/4 inch glass. Low-E coating on third surface. Provide integral blinds and all operating hardware where indicated on drawings.
- B. Performance Requirements:
 - U-Value: Winter Night – 0.29 Summer Day – 0.27
 - R-Value – 3.43
 - Shading Coefficient (sc) – 0.37
 - Solar Heat Gain Coefficient (SHGC) – 0.32

Relative Heat Gain (RHG) – 77
Light to Solar Gain (LSG) – 1.23
Sound Transmission Class (STC) - 35

2.03 SPECIAL GLASS AND GLAZING SYSTEMS

A. Vinyl Faced “Etched/Frosted” Glass.

1. Partially Etched/Partially Clear Glass with integrated logo and text. **Located as indicated on drawings.**

2. Etching vinyl shall be field applied.

3. Logo and pattern to be determined. For bidding purposes assume that the door glazing shall be 40% etched with pattern to be provided by architect.

2.04 GLAZING COMPOUNDS

A. Exterior windows that are not shop installed shall be glazed with vinyl or neoprene gaskets, extruded elastic polybutene tape sealant, a combination of polysulphide base compound and elastic glazing compound, or a combination of extruded polysulphide tape, polysulphide base compound elastic glazing compound.

B. Doors and interior stopped -in glass shall be glazed using putty or elastic glazing compound and stop beads.

C. Exterior glazing of steel sash shall be DAP Metal Glaze. Interior glazing of steel sash shall be DAP Steel Sash Putty.

2.05 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene or Silicone, 80 - 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene or Silicone, 50 - 60 Shore A durometer hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 - 15 Shore A durometer hardness; coiled on release paper.

D. Glazing Clips: Manufacturer’s standard type.

E. Mirror Attachment Accessories: Mirror adhesive, chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

D. Install glazing in accordance with Flat Jobbers Association Glazing Manual.

3.03 INSTALLATION - MIRRORS

A. Set mirrors with adhesive, applied in accordance with adhesive manufacturer’s instructions.

B. Place plumb and level.

3.04 CLEANING

A. Remove glazing materials from finish surfaces. Remove labels after work is complete. Clean glass and mirrors.

3.05 PROTECTION OF FINISHED WORK

A. After installation, mark pane with an “X” by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION 08800

SECTION 09111

METAL STUD FRAMING SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Formed metal stud framing at interior and exterior locations.
- B. Framing accessories.

1.02 RELATED SECTIONS

- A. Section 05400 Cold Form Metal Framing.
- B. Section 06112 - Sheathing.
- C. Section 06114 - Wood Blocking and Curbing: Wood blocking within stud framing.
- D. Section 07190 - Vapor and Air Barriers.
- E. Section 07213 - Batt and Blanket Insulation: Insulation within framing members.
- F. Section 07900 - Joint Sealers.
- G. Section 09260 - Gypsum Board Systems: Metal studs for partitioning.

1.03 SYSTEM DESCRIPTION

- A. Metal stud framing system for exterior wall infill, with exterior sheathing, batt insulation, and gypsum board as indicated.
- B. Metal stud framing system for interior walls, with batt type acoustic insulation where indicated, interior gypsum board specified in Section.
- C. Design and size components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with code.
- D. Maximum Allowable Deflection: 1/240 span.

1.04 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this section with minimum 3 years' experience.

1.05 COORDINATION

- A. Coordinate with the placement of components within the stud framing system.

PART 2 - PRODUCTS

2.01 STUD FRAMING MATERIALS

- A. Studs: non-load bearing rolled steel, channel shaped, punched for utility access, as indicated on the drawings.
 - 1. Depth: 1-5/8, 2-1/2, 3-5/8, 6 and 8 inches, as indicated on drawings.
 - 2. Thickness: 20 gage minimum at interior locations unless noted or scheduled otherwise. Refer to structural drawings for additional requirements.
- B. Runners: Of same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud. Ceiling Runners: With extended leg retainer.
- C. Furring and Bracing Members: Of same material as studs; thickness to suit purpose.
- D. Fasteners: Self drilling, self tapping screws.
- E. Sheet Metal Backing: 20 gage galvanized steel as required for reinforcement.
- F. Anchorage Devices: Power actuated, drilled expansion bolts, screws with sleeves as required for application.
- G. Galvanized coating: G90 Galvanized coating required at all framing related to locker rooms; steam room walls, benches, ceilings; and where at or adjacent to swimming pool areas.

2.02 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required; with framing members fitted, reinforced, and braced to suit design requirements.
- B. Fit and assemble in largest practical sections for delivery to site, ready for installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are ready to receive work.
- B. Verify that rough-in utilities are in proper location.

3.02 ERECTION

- A. Align and secure top and bottom runners at 24 inches oc.
- B. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- C. Install studs vertically at 12 and 16 inches as indicated oc.
- D. Align stud web openings horizontally.
- E. Secure studs to tracks using fastener method. Do not weld.
- F. Stud splicing not permissible.
- G. Fabricate corners using a minimum of three studs.
- H. Double stud at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.
- I. Brace stud framing system rigid. Stud profile and size shall be as required for wall height and bracing limitations. **Interior walls shall meet the IBC 2012 requirement for minimum 5 mph horizontal loading.** Installation, bracing, stiffening, of all stud wall systems shall be as required by stud manufacturers' published and/or specifically engineered data. Acoustical ceilings are not an approved method of bracing.
- J. Coordinate erection of studs with requirements of door frames, window frames; install supports and attachments.
- K. Coordinate installation of wood bucks, anchors, and wood blocking with electrical and mechanical work to be placed within or behind stud framing.
- L. Blocking: Secure wood blocking to studs. Secure steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, and hardware.
- M. Refer to Drawings for indication of partitions extend stud framing through the ceiling to the structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- N. Coordinate placement of insulation in stud spaces made inaccessible after stud framing erection.
- O. Install Vapor Barrier between studs and cement board at all framed wall, bench, and ceiling components in steam room areas.

3.03 ERECTION TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch.
- B. Maximum Variation of any Member from Plane: 1/8 inch.
- C. Maximum Variation From Plumb: 1/8 inch.

END OF SECTION 09111

SECTION 09260

GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Acoustical insulation.
- C. Gypsum board.
- D. Water resistant tile backer board.
- E. Taped and sanded joint treatment, **Level 5 finish**.

1.02 REFERENCES

- A. ASTM C36 - Gypsum Wallboard.
- B. ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.
- C. ASTM C630 - Water Resistant Gypsum Backing Board.

PART 2 PRODUCTS

2.01 MANUFACTURERS - GYPSUM BOARD SYSTEM

- A. National Gypsum Company.
- B. Other acceptable manufacturers offering equivalent products.
- C. Substitutions: Under provisions of the General Requirements.

2.02 FRAMING MATERIALS

- A. Reference Section 9111 Metal Stud.

2.03 GYPSUM BOARD MATERIALS

- A. Fire Rated Gypsum Board: ASTM C36; Gypsum, Type "X" fire resistive type, UL rated; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges. Product – **Goldbond XP Fireshield**. Provide **Hi-Abuse** Product at **all areas** below 8'. Standard 5/8" Type "X" shall be acceptable above 8'.
- B. Gypsum Wall Board Tile Backer: ASTM C36; Gypsum, Type "X" fire resistive type, UL rated; 5/8 inch thick. Acrylic coated mold and moisture resistant panel. Panels to be cut to maximum permissible length; ends square cut, tapered edges. Product – **Goldbond eXP**. **Located at all interior and exterior walls scheduled to receive tile.**

2.04 ACCESSORIES

- A. Acoustical Insulation: glass fiber, friction fit type, unfaced, 3 1/2 or 5 1/2 inch thick.
- B. Corner Beads: Metal. Provide 1" Radius corners at EBD office and EBD classrooms.
- C. Edge Trim: GA 201 and GA 216; Type L bead.
- D. Joint Materials: ASTM C475; reinforcing tape, joint compound, adhesive, and water.
- E. Fasteners: ASTM C1002, Type S12, W, and GA-216.
- F. Resilient channel: USG, RC-1 or equal.
- G. Molded Reveal Joints: Fry Reglet, 1/4" x 1/4"; DRM – 25 – 25.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

3.02 METAL STUD INSTALLATION

- A. Install studs in accordance with ASTM C754 and manufacturer's instructions.
- B. Metal Stud Spacing: 16 inches on center, unless noted otherwise.
- C. Refer to Drawings for indication of partitions, extend stud framing through the ceiling to the structure above, unless noted otherwise. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- D. Door Opening Framing: Install double studs at door frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
- E. Blocking: Nail wood blocking to studs or Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, and hardware.

- 3.03 WALL FURRING INSTALLATION
- A. Erect wall furring for direct attachment to concrete block walls.
 - B. Erect furring channels vertically; space maximum 16 inches on center, not more than 4 inches from floor and ceiling lines, abutting walls.
 - C. Install thermal insulation between furring channels directly attached to concrete masonry walls in accordance with manufacturer's instructions.
 - D. Erect free-standing metal stud framing tight to concrete masonry walls, attached by adjustable furring brackets in accordance with manufacturer's instructions.
- 3.04 FURRING FOR FIRE RATINGS
- A. Install furring as required for fire resistance ratings indicated.
 - B. Columns in rated walls shall be wrapped independently from wall system.
- 3.05 CEILING FRAMING INSTALLATION
- A. Coordinate location of hangers with other work.
 - B. Install ceiling framing independent of walls, columns, and above ceiling work.
 - C. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.
 - D. Laterally brace entire suspension system.
- 3.06 ACOUSTICAL ACCESSORIES INSTALLATION
- A. Install resilient channels at maximum 12 inches on center. Locate joints over framing members.
 - B. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
- 3.07 GYPSUM BOARD INSTALLATION
- A. Install gypsum board in accordance with manufacturer's instructions.
 - B. Erect single layer standard gypsum board vertical, with ends and edges occurring over firm bearing.
 - C. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.
 - D. Use screws when fastening gypsum board to metal furring or framing.
 - E. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.
 - F. Erect exterior gypsum soffit board perpendicular to supports, with staggered end joints over supports.
 - G. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum board with sealant.
 - H. Place control joints consistent with lines of building spaces and as directed. Install at approximately 30' intervals in walls. Coordinate locations with Architect.
 - I. Place corner beads at external corners as indicated. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated.
 - J. Caulk at sound walls.
- 3.08 JOINT TREATMENT
- A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready for finishes.
 - B. Feather coats onto adjoining surfaces so that camber is maximum 1/32.
 - C. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.
 - D. Tape joints and corners of cementitious backing board using cement based joint compound as recommended by the manufacturer.
 - E. **Level 5 finish.** Level 4 finish is acceptable at storage rooms only.
- 3.09 TOLERANCES
- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09260


SECTION 09260-A
Gypsum Board Systems Preinstallation Checklist

**Wall Framing Checklist for Construction Projects
Prior to Final Sheetrock Application**

Date: _____

Name of Inspector: _____

Location of walls inspected:

ITEMS TO INSPECT	
1. Clean all cavities in side wall frame with a vacuum. Do not leave any trash, dirt, dust or debris of any kind in side wall.	
2. Verify all framing is securely anchored and fastened. Verify no screws are missing. Any bent or twisted studs or track will be repaired or replaced. Verify anchoring is by specification or industry standard. Additional anchoring at door locations.	
3. Ensure all cross bracing and necessary seismic connections are in place when applicable.	
4. Any rusted framing or door frames will be removed and replaced with new material.	
5. Verify all door frame openings are properly fastened and frame grouted. Header installed, tabs anchored to the floor, heavy gage Jack studs and King studs used on each side of frame (Refer to spec for gage size).	
6. Verify all electrical boxes and conduits are anchored to stud securely in such a manner that pushing on any corners of the box will not allow the box to move inwards.	
7. All plumbing piping anchored securely. Verify all piping is connected, tested for leaks and insulated per specification.	
8. Verify all wall backing is installed for items such as hand rails and toilet accessories (refer to plans and specification for items and location). a. Verify any wood backing used is labeled fire rated stock.	
9. Verify all batt insulation is secured in place in such a manner to keep it from siding down over time once the wall is built. Supplement friction fit to ensure batts remaining as placed.	
10. Verify all sound attenuation material is installed per specification and manufactures instructions.	
11. Verify all trades have coordinated proper installation of items at the proper locations per project plans.	
12. Verify all medical gas piping is installed, supported an anchored per specification and code requirement.	
13. Verify mechanical ducting systems are installed, supported, and anchored per specification and all joints fully sealed and insulation is completed.	
14. Verify all through floor or deck penetrations that will be within the wall are properly caulked and sealed with specified materials.	

SECTION 09306

FLOOR AND WALL TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ceramic tile floor finish using the thinset application method or as recommended by Manufacturer.
- B. Ceramic tile wall finish using the thinset application method.

1.02 SUBMITTALS

- A. Submit under provisions of the General Requirements.
- B. Product Data: Provide instructions for using adhesives and grouts.
- C. Samples: Submit two samples illustrating pattern, color variations, and grout color.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site.
- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Do not install adhesives in an unventilated environment.
- B. Maintain 50 degrees F during installation of mortar materials.

1.05 EXTRA MATERIALS

- A. Provide 10 square feet (full/uncut) of each type of tile to Owner.

PART 2 PRODUCTS

2.01 TILE MANUFACTURER

- A. Crossville – Products: Reference Schedule.
- B. Substitutions: Under provisions of the General Requirements, Materials listed are for pricing purposes, final colors to be selected by Architect. Alternate tile manufacturers and styles may be selected at architect's discretion, based on similar cost and availability.

2.02 CERAMIC TILE MATERIALS

- A. Porcelain Floor, Wall & Base Tile: ANSI A137.1, reference schedule.

2.04 ADHESIVE MATERIALS

- A. Adhesives: Thinset bond type as recommended and/or manufactured by the tile manufacturer.

2.05 MORTAR MATERIALS

- A. Mortar Materials: Portland cement, sand, latex additive, and water as recommended and/or manufactured by the tile manufacturer, color to be selected.

2.06 GROUT MIX

- A. Mix and proportion pre-mix grout materials in accordance with manufacturer's instructions. Color to be selected.
- B. Manufacturer: TEC, AccuColor Power Grout, full range of colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.

3.02 PREPARATION

- A. Protect surrounding work from damage or disfiguration.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Apply sealer conditioner to substrate surfaces in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - THINSET METHOD

- A. Install adhesive tile, thresholds, and grout in accordance with manufacturer's instructions and/or the TCA Handbook.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Place edge strips at exposed tile edges.
- D. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly. Align floor, base, and wall joints.
- E. Place tile joints uniform in width, Floor joints shall be as narrow (approximately 1/8") as allowed by manufacturer, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout. **Provide mock-up area (approximately 4'x4') for owner review of joint spacing and grout depth prior to installation of finish floor tile.**
- F. Sound tile after setting. Replace hollow sounding units.
- G. Keep expansion, control joints free of adhesive or grout. Apply sealant to joints.
- H. Allow tile to set for a minimum of 48 hours prior to grouting.
- I. Grout tile joints.
- J. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- K. Install shower pans per manufacturer's instructions.

3.04 CLEANING

- A. Clean tile and grout surfaces.
- B. **Grout Joints shall be sealed (2 coats) using sealer product as recommended by the grout manufacturer.**

3.05 PROTECTION OF FINISHED WORK

- A. Do not permit traffic over finished floor surface for 4 days after installation.
- B. Install protective material as required to protect finished installation thru completion of construction.

3.06 SCHEDULE OF TILES

- A. Styles and colors identified are for bidding purposes, final styles and colors may vary depending on availability and alternate manufacturers or installers.
 - 1. Wall Tile CT1 (field) – Crossville, Necessary Objects, 3"x6" subway style, polished; Color – To be Selected.
 - A. Equivalent product by Dal-Tile, AO, acceptable
 - 2. Grout colors to be selected by Architect.

END OF SECTION 09306

SECTION 09511

SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system and perimeter trim, to match existing.
- B. Acoustical tile, to match existing.

1.02 SYSTEM DESCRIPTION

- B. Suspension system to rigidly secure acoustical ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

1.03 SUBMITTALS

- A. Product Data: Provide data on metal grid system components, and acoustical units.
- B. Samples: Submit two samples illustrating material and finish of acoustical units.
- C. Samples: Submit two samples each, of suspension system main runner, cross runner, and edge trim.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.04 QUALIFICATIONS

- A. Grid and Tile Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Conform to applicable code for fire rated assembly and combustibility requirements for materials.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS - SUSPENSION SYSTEM

- A. Armstrong - Product: Prelude XL Heavy Duty Galvanized Exposed Tee 15/16"
- B. Armstrong – Product Prelude Plus XL Aluminum Exposed Tee 15/16"> MRI Room Compatible
- C. Substitutions: Under provisions of the General Requirements.

2.02 SUSPENSION SYSTEM MATERIALS

- A. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
- B. Exposed Grid Surface Width: 15/16 inch.
- C. Grid Finish: White.
- D. Accessories: Stabilizer bars, clips, splices, edge moldings, hold down clips, and light protection hoods required for rated suspended grid systems.
- E. AXIOM Classic Edge trim. 4" extruded ceiling edge accent pieces. Straight and curved application.
- E. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

2.03 ACOUSTICAL UNIT MATERIALS

- A. Acoustical Panels: ASTM E1264, conforming to the following:
 - 1. Type I – Armstrong Fine Fissured, High CAC, High NRC, 2'x2'x7/8", Angled Tegular edge. Item No. 1756, Non-Rated, Class A, Color White.

2.04 ACCESSORIES

- A. Touch-up Paint: Type and color to match acoustical and grid units.
- B. Extra Material: Provide one unopened carton of each ceiling type to the owner.

PART 3 EXCUTION

3.01 EXAMINATION

- A. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636 and manufacturer's instructions and as supplemented in this section.
- B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Locate system on room axis according to reflected plan.
- E. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- F. Supply hangers or inserts for installation to Section with instructions for their correct placement.
- G. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- H. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
- J. Do not eccentrically load system, or produce rotation of runners.
- K. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.
- L. Form expansion joints as required or detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.
- M. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with UL assembly requirements at fire rated ceiling assemblies at rated ceiling assemblies.
- N. Install support hangers at (4) four corners of recessed light fixtures.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units one way with pattern parallel to shortest room axis. Fit border trim neatly against abutting surfaces.
- D. Install units after above ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp and dents.
- F. Cut tile to fit irregular grid and perimeter edge trim. Field rabbet tile edge. Double cut and field paint exposed edges of tegular units.
- G. Where bullnose concrete block corners or round obstructions occur, provide preformed closers to match edge molding.
- H. Install hold-down clips to retain panels tight to grid system as required to meet ratings.

3.04 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION 09511

SECTION 09650

RESILIENT FLOORING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Resilient base.

1.02 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical characteristics; sizes, patterns and colors available.
- B. Samples: Submit one sample, illustrating color and pattern for each floor material.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and seaming recommendations.

1.03 REGULATORY REQUIREMENTS

- A. Conform to code for flame/smoke rating requirements in accordance with ASTM E84.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of the General Requirements.
- B. Protect roll materials from damage.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- B. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

1.06 MAINTENANCE DATA

- A. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.07 EXTRA MATERIALS

- A. Provide 10 lineal feet of base material specified.
- B. Provide 60 sf of each type & color of flooring.

PART 2 - PRODUCTS

2.01 MATERIALS – Luxury Vinyl Tile and Plank Flooring

- A. Vinyl Plank Flooring: ASTM F1700, J&J Industries, Legend Series, Class 3, Type B. Color to be selected from manufacturer's full line.
 - 1. Size: 18" wide x 36" Install staggered/random joints.
 - 2. Thickness: 5 mm, Wear layer 20mil
 - 3. Adhesives: Install using manufacturer recommended adhesives for 12 year warranty.
 - a. Adhesive shall be type recommended and approved by the manufacturer for installation over subfloor with moisture content 99% or higher.

2.02 MATERIALS - BASE

- A. Base: FS SS-W-40. Rubber; coved; premolded external corners only where mitering and bending of base is not possible or where returns are less than 4" long.
 - 1. Height: 4 inch
 - 2. Thickness: 1/8 inch thick
 - 3. Length: Roll. Strips are not acceptable. Maximum of 1 joint/seam on any wall.
 - 4. Manufacturers:
 - a) Roppe.
 - b) Johnsonite
 - c) Or as approved equal.
 - 5. Color to be selected from manufacturer full range
- B. Base: Rubber; Non-cove at base of columns.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Edge Strips: Flooring material as approved.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting.
- B. Verify floor and lower wall surfaces are free of substances that may impair adhesion of new adhesive and finish materials.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. The contractor and installer shall review existing floor condition. Existing carpet backing, adhesive residue, and any and all materials shall be thoroughly removed, cleaned, and prepped prior to any floor installation.
- C. The Contractor and installer shall include all cost for labor and material to prep, level, skim, grind, and any other measures to ensure level and stable subfloor prior to installing flooring to ensure that final floor installation is free of bumps, waves, and physical and/or aesthetic flaws in the installation.
- B. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.
- D. Apply primer as recommended by manufacturer.

3.03 INSTALLATION - BASE

- A. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units or "V" cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tight to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.04 INSTALLATION - TILE FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Mix tile from container to ensure shade variations are consistent when tile is placed.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Set flooring in place, press with heavy roller to attain full adhesion.
- E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- F. Install tile to basket weave pattern. Allow minimum 1/2 full size tile width at room or area perimeter.
- G. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- H. Install resilient edge strips at unprotected or exposed edges, and where flooring terminates.
- I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.05 CLEANING

- A. Clean all work as described in the General Requirements.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Clean, and buff floors in accordance with manufacturer's instructions.

3.07 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Prohibit traffic on floor finish for 48 hours after installation.

END OF SECTION 09650

SECTION 09688

CARPET TILE

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
- A. Carpet Tile placed with glue down method.
 - B. Accessories.
- 1.02 ALLOWANCES
- A. Cash Allowance: This contractor shall install and furnish all carpet.
All carpet tile areas: This contractor shall allow the sum of **\$32.00 per square yard** for purchase and delivery of carpet only.
 - B. Allowance includes purchase and delivery of carpet only. Installation, glue, and accessories are included in the Contractors Bid price, **not** the allowance. Any differential in the allowance amount listed above and original invoices from the supplier will be adjusted in the contract price.
- 1.03 SUBMITTALS
- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
 - B. Samples: Submit one sample illustrating color and pattern for each carpet material specified.
 - C. Submit one sample of edge strip, material for each color specified.
 - D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- 1.04 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing specified carpet with minimum three years documented experience.
 - B. Installer: Company specializing in installing carpet with minimum three years documented experience and approved by manufacturer.
- 1.05 ENVIRONMENTAL REQUIREMENTS
- A. Store materials for 3 days prior to installation in area of installation to achieve temperature stability.
 - B. Maintain minimum 70 degrees F ambient temperature 1 day prior to, during and 24 hours after installation.
- 1.06 MAINTENANCE DATA
- A. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- 1.07 EXTRA MATERIAL
- A. Provide 100 sq. ft. of carpeting of each type, color, and pattern specified.

PART 2 - PRODUCTS

- 2.01 ACCEPTABLE MANUFACTURERS - CARPETING
- A. J & J Industries or Invision
 - B. Patcraft
 - C. Lees
 - D. Shaw Contract Group
 - E. Substitutions: Under provisions of the General Requirements.
- 2.02 CARPET PRODUCTS
- A. As selected by Architect. A variety of carpet types and styles may be used. For bidding purposes; it is recommended that Installer figure labor involving greatest amount of work.
 - B. It is anticipated that up to 2 carpet tile styles may be selected.
- 2.03 ACCESSORIES
- A. Sub-Floor Filler: White premix latex; type recommended by adhesive material manufacturer.

- B. Adhesive: Compatible with carpet material and as Recommended by carpet manufacturer. Adhesive shall be type approved by the manufacturer for slab moisture content of 95% or higher.
- C. Edge Strips: Type, finish, color as selected.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are smooth and flat with maximum variation of 1/4 inch in 10 ft., and are ready to receive work.
- B. Verify concrete floors are dry to maximum moisture content of 7 percent; and exhibit negative alkalinity, carbonization, or dusting.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

3.03 INSTALLATION

- A. Apply carpet and adhesive in accordance with manufacturer's instructions.
- B. Verify carpet match before cutting to ensure minimal variation between dye lots.
- C. Double cut carpet, to allow intended seam and pattern match. Make cuts straight, true, and unfrayed. Edge seam carpet at traffic areas.
- D. Locate seams in area of least traffic.
- E. Join seams by hot adhesive tape method. Form seams straight, not overlapped or peaked, and free of gaps.
- F. Lay carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance. Provide monolithic color, pattern, and texture match within any one area.
- G. Do not change run of pile in any room where carpet is continuous through a wall opening into another room. Locate change of color or pattern between rooms under door centerline.
- H. Cut and fit carpet around interruptions.
- I. Bind cut edges where not concealed by edge strips.
- J. Fit carpet tight to intersection with vertical surfaces without gaps.
- K. Where wall bases are scheduled, cut carpet tight to walls. Fit carpet tight to vertical interruptions, leaving no gaps.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION 09688

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and field application of paints and coatings.

1.2 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing the work of this section with minimum years documented experience and approved by manufacturer.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish and Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

1.5 EXTRA MATERIALS

- A. Provide one gallon of each color to owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer - Paint, Transparent Finishes, Stain, Primer Sealers, and Block Filler by SHERWIN- WILLIAMS or as approved equal.

2.2 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners, and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

2.3 FINISHES

- A. Refer to schedule at end of section for surface finish schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

- A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.
- C. Seal with shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- I. Copper Surfaces Scheduled for a Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- J. Copper Surfaces Scheduled for a Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.
- K. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- L. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- M. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of trisodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- N. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- O. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand, power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- P. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- Q. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- R. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- S. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

- T. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.
- U. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease, and dirt.
- V. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand wood and metal lightly between coats to achieve required finish.
- F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- G. Allow applied coat to dry before next coat is applied.
- H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- I. Prime concealed surfaces of interior and exterior woodwork with primer paint.
- J. Prime concealed surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars, and supports except where items are prefinished.
- C. Paint interior surfaces of air ducts, and convactor and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convactor and baseboard cabinets to match face panels.
- D. Paint exposed conduit and electrical equipment occurring in finished areas.
- E. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 CLEANING

- A. Collect waste material, which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.6 SCHEDULE

The following are for exterior and interior surfaces, and are all products of Sherwin-Williams.

EXTERIOR SURFACES

1. WOOD

- A. Flat Finish/Latex Base
 - 1st Coat: Exterior Wood Primer, B42W8041
 - 2nd Coat: A-100 Exterior Latex Satin A82 Series
 - 3rd Coat: A-100 Exterior Latex Satin A82 Series

2. FERROUS METAL

- A. Painted (Gloss Finish/Alkyd Base)
 - 1st Coat: Pro Industrial Pro-Cryl Universal Metal Primer, B66-310
 - 2nd Coat: Waterbased Acrolon 100 Polyurethane Gloss, B65-700 Series
 - 3rd Coat: Waterbased Acrolon 100 Polyurethane Gloss, B65-700 Series

3. GALVANIZED and ALUMINUM METALS
 - A. Painted (Semi-Gloss Finish/Latex Base)
 - 1st Coat: Pro Industrial Pro-Cryl Universal Metal Primer, B66-310
 - 2nd Coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66 Series.
 - 3rd Coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66 Series.
4. CONCRETE MASONRY UNITS
 - A. Painted (Flat Finish/Latex Base)
 - 1st Coat: Loxon Block Surfacers, A24W200
 - 2nd Coat: Emerald Exterior Latex Satin, A82 Series
 - 3rd Coat: Emerald Exterior Latex Satin, A82 Series
5. CONCRETE/BRICK
 - A. Painted (Flat Finish/Latex Base)
 - 1st Coat: Loxon Concrete and Masonry Primer, A24W8300
 - 2nd Coat: DuraCraft Exterior Latex Satin, C7 Series
 - 3rd Coat: DuraCraft Exterior Latex Satin, C7 Series
6. PLASTER/STUCCO/EIFS
 - A. Painted (Flat Finish/Latex Base)
 - 1st Coat: Loxon Concrete and Masonry Primer, A24W8300
 - 2nd Coat: Emerald Exterior Latex Satin, A82 Series
 - 3rd Coat: Emerald Exterior Latex Satin, A82 Series
7. TRAFFIC AND PARKING LINE MARKING
 - A. Painted (ProMar Traffic Marking Paint)
 - 1st Coat: B29W1-WHITE

INTERIOR SURFACES

1. WOOD AND PLYWOOD
 - A. Painted (Eg-Shel Finish/Alkyd Base)
 - 1st Coat: ProMar 200 Zero VOC Primer, B28W2600
 - 2nd Coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 Series
 - 3rd Coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 Series
 - B. Stained and Varnished (Clear Finish) Opened Grained Wood
 - 1st Coat: Wood Classics, A49W800 Series
 - 2nd Coat: Wood Classics WB Polyurethane A68
 - 3rd Coat: Wood Classics WB Polyurethane A68
2. CONCRETE BLOCK (CMU)
 - A. Painted (Semi-Gloss Finish/Epoxy Base)
 - 1st Coat: PrepRite® Block Filler, B25W25
 - 2nd Coat: Pro Industrial Pre-Catalyzed Water Based Epoxy, Semi-Gloss, K46W051 VOC
 - 3rd Coat: Pro Industrial Pre-Catalyzed Water Based Epoxy, Semi-Gloss, K46W051 VOC
3. GLAZED TILE BLOCK (GTB)
 - A. Painted (Semi-Gloss Finish/Epoxy Base)
 - 1st Coat: Extreme Bond Primer, B-51-W150
 - 2nd Coat: Pro Industrial Pre-Catalyzed Water Based Epoxy, Semi-Gloss, K46W051 VOC
 - 3rd Coat: Pro Industrial Pre-Catalyzed Water Based Epoxy, Semi-Gloss, K46W051 VOC
4. GYPSUM WALLBOARD
 - A. Painted (Eg-Shel Finish/Latex Base)
 - 1st Coat: ProMar 200, Zero VOC Interior Latex Primer, B28W2600
 - 2nd Coat: ProMar 200 Zero VOC Interior Latex Eg-Shel, B20W2650
 - 3rd Coat: ProMar 200 Zero VOC Interior Latex Eg-Shel, B20W2650

5. FERROUS METAL
 - A. Painted (Gloss Finish/Alkyd Base)
 - 1st Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310
 - 2nd Coat: Pro Industrial Zero VOC Waterbased Epoxy Gloss, B73-300 Series
 - 3rd Coat: Pro Industrial Zero VOC Waterbased Epoxy Gloss, B73-300 Series

NOTE: Doors and Frames to be sprayed. No brush/roller marks will be accepted.
6. GALVANIZED METAL
 - A. Painted (Semi-Gloss Finish/Alkyd Base)
 - 1st Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series
 - 2nd Coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 Series
 - 3rd Coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 Series

NOTE: Doors and Frames to be sprayed. No brush/roller marks will be accepted.
7. CONCRETE FLOORS (SEALED)
 - A. Painted (Clear Acrylic Floor Finish)
 - 1st Coat: WR Meadows Tiah Acrylic Concrete Sealer, Solvent Based
 - 2nd Coat: WR Meadows Tiah Acrylic Concrete Sealer, Solvent Based
8. PRECAST CONCRETE WALL PANELS
 - A. Painted and Textured
 - 1st Coat: SW Loxon Concrete and masonry primer-sealer A24W3300
 - 2nd Coat: SW Ultracrete A44W800 (Apply to Mfg recommended coverage).
 - 3rd&4th Coat: 2 coats Pro Industrial Pre-Catalyzed Water Based Epoxy, Semi-Gloss K46W051 VOC

END OF SECTION 09900

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers. (1 total), Cabinets – 1 total..

1.2 SUBMITTALS

- A. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
- B. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. LARSEN'S - Architectural Series 2409-R3, Vertical Duo Door, baked enamel interior finish.
- B. Substitutions: Under provisions of the General Requirements.

2.2 EXTINGUISHERS

- A. Dry Chemical Type: Larsen's MP series MP5, Cast steel tank, with pressure gage.

2.3 CABINETS

- A. Interior Metal: Formed sheet steel, baked enamel box.
- B. Configuration: Semi-recessed type, exterior nominal dimensions of 27 1/2 inch high x 13 inch wide x 5 inch deep.
- C. Trim Type: Returned to wall surface, with 2 1/2 inch projection.
- D. Exterior Door and Trim: Stainless Steel, reinforced for flatness and rigidity; latch with vertical glass.
- E. Door Glazing: Glass, clear, 1/8 inch thick tempered.
- F. Cabinet Mounting Hardware: Appropriate to cabinet.

2.4 FABRICATION

- A. Form cabinet enclosure with right angle inside corners and seams. Formed trim and door stiles.
- B. Pre-drill for anchors.
- C. Hinge doors for 180 degree opening with continuous piano hinge. Provide roller type catch.
- D. Weld, fill, and grind components smooth.
- E. Glaze doors with resilient channel gasket glazing.
- F. Provide **One (1) Fire Rated Cabinet** as indicated on Code Footprint plan.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 24 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.
- E. Verify exact location with Architect.

END OF SECTION 10522

SECTION 10730

SPECIALTIES MANUFACTURERS OF PROTECTIVE COVERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Sloped Roof Steel Shelters
- B. **This section is included for references purposes. Installation of this structure is to be by owner per separate contract. Construction of the six (6) footings associated with this structure is to be bid by the General Contractor per Alternate 4.**

1.2 REFERENCES

A. REFERENCE STANDARDS:

- 1. AISC - American Institute of Steel Construction Manual of Steel Construction.
- 2. ASTM - American Society for Testing and Materials.
- 3. AWS - American Welding Society.
- 4. LEED - Leadership in Energy and Environmental Design.
- 5. OSHA – Occupational Safety and Health Administration Steel Erection Standard 29 CFR 1926 Subpart R-Steel Erection.
- 6. PCI - Powder Coating Institute.
- 7. SSPC - Steel Structures Painting Council.

1.3 SUBMITTALS

A. GENERAL SUBMITTAL:

Submit 2 sets of submittal drawings and 2 sets of calc books, both signed and sealed by a Professional Engineer licensed in the State of Kansas.

B. PRODUCT DESIGN LOADS:

The building shall be designed to meet the governing building code with the following design loads:

- 1. Building Code: 2018 IBC
- 2. Ground Snow Load (Pg): 20 pounds per square foot.
- 3. Ultimate Design Wind Speed (V): 115 miles per hour. Exposure C
- 4. Seismic Design: as required for site specific conditions.
- 5. Frost Depth: 36"

C. SUBMITTAL REQUIREMENTS:

Calculations and Submittal drawings shall include, at a minimum:

- 1. Calculations:
 - a. References to building codes and design manuals used for calculations.
 - b. Identification of lateral force resisting system.
 - c. Formulas used for determining snow, wind, and seismic loads to specific project location.
 - d. Three dimensional modeling input, model geometry, and analysis results.
 - e. Member design results and controlling load combinations.
 - f. Connection design for structural bolts, welds, plate thicknesses, and anchorage to the foundation.
 - g. Foundation designs must include the required combinations of gravity and lateral loads.
- 2. Submittal Drawings:
 - a. Anchor bolt layout.
 - b. Foundation design.
 - c. Three dimensional views of frame.
 - d. Member sizes and locations.
 - e. Structural connection details, including bolt sizes and plate thicknesses.
 - f. Roof trim and connection details.

D. FOUNDATION DESIGN:

The foundation design is the responsibility of the shelter manufacturer.

E. ANCHOR BOLTS:

Anchor bolts shall be provided by manufacturer.

1.4 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS:

1. Minimum of 10 years in the shelter construction industry.
2. Full time on-staff Quality Assurance Manager.
3. All welders AWS Certified.
4. Annual audit of Quality System by Third Party Agency.
5. Annual audit of powder coat finish system by Third Party Agency (PCI).

1.5 STORAGE AND HANDLING

A. STORAGE AND HANDLING REQUIREMENTS:

1. Installer shall store product in a dry place or covered if out in the weather and keep product out of direct sun.
2. Installer shall store product elevated from soils to allow air circulation and to not introduce mold, fungi decay, or insects to the product.
3. Product must be handled with protective straps or padded forks if lifting with mechanical equipment. Use of chain or cable to lift product into place will not be accepted.

1.6 FIELD OR SITE CONDITIONS

- A. Foundations shall be at the same elevation unless specifically noted otherwise on the drawings.

1.7 MANUFACTURER WARRANTY

- A. Shelter must have a 10-year limited warranty on steel frame members
B. Shelter must have a 10-year limited warranty on paint system.
C. Pass through warranty of metal roof manufacturer to be provided upon request.

PART 2 - PRODUCTS

2.1 SHELTER SYSTEM AND MATERIALS

A. MANUFACTURERS:

1. Acceptable Manufacturer: Coverworx Recreational Architecture, 11800 E. Nine Mile Rd., Warren, MI 48089; 586-486-1088; E-mail: info@coverworx.com; www.coverworx.com.
2. The product shall be designed, produced, and finished at a facility owned and directly supervised by the supplier who has a minimum of ten years under same ownership making pre-manufactured shelters.

B. SUBSTITUTION LIMITATIONS:

1. Substitutions must be approved a minimum of seven (3) days before bid.
2. Alternate suppliers must meet the qualifications and provide proof of certifications listed under section 1.4 QUALITY ASSURANCE.

C. DESCRIPTION OF PRODUCT:

1. One (1) SINGLE SLOPE STRUCTURES.
2. DESCRIPTION AND SIZE: Approximately 42'-0" x 48'-0"
3. ROOF SLOPE: 2:12
4. EAVE HEIGHT: Per Drawings. Clearance height from finish grade to the underside of the perimeter beam.
5. ADDITIONAL OPTIONS: Reference Drawings.

D. PRODUCT REQUIREMENTS AND MATERIALS:

1. GENERAL: The pre-engineered package shall be pre-cut unless otherwise noted and pre-fabricated which will include all parts necessary to field construct the shelter. The shelter shall be shipped knocked to minimize shipping expenses. Field labor will be kept to a minimum by pre-manufactured parts. Onsite welding is not necessary.
2. REINFORCED CONCRETE:
 - a. Concrete shall have minimum 28-day compressive strength of 3,000 psi and slump of 4" (+/- 1"), unless otherwise noted on the drawings.
 - b. Reinforcing shall be ASTM A615, grade 60.

3. STEEL COLUMNS:
 - a. Hollow structural steel tube minimum ASTM A500 grade B with a minimum wall thickness of 1/8".
 - b. Unless columns are direct buried columns shall be anchored directly to concrete foundation with a minimum of four anchor rods to meet OSHA requirement 1926.755(a)(1).
4. STRUCTURAL FRAMING:

Hollow Structural Steel tube minimum ASTM500 grade B. "I" beams, tapered columns, or open channels shall not be accepted for primary beams.
5. COMPRESSION MEMBERS:

Compression rings of welded plate minimum ASTM A36 or compression tubes or structural steel tube minimum ASTM A500 grade B shall only be used.
6. CONNECTIONS:

Connection Requirements:

 - a. Anchor bolts shall be ASTM F1554 (Grade 36) unless otherwise noted.
 - b. Structural fasteners shall be zinc plated ASTM A325 high strength bolts and high strength nuts.
 - c. All structural fasteners shall be hidden within framing members.
 - d. No field welding shall be required to construct the shelter.
 - e. All welds shall be free of burrs and inconsistencies.
 - f. All exposed fasteners shall be painted by manufacturer prior to shipment to match frame or roof colors as applicable.
 - g. Manufacturer shall provide extra structural and roofing fasteners.
7. ROOFING MATERIALS:
 - a. ROOF SYSTEM OF STANDING SEAM METAL ROOFING:
 - 1) Standing seam metal roofing to be 24-gauge galvalume 16" wide with ribs 1-3/4" high.
 - 2) Roof surface shall be painted with Kynar 500 to the manufacturer's standard color: *To Be Selected*. Ceiling surface shall be a "wash coat" primer.
 - 3) Roof panels shall be factory precut to size and angled to provide ease of one-step installation.
 - 4) Metal roofing trim shall match the color of the roof and shall be factory made of 24 gauge Kynar 500 painted steel.
 - 5) Trim shall include panel ridge caps, hip caps, eave trim, rake trim, roof peak cap, and corner trim as applicable for model selected. Trim may need to be cut to length and notched. Reference drawings for additional information.
 - 6) Ridge, hip, and valley caps shall be pre-formed with a single central bend to match the roof pitch and shall be hemmed on the sides.
 - 7) Roof peak cap shall be pre-manufactured.
 - 8) Manufacturer must supply painted screws with metal and neoprene washers.
8. FINISHES:
 - a. STANDARD POWDER COAT FINISH:
 - 1) Steel shall be cleaned, pretreated, and finished at a facility directly supervised by the manufacturer.
 - 2) Steel shall be shot blasted to SSPC-SP10 near-white blast cleaning. SSPC-SP2 hand tool cleaning will not be an acceptable alternative.
 - 3) Parts shall be pretreated in a 3 stage iron phosphate or equal washer.
 - 4) Epoxy primer powder coat to be applied to parts for superior corrosion protection.
 - 5) Top coat of Super Durable TGIC powder coat shall be applied over the epoxy primer.
 - 6) Finish shall not have any VOC emissions.
 - 7) Sample production parts shall have been tested and meet the following criteria:
 - a) Salt spray resistance per ASTM B 117/ ASTM D 1654 to 5,000 hours with no creep from scribe line and rating of 10.
 - b) Humidity resistance per ASTM D2247-02 to 3,000 hours with no loss of adhesion or blistering.
 - c) Color/UV resistance per ASTM G154-04 to 2,000 hours exposure, alternate cycles with results of no chalking, 75% color retention, color variation maximum 3.0 E variation CIE formula (before and after 2,000 hours exposure).
 - 8) The manufacturer shall be PCI 4000 S Certified

b. **HOT DIP GALVANIZED FINISH:**

- 1) Steel members, fabrications, and assemblies shall be galvanized after by the hot dip process in accordance with ASTM A123. The composition of metal in the galvanizing bath shall be no less than 98% zinc.
- 2) The galvanized coating shall be continuous, adherent, and free from any detrimental defect.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Protect building products after arrival at destination from weather, sunlight, and damage.
- B. Building products shall be placed on blocks well off the ground and separated with wood strips so that air can circulate around each member.
- C. Cover top and bottom with moisture-resistant paper.
- D. Non-marring slings and/or padded forks shall be used when handling.
- E. Installers are to use proper building practices recognized by OSHA and to have minimum 5 years experience in installing shelters of similar construction. These trades include but are not limited to: masonry work, steel construction, sheet metal work, carpentry, electrical and paint finishing.
- F. Examination of final work is done by verifying that the erection of the structure was done in conformance to the installation instructions provided by Coverworx and local building codes.

3.2 ERECTION

A. FOUNDATIONS:

The shelter shall be placed on Coverworx designed foundations with materials by others. Design approved by the Engineer of Record identified in Section 1.3 D. FOUNDATION DESIGN.

B. INSTALLATION:

Install all components according to manufacturer's installation instructions and these specifications.

C. GENERAL CONTRACTOR:

Interface with other work is to be coordinated by the customer or the customer's agent. Certain designs have electrical or other plumbing requirements that are not supplied by Coverworx.

D. TOLERANCES:

Tolerances on steel structural members are set according to AISC construction practices, abided in the factory, and cannot be increased. No field slotting or opening of holes will be allowed. It is therefore essential that contractors conform to the tolerances specified on the installation drawings for anchor bolt or column layout details.

E. OSHA COMPLIANCE:

OSHA Compliance to Steel Erection Standard 29CRF 1926 Subpart R-Steel Erection.

3.3 REPAIR

- A. Do not attempt any field repairs without first contacting Coverworx.

3.4 FIELD OR SITE QUALITY CONTROL

- A. Field or Site Tests and Inspections are not required by Coverworx but may be required by the customer or by the local building inspector.

END OF SECTION 10730



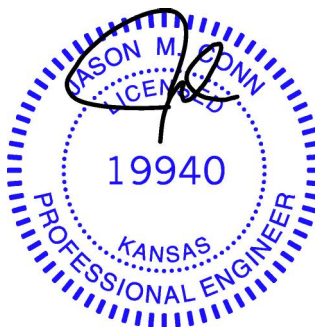
CALCULATIONS FOR:

**Coverworx #92999
MO-4048-SW-212-10E
FIRST COVENANT CHURCH
2625 EAST MAGNOLIA ROAD
SALINA, KS 67401**

2012 INTERNATIONAL BUILDING CODE WITH LOCAL AMENDMENTS

October 9, 2025

PREPARED UNDER THE DIRECT CONTROL AND SUPERVISION OF:



Digitally signed
by Jason M.
Conn, P.E.
Date:
2025.10.10
11:31:47 -04'00'

*THIS SEAL PERTAINS ONLY TO THE MATERIALS SUPPLIED BY COVERWORX
THIS SEAL DOES NOT SERVE AS - OR REPRESENT - THE PROJECT
ENGINEER OF RECORD AND SHALL NOT BE CONSTRUED AS SUCH.*

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DESIGN CRITERIA

2012 INTERNATIONAL BUILDING CODE WITH LOCAL AMENDMENTS

Risk Category:	II	
Dead Loads, D:	Weight of Roofing System =	10.00 psf + Structure Dead Weight
Snow Loads, S:	Basic Ground Snow Load, P_g =	20.00 psf
	Importance Factor, I_s =	1.00
	Slope Factor, C_s =	1.00
	Thermal Factor, C_t =	1.20
	Exposure Factor, C_e =	1.00
	Flat Roof Snow Load, P_f =	16.80 psf
	Sloped Roof Snow Load, P_s =	16.80 psf
	Unbalanced Roof Snow Load, $W < 20$ ft =	20.00 psf
Live Loads, L_r:	Roof Live Load, L_r =	20.00 psf
Wind Loads, W:	Ultimate Design Wind Speed = V_{ult} =	115.00 mph
	Nominal Design Wind Speed = V_{asd} =	90.00 mph
	See Wind Analysis Sheets	
Seismic Loads, E:	Equivalent Lateral Force Procedure	
	Seismic Site Class =	D
	Seismic Force Resisting System =	Steel Ordinary Cantilever Column System
	Short Spectral Response Parameter, S_s =	0.099
	1-Sec Spectral Response Parameter, S_1 =	0.049
	Seismic Design Category =	B
	Importance Factor, I_e =	1.00
	Response Modification Coefficient, R =	1.25
	Redundancy Factor, p =	1.00
	Overstrength Factor, Ω_o =	1.25
	Site Coefficient, F_a =	1.600
	Site Coefficient, F_v =	2.400
	Adjusted Short Spectral Response Parameter, S_{MS} =	0.158
	Adjusted 1-Sec Spectral Response Parameter, S_{M1} =	0.118
	Design Short Spectral Response Parameter, S_{DS} =	0.106
	Design 1-Sec Spectral Response Parameter, S_{D1} =	0.078
	Seismic Response Coefficient, C_s =	0.084
	Effective Seismic Weight, W =	33003.64 lbs
	Seismic Base Shear, V =	2788.15 lbs
	Seismic Load, E =	2788.15 lbs
	Seismic Load with Overstrength Factor, E_m =	3485.18 lbs
Frost Depth:	36" Below Finish Grade	

Load Combinations:

Basic Load Combinations Per Local Building Codes

Strength Design Load Combinations

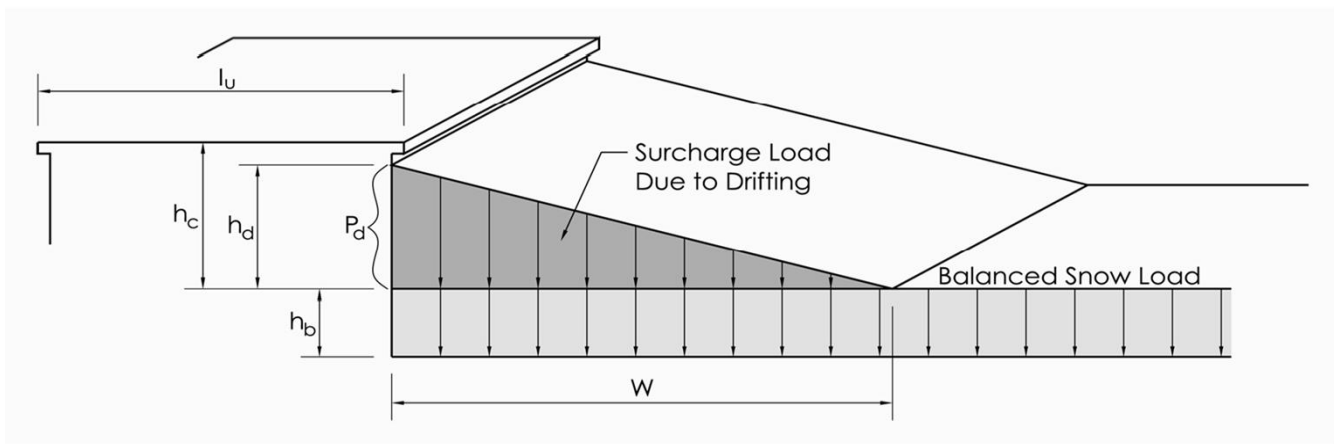
$1.4D$	(Equation 16-1)
$1.2D + 1.6(L_r \text{ or } S) + 0.5W$	(Equation 16-3)
$1.2D + 1.0W + 0.5(L_r \text{ or } S)$	(Equation 16-4)
$1.2D + 1.0E + 0.2S$	(Equation 16-5)
$0.9D + 1.0W$	(Equation 16-6)
$0.9D + 1.0E$	(Equation 16-7)

Allowable Stress Design Load Combinations

$1.0D$	(Equation 16-8)
$1.0D + 1.0(L_r \text{ or } S)$	(Equation 16-10)
$1.0D + (0.6W \text{ or } 0.7E)$	(Equation 16-12)
$1.0D + 0.75(0.6W) + 0.75(L_r \text{ or } S)$	(Equation 16-13)
$1.0D + 0.75(0.7E) + 0.75(L_r \text{ or } S)$	(Equation 16-14)
$0.6D + 0.6W$	(Equation 16-15)
$0.6D + 0.7E$	(Equation 16-16)

SNOW DRIFT CALCULATION

Ground Snow Load, $P_g =$	20.00 psf	
Exposure Factor, $C_e =$	1.0	
Thermal Factor, $C_t =$	1.2	
Importance Factor, $I =$	1.0	
Roof Snow Load, $P_r = 0.7C_eC_tIP_g =$	16.80 psf	
Length of Upper Roof, $l_u =$	120.00 ft.	(If $l_u < 25$ ft., Use $l_u = 25$ ft.)
Length of Lower Roof $l_{u \text{ Lower}} =$	44.00 ft.	
Density, $\gamma = 0.13(P_g) + 14 =$	16.60 pcf	
Balanced Snow Load Height, $h_b = P_r/\gamma =$	1.01 ft.	
Clear Height, $h_c =$	0.49 ft.	
Roof Height Difference, $h_c + h_b =$	1.50 ft.	



Leeward Drift Height, $h_d = 0.43 \sqrt[3]{l_u^4 P_g + 10} - 1.5 =$	3.46 ft.	
Windward Drift Height, $h_d = 0.75(0.43 \sqrt[3]{l_{u \text{ Lower}}^4 P_g + 10} - 1.5) =$	1.54 ft.	
Governing $h_d =$	3.46 ft.	
If h_d is equal to or less than h_c , use Drift Width, $w = 4h_d =$	13.85 ft.	Does Not Govern Width
If h_d exceeds h_c , use Drift Width, $w = 4h_d^2/h_c =$	98.35 ft.	
Drift Width, w shall not be greater than $8h_c =$	3.90 ft.	

Governing Drift Height =	$h_c =$	0.49 ft.
Governing Drift Width =	$w =$	3.90 ft.

Peak Load, $P_d = (h_c \text{ or } h_d)(\gamma) =$	8.10 psf
Minimum Drift Load =	0.00 psf

Project : ON COVER
 Subject : WIND ANALYSIS
 Location : ON COVER

File : ON COVER
 Date : 10/9/2025
 Eng : ON COVER

Design Wind Pressure, p , Equation 27.4-3 (ASCE 7-10)

System Type	Structure Type	Equation
Main Wind Force Resisting System (Directional Procedure)	Rigid Structures of all Heights Free Monoslope Roofs	$p = qh G C_n$ qh : velocity pressure at h G : Section 26.9.4 C_n : Figure 27.4-4 & 27.4-7.

Velocity Pressure Calculations:

Velocity pressure qh is calculated in accordance with section 27.3.2

qh = Velocity pressure @ height (h)

$qh = \text{Constant} \cdot K_h \cdot K_{zt} \cdot K_d \cdot V^2$ (Eq. 27.3-1)

Where : Constant = Numerical constant (Section C27.3.2)

$$\frac{1}{2} \cdot \left[\left(\text{Air density lb/ cu ft} \right) / \left(32.2 \text{ ft/s}^2 \right) \right] \cdot \left[\left(\text{mi/h} \right) \left(5280 \text{ ft/mi} \right) \cdot \left(1 \text{ hr/3600 s} \right) \right]^2$$

$$= 0.00256$$

Mean Sea Level = 0.00 ft

Air Density @MSL = 0.0765 lb/cu ft (Table C27.3-2)

Occupancy Category = II (Table 1.5-1)

Exposure Category = C (Section 26.7.3)

α = 9.50 (Table 26.9-1)

Z_g = 900.00 ft (Table 26.9-1)

Basic Wind Speed = 115.00 mph (Figure 26.5-1 A-C)

Structure Height = 16.30 ft

Width = 44.00 ft

Depth = 48.00 ft

K_h = Velocity pressure coefficient at height h
 = $2.01 \cdot (Z/Z_g)^\alpha$ for $15 \text{ ft} \leq Z \leq Z_g$ (Table 27.3-1)
 = $2.01 \cdot (15/Z_g)^\alpha$ for $Z < 15 \text{ ft}$
 = 0.86

K_{zt} = Topographic factor (Figure 26.8-1)
 = $(1 + K_1 \cdot K_2 \cdot K_3)^2$

Topography = None

$K_{zt} @ h$ = 1.00

K_d = Wind directionality factor (Table 26.6-1)
 = 0.85

Project : ON COVER
 Subject : WIND ANALYSIS
 Location : ON COVER

File : ON COVER
 Date : 10/9/2025
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Gust Effect Factor, G_f , Obtained by Rational Analysis

The gust effect factor G_f obtained by rational analysis uses the dynamic properties of the system.

Values Obtained from Table 26.9-1

Z_{min}	15 ft
e	0.2
ℓ	500 ft
c	0.2

Calculated Values

Analysis	Category II : Rigid Structure-Complete Analysis	
$z(\sim)$	15 ft	
I_z	$c \cdot (33/z(\sim))^{1/6}$	(Eq. 26.9-7)
	0.2280869	
L_z	$\ell \cdot (z(\sim)/33)^e$	(Eq. 26.9-9)
	427.0566 ft	
Q	$Sqr [1 / (1 + 0.63 \cdot [(b+h)/L_z]^{0.63})]$	(Eq. 26.9-8)
	0.919	
g_q	3.4	
g_v	3.4	
Gust Factor (G)	$0.925 \cdot [(1 + 1.7 \cdot g_q \cdot I_z \cdot Q) / (1 + 1.7 \cdot g_v \cdot I_z)]$	(Eq. 26.9-6)
G	0.882	

Project : ON COVER
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Design Wind Pressure, p, Equation 27.4-3

Figure 27.4-4 (Monoslope Free Roofs)

Roof Height = 16.30 ft
 Roof Angle = 9.47
 h/L = 0.37

Clear Flow

Load Case	Gamma	Side	kz	K3	Kzt	Kd	qh (psf)	G	Cn	p (psf)
A	0	Windward	0.86	1.00	1.00	0.85	24.86	0.882	-0.68	-14.89
A	0	Leeward	0.86	1.00	1.00	0.85	24.86	0.882	-1.08	-23.67
A	180	Windward	0.86	1.00	1.00	0.85	24.86	0.882	1.01	22.05
A	180	Leeward	0.86	1.00	1.00	0.85	24.86	0.882	1.53	33.48
B	0	Windward	0.86	1.00	1.00	0.85	24.86	0.882	-1.53	-33.60
B	0	Leeward	0.86	1.00	1.00	0.85	24.86	0.882	0.00	0.00
B	180	Windward	0.86	1.00	1.00	0.85	24.86	0.882	1.65	36.25
B	180	Leeward	0.86	1.00	1.00	0.85	24.86	0.882	0.38	8.31

Project : ON COVER
Subject : WIND ANALYSIS
Location : ON COVER

File : ON COVER
Date : 10/9/2025
Eng : ON COVER

Design Wind Pressure, p, Equation 27.4-3

Figure 27.4-7 (Free Roofs -wind parallel to ridge)

Wind pressures are for gamma = 90 and 270 degrees using Figure 27.7-7.

Roof Height = 16.30 ft
 Roof Angle = 9.47
 h/L = 0.37

Clear Flow

Horizontal Distance from Windward Edge	Load Case	kz	K3	Kzt	Kd	qh (psf)	G	Cn	p (psf)
<= h	A	1.00	1.00	1.00	0.85	24.86	0.882	-0.80	-17.55
<= h	B	1.00	1.00	1.00	0.85	24.86	0.882	0.80	17.55
>h, <=2h	A	1.00	1.00	1.00	0.85	24.86	0.882	-0.60	-13.16
>h, <=2h	B	1.00	1.00	1.00	0.85	24.86	0.882	0.50	10.97
>2h	A	1.00	1.00	1.00	0.85	24.86	0.882	-0.30	-6.58
>2h	B	1.00	1.00	1.00	0.85	24.86	0.882	0.30	6.58

Project : ON COVER
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Design Wind Pressure, p, Equation 30.8-1 (ASCE 7-10).

System Type	Structure Type	Equation
Components and Cladding	Rigid Structures Monoslope Free Roof Open Buildings	$p : qh G C_n$ $qh : \text{velocity pressure at } h$ $G : \text{Section 26.9.4}$ $C_n : \text{Figure 30.8-1}$

Velocity Pressure Calculations:

Velocity pressure is calculated in accordance with section 30.3.

qh = Velocity pressure @ mean roof height, h

$$qh = \text{Constant} \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \quad (\text{Eq 30.3-1})$$

Where : Constant = Numerical constant (Section C27.3.2)

$$= \frac{1}{2} \cdot \left[\left(\text{Air density lb/cu ft} \right) / \left(32.2 \text{ ft/s}^2 \right) \right] \cdot \left[\left(\text{mi/h} \right) \left(5280 \text{ ft/mi} \right) \cdot \left(1 \text{ hr/3600 s} \right) \right]^2$$

$$= 0.00256$$

Mean Sea Level = 0.00 ft

Air Density @MSL = 0.0765 lb/cu ft (Table C27.3-2)

Occupancy Category = II (Table 1.5-1)

Exposure Category = C (Section 26.7.3)

α = 9.50 (Table 26.9-1)

Z_g = 900.00 ft (Table 26.9-1)

Basic Wind Speed = 115.00 mph (Figure 26.5-1 A-C)

Structure Height = 16.30 ft

Width = 44 ft

Depth = 48.00 ft

K_h = Velocity pressure coefficient at height h

$$= 2.01 \cdot \left(Z/Z_g \right)^{2/\alpha} \text{ for } 15 \text{ ft} \leq Z \leq Z_g \quad (\text{Table 30.3-1})$$

$$= 2.01 \cdot \left(15/Z_g \right)^{2/\alpha} \text{ for } Z < 15 \text{ ft}$$

K_h = 0.86

K_{zt} = Topographic factor (Figure 26.8-1)

$$= \left(1 + K_1 \cdot K_2 \cdot K_3 \right)^2$$

Topography = None

$K_{zt} @ h$ = 1.00

K_d = Wind directionality factor (Table 26.6-1)

$$= 0.85$$

Project : ON COVER
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Gust Effect Factor, G_f , Obtained by Rational Analysis

The gust effect factor G_f obtained by rational analysis uses the dynamic properties of the system.

Values Obtained from Table 26.9-1

Z_{min}	15 ft
e	0.2
l	500 ft
c	0.2

Calculated Values

Analysis	Category II : Rigid Structure-Complete Analysis	
$z(^{\circ})$	15 ft	
l_z	$c \cdot (33/z(^{\circ}))^{1/6}$	(Eq. 26.9-7)
	0.2280869	
L_z	$l \cdot (z(^{\circ})/33)^e$	(Eq. 26.9-9)
	427.0566 ft	
Q	$Sqr [1 / (1 + 0.63 \cdot [(b+h)/L_z]^{0.63})]$	(Eq. 26.9-8)
	0.919	
g_q	3.4	
g_v	3.4	
Gust Factor (G)	$0.925 \cdot [(1 + 1.7 \cdot g_q \cdot l_z \cdot Q) / (1 + 1.7 \cdot g_v \cdot l_z)]$	(Eq. 26.9-6)
G	0.882	

Design Wind Pressure, p , Equation 30.8-1.

Figure 30.8-1 (Monoslope Free Roofs)

Roof Height	=	16.30 ft
Roof Angle	=	9.47 deg.
Dimension, a	=	4.4 ft.
Zone 1 Area	=	802 Sq.ft.
Zone 2 Area	=	578 Sq.ft.
Zone 3 Area	=	732 Sq.ft.

Clear Flow

Zone	k_h	K_3	K_{zt}	K_d	q_h (psf)	G	C_n	p (psf)
1(+)	0.86	1.00	1.00	0.85	24.86	0.882	1.65	36.25
1(-)	0.86	1.00	1.00	0.85	24.86	0.882	-1.53	-33.60
2(+)	0.86	1.00	1.00	0.85	24.86	0.882	1.65	36.25
2(-)	0.86	1.00	1.00	0.85	24.86	0.882	-1.53	-33.60
3(+)	0.86	1.00	1.00	0.85	24.86	0.882	1.65	36.25
3(-)	0.86	1.00	1.00	0.85	24.86	0.882	-1.53	-33.60

BUILDING MATERIALS

Member Description	Member Size:	Steel F _y (ksi)
Column C1	HSS8x8x1/4"	46
Column C2	HSS8x8x3/8"	46
Rafter Beam RA1	HSS12x8x1/4"	46
Rafter Beam RA2	HSS12x8x1/4"	46
Purlin P1	HSS7x5x3/16"	46
Purlin P2	HSS7x5x3/16"	46

Steel & Hardware Shop Notes:

1. All steel is to be ASTM A-36 except steel tubes.
2. Steel tubes shall be ASTM A-500 Grade B.
3. All welding is to be done in accordance with the latest AWS standards and all welds are to develop full strength of component parts. (E7081 Electrodes).
4. All bolts to be ASTM A-325.
5. All steel framing will receive a SPG commercial blast to a profile of 1.0 mil with a zinc-rich epoxy primer applied to 2.0 mil thickness and baked at 400 degrees F finished by a TGIC Polyester top coat applied to a 3.0 to 5.0 mil thickness and baked at 400 degrees F.

SUPPORT REACTIONS

Support Reactions

Units: Force Reactions Rx, Ry, Rz [lb]; Moment Reactions Rox, Roy, Roz [lb-ft]

Load Combination 66: ASCE7-10_1.4D

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-330.174	6840.616	1098.167	4365.179	-89.055	1508.971
3	-241.668	7038.500	-1098.205	-7420.264	-82.554	1518.420
5	0.000	9167.413	1432.406	5702.121	-0.000	-0.000
7	0.000	9279.455	-1432.329	-9688.889	-0.000	-0.000
9	330.174	6840.616	1098.167	4365.179	89.055	-1508.971
11	241.668	7038.500	-1098.205	-7420.264	82.554	-1518.420

Load Combination 67: ASCE7-10_1.2D+1.6LrorS+0.5WA-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-836.100	15168.561	3413.437	16355.545	-224.409	3835.545
3	-643.836	15374.038	-2184.978	-13477.099	-219.304	4064.886
5	0.000	21127.280	4592.285	22209.931	0.000	-0.000
7	0.000	21321.576	-2948.655	-18090.223	0.000	-0.000
9	836.100	15168.561	3413.437	16355.545	224.409	-3835.545
11	643.836	15374.038	-2184.978	-13477.099	219.304	-4064.886

Load Combination 68: ASCE7-10_1.2D+1.6LrorS+0.5WB-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-965.139	17798.503	3441.679	15905.952	-259.853	4432.497
3	-584.271	13492.033	-2229.604	-14246.731	-198.593	3684.693
5	0.000	24880.164	4605.221	21434.419	-0.000	-0.000
7	0.000	18637.307	-3031.088	-19290.640	-0.000	-0.000
9	965.139	17798.503	3441.679	15905.952	259.853	-4432.497
11	584.271	13492.033	-2229.604	-14246.731	198.593	-3684.693

Load Combination 69: ASCE7-10_1.2D+1.6LrorS+0.5WA-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-1283.822	21647.709	2973.478	7890.274	-347.330	5905.872
3	-981.784	23083.398	-4737.364	-34347.796	-336.777	6226.788
5	-0.000	30401.458	4006.781	10365.245	0.000	0.000
7	0.000	32316.587	-6364.264	-46730.797	0.000	-0.000
9	1283.822	21647.709	2973.478	7890.274	347.330	-5905.872
11	981.784	23083.398	-4737.364	-34347.796	336.777	-6226.788

Load Combination 70: ASCE7-10_1.2D+1.6LrorS+0.5WB-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-1328.605	22974.442	2958.886	8217.842	-359.678	6115.410
3	-871.028	20102.193	-4476.921	-32297.825	-298.194	5514.645
5	0.000	32298.398	4007.657	10955.170	-0.000	-0.000
7	-0.000	28056.322	-6001.589	-43802.054	-0.000	-0.000
9	1328.605	22974.442	2958.886	8217.842	359.678	-6115.410
11	871.028	20102.193	-4476.921	-32297.825	298.194	-5514.645

Load Combination 71: ASCE7-10_1.2D+1.6LrorS+0.5WA-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-586.204	16485.989	3256.876	14662.768	-19.557	-39.195
3	-302.036	15902.206	-2594.627	-16673.003	-440.755	-1408.550
5	320.742	22572.435	4432.265	20529.755	226.581	-4225.048
7	358.071	21567.369	-3328.850	-21086.255	-212.248	-5613.622
9	1206.244	15861.502	3277.489	15305.641	462.028	-8263.123
11	1010.502	15202.804	-2394.688	-14983.160	6.023	-9691.779

Load Combination 72: ASCE7-10_1.2D+1.6LrorS+0.5WB-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-854.455	19909.444	3206.666	11278.572	-64.651	1474.018
3	-494.279	19756.216	-3759.810	-26511.878	-481.449	22.419
5	282.502	28574.800	4265.785	14229.104	245.417	-3780.921
7	332.000	28324.483	-5288.567	-37914.821	-193.520	-5258.736
9	1507.427	20844.187	3175.745	10291.033	573.828	-9388.418

11	1234.124	20805.997	-4059.376	-29075.524	110.883	-10928.010
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Load Combination 73: ASCE7-10_1.2D+1.0WA-Z+0.5LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-106.627	3382.926	2030.304	13450.061	-26.955	486.861
3	-141.488	4528.170	426.415	5536.819	-47.206	887.485
5	-0.000	4287.076	2701.371	18221.649	0.000	0.000
7	0.000	5831.269	586.284	7827.723	0.000	-0.000
9	106.627	3382.926	2030.304	13450.061	26.955	-486.861
11	141.488	4528.170	426.415	5536.819	47.206	-887.485

Load Combination 74: ASCE7-10_1.2D+1.0WB-Z+0.5LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-363.748	8647.199	2077.680	12560.773	-97.374	1663.894
3	-23.004	759.840	346.526	4054.018	-6.232	143.698
5	0.000	11801.132	2709.733	16694.138	-0.000	-0.000
7	0.000	454.303	438.420	5533.097	-0.000	-0.000
9	363.748	8647.199	2077.680	12560.773	97.374	-1663.894
11	23.004	759.840	346.526	4054.018	6.232	-143.698

Load Combination 75: ASCE7-10_1.2D+1.0WA+Z+0.5LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-998.532	16365.165	1137.384	-3192.603	-271.348	4582.585
3	-814.473	19922.928	-4663.772	-35611.747	-280.491	5156.405
5	0.000	22880.095	1506.454	-4903.762	-0.000	-0.000
7	0.000	27776.665	-6224.188	-48345.627	-0.000	-0.000
9	998.532	16365.165	1137.384	-3192.603	271.348	-4582.585
11	814.473	19922.928	-4663.772	-35611.747	280.491	-5156.405

Load Combination 76: ASCE7-10_1.2D+1.0WB+Z+0.5LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-1088.060	19019.704	1113.357	-2537.862	-295.995	4999.229
3	-593.515	13959.476	-4148.067	-31550.403	-203.672	3744.374
5	0.000	26675.883	1518.093	-3728.229	-0.000	-0.000
7	0.000	19254.162	-5508.677	-42564.132	-0.000	-0.000
9	1088.060	19019.704	1113.357	-2537.862	295.995	-4999.229
11	593.515	13959.476	-4148.067	-31550.403	203.672	-3744.374

Load Combination 77: ASCE7-10_1.2D+1.0WA-X+0.5LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	389.124	6023.988	1714.432	10147.027	368.820	-6751.764
3	533.779	5578.311	-390.083	-725.322	-493.620	-9285.967
5	653.098	7185.798	2376.745	14972.643	439.572	-7966.511
7	726.803	6314.417	-170.019	2005.219	-427.888	-10506.426
9	843.481	4772.078	1756.564	11391.671	487.843	-8818.910
11	868.351	4182.445	9.290	2582.443	-383.015	-11369.113

Load Combination 78: ASCE7-10_1.2D+1.0WB-X+0.5LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-141.092	12884.450	1608.831	3542.549	284.742	-3980.548
3	156.958	13272.767	-2713.726	-20068.093	-571.492	-6799.746
5	572.277	19220.926	2032.472	2764.125	482.195	-7288.961
7	669.890	19798.273	-4080.439	-30901.185	-388.073	-10107.486
9	1443.124	14755.809	1545.561	1585.172	715.437	-11255.256
11	1313.480	15370.455	-3311.812	-25144.587	-172.250	-14121.739

Load Combination 79: ASCE7-10_1.2D+1.0E-Z+0.2LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-377.812	7674.376	1882.288	10122.853	-101.848	1727.369
3	-276.496	7279.615	-835.183	-4133.408	-94.392	1737.535
5	0.000	10414.456	2489.866	13425.993	-0.000	-0.000
7	-0.000	9765.133	-1098.076	-5418.143	-0.000	-0.000
9	377.812	7674.376	1882.288	10122.853	101.848	-1727.369
11	276.496	7279.615	-835.183	-4133.408	94.392	-1737.535

Load Combination 80: ASCE7-10_1.2D+1.0E+Z+0.2LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-377.786	7176.707	568.830	-379.260	-101.835	1726.879
3	-276.524	7777.278	-1616.037	-12439.168	-94.410	1738.208
5	-0.000	9761.405	740.112	-566.079	-0.000	0.000
7	-0.000	10418.197	-2131.697	-16449.195	0.000	0.000
9	377.786	7176.707	568.830	-379.260	101.835	-1726.879
11	276.524	7777.278	-1616.037	-12439.168	94.410	-1738.208

Load Combination 81: ASCE7-10_1.2D+1.0E-X+0.2LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	200.802	7425.566	1225.815	4871.834	-62.885	-6886.792
3	313.391	7528.421	-1225.857	-8287.025	-68.347	-9472.674
5	569.661	10087.972	1615.422	6429.942	36.163	-8595.453
7	579.334	10091.623	-1615.319	-10934.995	28.718	-11179.457
9	956.401	7425.563	1225.804	4871.745	140.798	-10341.040
11	866.410	7528.426	-1225.864	-8287.098	120.455	-12948.416

Load Combination 82: ASCE7-10_0.9D+1.0WA-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	200.478	-1994.187	1084.896	9602.080	55.636	-912.501
3	83.292	-712.825	1371.515	11819.786	29.349	-521.182
5	0.000	-3263.391	1427.791	12981.371	-0.000	-0.000
7	0.000	-1491.141	1860.481	16250.126	-0.000	-0.000
9	-200.478	-1994.187	1084.896	9602.080	-55.636	912.501
11	-83.292	-712.825	1371.515	11819.786	-29.349	521.182

Load Combination 83: ASCE7-10_0.9D+1.0WB-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-56.171	3272.081	1129.920	8713.778	-14.552	256.395
3	201.512	-4483.121	1294.066	10355.325	70.138	-1258.002
5	0.000	4254.385	1431.807	11457.432	0.000	-0.000
7	0.000	-6871.884	1716.786	13988.873	-0.000	-0.000
9	56.171	3272.081	1129.920	8713.778	14.552	-256.395
11	-201.512	-4483.121	1294.066	10355.325	-70.138	1258.002

Load Combination 84: ASCE7-10_0.9D+1.0WA+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-689.198	11004.392	186.668	-6830.744	-187.851	3155.442
3	-587.701	14665.576	-3712.353	-28932.591	-202.789	3709.682
5	0.000	15359.550	223.511	-9743.058	-0.000	0.000
7	-0.000	20424.365	-4942.653	-39195.517	-0.000	0.000
9	689.198	11004.392	186.668	-6830.744	187.851	-3155.442
11	587.701	14665.576	-3712.353	-28932.591	202.789	-3709.682

Load Combination 85: ASCE7-10_0.9D+1.0WB+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-778.659	13658.525	161.227	-6200.439	-212.436	3569.163
3	-367.320	8702.561	-3195.318	-24912.157	-126.334	2310.494
5	-0.000	19154.432	232.176	-8617.776	0.000	0.000
7	0.000	11902.709	-4223.998	-33492.226	0.000	-0.000
9	778.659	13658.525	161.227	-6200.439	212.436	-3569.163
11	367.320	8702.561	-3195.318	-24912.157	126.334	-2310.494

Load Combination 86: ASCE7-10_0.9D+1.0WA-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	695.086	649.488	768.001	6330.435	445.634	-7931.356
3	755.662	334.707	556.032	5611.775	-417.714	-10368.462
5	658.054	-361.217	1101.746	9772.862	433.896	-7756.625
7	730.949	-1011.454	1105.430	10494.880	-428.520	-10199.092
9	534.583	-603.629	810.677	7560.105	399.242	-7192.093
11	640.302	-1059.951	955.043	8888.652	-460.312	-9631.091

Load Combination 87: ASCE7-10_0.9D+1.0WB-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	166.062	7517.822	659.319	-180.218	360.885	-5177.559

3	379.627	8021.282	-1763.675	-13535.037	-496.046	-7890.814
5	577.353	11691.480	750.893	-2211.655	475.388	-7082.393
7	674.427	12454.853	-2799.652	-21974.726	-389.724	-9791.646
9	1132.916	9391.118	595.249	-2112.784	625.025	-9611.103
11	1084.252	10117.033	-2361.248	-18563.022	-251.409	-12347.006

Load Combination 88: ASCE7-10_0.9D+1.0E-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-212.137	4645.354	1361.484	8028.381	-57.203	968.616
3	-155.245	4276.936	-314.413	-623.693	-53.005	973.937
5	0.000	6218.089	1793.836	10610.424	-0.000	-0.000
7	-0.000	5640.612	-401.978	-725.885	-0.000	0.000
9	212.137	4645.354	1361.484	8028.381	57.203	-968.616
11	155.245	4276.936	-314.413	-623.693	53.005	-973.937

Load Combination 89: ASCE7-10_0.9D+1.0E+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-212.123	4150.376	48.913	-2420.042	-57.195	968.340
3	-155.260	4771.909	-1096.016	-8890.107	-53.015	974.314
5	-0.000	5569.724	45.372	-3285.660	0.000	0.000
7	0.000	6288.983	-1437.168	-11686.901	0.000	-0.000
9	212.123	4150.376	48.913	-2420.042	57.195	-968.340
11	155.260	4771.909	-1096.016	-8890.107	53.015	-974.314

Load Combination 90: ASCE7-10_0.9D+1.0E-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	365.418	4397.889	705.451	2804.189	-21.229	-7497.311
3	432.731	4524.398	-705.461	-4757.648	-28.861	-10017.156
5	572.742	5893.948	920.034	3662.372	33.350	-8456.961
7	582.196	5964.756	-920.002	-6207.704	26.900	-10974.995
9	789.678	4397.887	705.445	2804.141	93.169	-9434.267
11	743.236	4524.401	-705.465	-4757.687	77.159	-11965.407

Load Combination 91: ASD_ASCE7-10_1.0D

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-235.728	4886.465	783.945	3116.191	-63.566	1076.436
3	-172.526	5027.188	-783.965	-5289.070	-58.913	1082.806
5	-0.000	6548.696	1022.437	4070.037	-0.000	0.000
7	-0.000	6627.641	-1022.398	-6902.075	-0.000	0.000
9	235.728	4886.465	783.945	3116.191	63.566	-1076.436
11	172.526	5027.188	-783.965	-5289.070	58.913	-1082.806

Load Combination 92: ASD_ASCE7-10_1.0D+1.0LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-710.556	12694.998	2210.115	8780.698	-191.463	3255.996
3	-520.074	12506.682	-2210.308	-15004.984	-177.525	3278.238
5	-0.000	17695.235	2966.477	11804.928	0.000	0.000
7	-0.000	17321.047	-2966.091	-20199.207	0.000	0.000
9	710.556	12694.998	2210.115	8780.698	191.463	-3255.996
11	520.074	12506.682	-2210.308	-15004.984	177.525	-3278.238

Load Combination 93: ASD_ASCE7-10_1.0D+0.6WA-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	12.032	1053.026	1011.042	7222.806	4.217	-54.721
3	-29.270	1883.051	462.914	4697.319	-9.425	183.265
5	-0.000	1057.540	1325.933	9713.638	0.000	0.000
7	-0.000	2150.849	646.813	6645.647	-0.000	0.000
9	-12.032	1053.026	1011.042	7222.806	-4.217	54.721
11	29.270	1883.051	462.914	4697.319	9.425	-183.265

Load Combination 94: ASD_ASCE7-10_1.0D+0.6WB-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-142.060	4212.204	1040.558	6686.322	-37.949	648.562
3	41.772	-378.555	413.898	3806.133	15.121	-261.498
5	-0.000	5567.145	1333.153	8792.331	0.000	0.000
7	-0.000	-1076.515	555.873	5265.624	0.000	0.000

9	142.060	4212.204	1040.558	6686.322	37.949	-648.562
11	-41.772	-378.555	413.898	3806.133	-15.121	261.498

Load Combination 95: ASD_ASCE7-10_1.0D+0.6WA+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-521.803	8852.840	474.187	-2619.302	-141.894	2386.792
3	-431.775	11109.422	-2589.419	-19743.959	-148.650	2719.711
5	-0.000	12232.672	607.333	-3885.020	0.000	0.000
7	-0.000	15298.791	-3439.175	-26599.990	0.000	0.000
9	521.803	8852.840	474.187	-2619.302	141.894	-2386.792
11	431.775	11109.422	-2589.419	-19743.959	148.650	-2719.711

Load Combination 96: ASD_ASCE7-10_1.0D+0.6WB+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-575.447	10444.542	455.482	-2258.427	-156.621	2633.991
3	-299.709	7532.399	-2275.810	-17343.028	-102.881	1883.865
5	0.000	14508.092	605.767	-3244.198	-0.000	-0.000
7	0.000	10187.290	-3001.113	-23199.540	-0.000	-0.000
9	575.447	10444.542	455.482	-2258.427	156.621	-2633.991
11	299.709	7532.399	-2275.810	-17343.028	102.881	-1883.865

Load Combination 97: ASD_ASCE7-10_1.0D+0.6WA-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	309.604	2638.259	821.421	5244.617	239.867	-4323.278
3	375.434	2512.539	-26.914	951.641	-276.908	-5814.718
5	393.689	2797.554	1131.353	7768.248	261.949	-4707.949
7	437.296	2439.957	192.823	3164.447	-256.371	-6202.041
9	429.110	1886.871	847.013	5990.491	270.393	-4865.548
11	463.649	1675.262	212.462	2928.827	-248.392	-6361.612

Load Combination 98: ASD_ASCE7-10_1.0D+0.6WB-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-9.690	6758.685	756.354	1330.476	186.204	-2579.933
3	147.151	7125.060	-1418.917	-10550.321	-325.448	-4184.700
5	347.043	10028.136	921.141	563.562	284.212	-4221.541
7	405.510	10520.776	-2150.458	-16342.842	-234.521	-5829.654
9	788.482	7883.170	717.969	180.226	403.203	-6232.671
11	730.286	8382.002	-1777.558	-13556.032	-124.463	-7858.750

Load Combination 99: ASD_ASCE7-10_1.0D+0.7E-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-235.734	5059.846	1243.275	6776.125	-63.569	1076.543
3	-172.520	4853.809	-510.326	-2393.268	-58.909	1082.660
5	0.000	6775.857	1634.263	8938.851	-0.000	-0.000
7	0.000	6400.477	-659.959	-3061.304	-0.000	-0.000
9	235.734	5059.846	1243.275	6776.125	63.569	-1076.543
11	172.520	4853.809	-510.326	-2393.268	58.909	-1082.660

Load Combination 100: ASD_ASCE7-10_1.0D+0.7E+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-235.722	4713.062	324.372	-543.739	-63.563	1076.329
3	-172.532	5200.590	-1057.359	-8184.119	-58.917	1082.953
5	-0.000	6321.494	410.190	-798.766	-0.000	0.000
7	-0.000	6854.846	-1384.416	-10741.558	-0.000	0.000
9	235.722	4713.062	324.372	-543.739	63.563	-1076.329
11	172.532	5200.590	-1057.359	-8184.119	58.917	-1082.953

Load Combination 101: ASD_ASCE7-10_1.0D+0.7E-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	168.660	4886.466	783.948	3116.209	-38.051	-4865.646
3	239.250	5027.187	-783.963	-5289.055	-41.787	-6634.961
5	400.617	6548.696	1022.437	4070.037	23.663	-5934.957
7	407.256	6627.641	-1022.398	-6902.075	19.044	-7704.914
9	640.116	4886.465	783.943	3116.172	89.080	-7018.519
11	584.303	5027.189	-783.966	-5289.085	76.040	-8800.574

Load Combination 102: ASD_ASCE7-10_1.0D+0.45WA-Z+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-405.313	7872.101	2021.649	10489.443	-108.355	1853.460
3	-325.208	8274.389	-916.058	-4980.955	-110.453	2044.777
5	0.000	10798.209	2704.086	14190.571	-0.000	-0.000
7	-0.000	11282.130	-1224.775	-6519.609	-0.000	0.000
9	405.313	7872.101	2021.649	10489.443	108.355	-1853.460
11	325.208	8274.389	-916.058	-4980.955	110.453	-2044.777

Load Combination 103: ASD_ASCE7-10_1.0D+0.45WB-Z+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-521.145	10240.337	2045.694	10085.584	-140.108	2385.511
3	-271.765	6579.314	-954.787	-5662.069	-91.930	1706.987
5	-0.000	14178.249	2713.136	13495.605	-0.000	0.000
7	-0.000	8863.806	-1296.495	-7578.351	0.000	0.000
9	521.145	10240.337	2045.694	10085.584	140.108	-2385.511
11	271.765	6579.314	-954.787	-5662.069	91.930	-1706.987

Load Combination 104: ASD_ASCE7-10_1.0D+0.45WA+Z+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-806.794	13714.297	1622.340	3012.996	-218.388	3698.493
3	-628.039	15201.839	-3209.133	-23500.625	-215.418	3965.198
5	-0.000	19165.366	2171.154	3807.868	-0.000	0.000
7	-0.000	21157.263	-4294.297	-31804.386	-0.000	0.000
9	806.794	13714.297	1622.340	3012.996	218.388	-3698.493
11	628.039	15201.839	-3209.133	-23500.625	215.418	-3965.198

Load Combination 105: ASD_ASCE7-10_1.0D+0.45WB+Z+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-847.052	14908.028	1607.990	3290.285	-229.459	3885.053
3	-528.753	12519.105	-2973.580	-21683.472	-180.941	3333.057
5	0.000	20871.894	2169.434	4302.617	-0.000	-0.000
7	-0.000	17323.700	-3965.257	-29222.154	-0.000	-0.000
9	847.052	14908.028	1607.990	3290.285	229.459	-3885.053
11	528.753	12519.105	-2973.580	-21683.472	180.941	-3333.057

Load Combination 106: ASD_ASCE7-10_1.0D+0.45WA-X+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-181.259	9059.466	1880.105	8986.092	71.792	-1475.672
3	-19.733	8748.062	-1284.105	-7822.732	-310.487	-2644.918
5	292.313	12101.118	2559.190	12705.274	199.797	-3652.234
7	325.374	11501.068	-1566.191	-9172.287	-191.721	-4830.357
9	737.127	8496.654	1899.018	9555.128	317.843	-5675.164
11	652.764	8119.374	-1104.399	-6321.564	-82.287	-6870.380

Load Combination 107: ASD_ASCE7-10_1.0D+0.45WB-X+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-421.956	12145.813	1832.905	6003.267	30.789	-125.886
3	-192.278	12211.429	-2330.155	-16548.324	-347.334	-1364.180
5	257.946	17515.140	2404.989	7188.454	216.030	-3255.402
7	302.148	17570.588	-3326.453	-24025.086	-175.458	-4506.896
9	1007.388	12988.404	1804.544	5131.670	417.303	-6677.498
11	853.338	13154.909	-2599.431	-18822.688	10.947	-7960.805

Load Combination 108: ASD_ASCE7-10_1.0D+0.525E-Z+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-591.687	10874.760	2197.826	10134.678	-159.423	2709.118
3	-433.033	10504.914	-1648.152	-10367.860	-147.783	2726.410
5	-0.000	15082.354	2938.842	13569.378	0.000	0.000
7	-0.000	14473.941	-2208.040	-13927.866	0.000	0.000
9	591.687	10874.760	2197.826	10134.678	159.423	-2709.118
11	433.033	10504.914	-1648.152	-10367.860	147.783	-2726.410

Load Combination 109: ASD_ASCE7-10_1.0D+0.525E+Z+0.75LrorS						
Node	Rx	Ry	Rz	Rox	Roy	Roz

1	-591.666	10611.895	1507.769	4589.262	-159.412	2708.714
3	-433.055	10767.773	-2057.707	-14751.795	-147.798	2726.964
5	-0.000	14736.615	2019.494	6164.115	0.000	0.000
7	0.000	14819.692	-2749.769	-19762.657	0.000	-0.000
9	591.666	10611.895	1507.769	4589.262	159.412	-2708.714
11	433.055	10767.773	-2057.707	-14751.795	147.798	-2726.964

Load Combination 110: ASD_ASCE7-10_1.0D+0.525E-X+0.75LrorS

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-287.172	10743.335	1852.872	7362.005	-137.180	-1905.904
3	-121.990	10636.335	-1852.996	-12560.012	-133.041	-3294.833
5	296.899	14909.496	2479.289	9866.740	20.648	-4598.325
7	302.133	14646.805	-2479.025	-16845.632	16.087	-5994.729
9	896.181	10743.333	1852.862	7361.929	181.655	-7323.736
11	744.098	10636.339	-1853.002	-12560.074	162.541	-8748.207

Load Combination 111: ASD_ASCE7-10_0.6D+0.6WA-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	106.192	-902.815	697.683	5957.591	29.588	-483.573
3	39.651	-126.570	776.214	6786.328	14.090	-248.231
5	-0.000	-1564.130	917.398	8052.080	0.000	0.000
7	-0.000	-498.014	1055.466	9359.154	0.000	0.000
9	-106.192	-902.815	697.683	5957.591	-29.588	483.573
11	-39.651	-126.570	776.214	6786.328	-14.090	248.231

Load Combination 112: ASD_ASCE7-10_0.6D+0.6WB-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-47.807	2256.779	726.736	5421.603	-12.532	218.109
3	110.641	-2388.587	727.679	5899.049	38.600	-691.610
5	-0.000	2946.227	923.782	7132.009	0.000	0.000
7	0.000	-3726.140	965.328	7986.058	0.000	0.000
9	47.807	2256.779	726.736	5421.603	12.532	-218.109
11	-110.641	-2388.587	727.679	5899.049	-38.600	691.610

Load Combination 113: ASD_ASCE7-10_0.6D+0.6WA+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-427.198	6900.407	159.868	-3840.006	-116.342	1952.413
3	-362.455	9096.390	-2274.981	-17573.067	-124.905	2280.597
5	-0.000	9616.991	197.143	-5465.589	0.000	0.000
7	-0.000	12643.945	-3029.223	-23741.894	0.000	0.000
9	427.198	6900.407	159.868	-3840.006	116.342	-1952.413
11	362.455	9096.390	-2274.981	-17573.067	124.905	-2280.597

Load Combination 114: ASD_ASCE7-10_0.6D+0.6WB+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-480.831	8492.028	140.894	-3484.013	-131.058	2199.050
3	-230.504	5519.453	-1961.118	-15180.477	-79.208	1447.297
5	0.000	11892.242	195.039	-4834.344	-0.000	-0.000
7	-0.000	7532.603	-2590.595	-20356.749	-0.000	0.000
9	480.831	8492.028	140.894	-3484.013	131.058	-2199.050
11	230.504	5519.453	-1961.118	-15180.477	79.208	-1447.297

Load Combination 115: ASD_ASCE7-10_0.6D+0.6WA-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	403.560	682.975	507.878	3986.299	264.006	-4706.570
3	443.827	502.363	286.569	3052.051	-253.623	-6177.945
5	394.585	176.592	722.562	6115.237	260.733	-4664.095
7	438.045	-209.616	601.700	5891.633	-256.600	-6137.136
9	334.626	-68.672	533.567	4728.865	243.744	-4389.636
11	394.138	-334.656	525.882	5022.741	-272.156	-5861.247

Load Combination 116: ASD_ASCE7-10_0.6D+0.6WB-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	84.530	4805.044	442.243	92.175	210.296	-2969.102
3	215.753	5113.238	-1104.713	-8409.381	-302.184	-4553.723
5	347.924	7410.708	511.182	-1043.775	282.853	-4180.594

7	406.287	7867.673	-1740.632	-13528.582	-234.886	-5766.788
9	693.737	5929.933	403.715	-1052.816	376.278	-5755.657
11	660.551	6369.776	-1463.263	-11405.078	-148.531	-7354.973

Load Combination 117: ASD_ASCE7-10_0.6D+0.7E-Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-141.374	3104.847	929.216	5516.655	-38.114	645.087
3	-103.456	2843.345	-196.282	-279.694	-35.313	648.531
5	0.000	4155.691	1224.568	7288.419	-0.000	-0.000
7	-0.000	3750.112	-250.235	-304.427	-0.000	0.000
9	141.374	3104.847	929.216	5516.655	38.114	-645.087
11	103.456	2843.345	-196.282	-279.694	35.313	-648.531

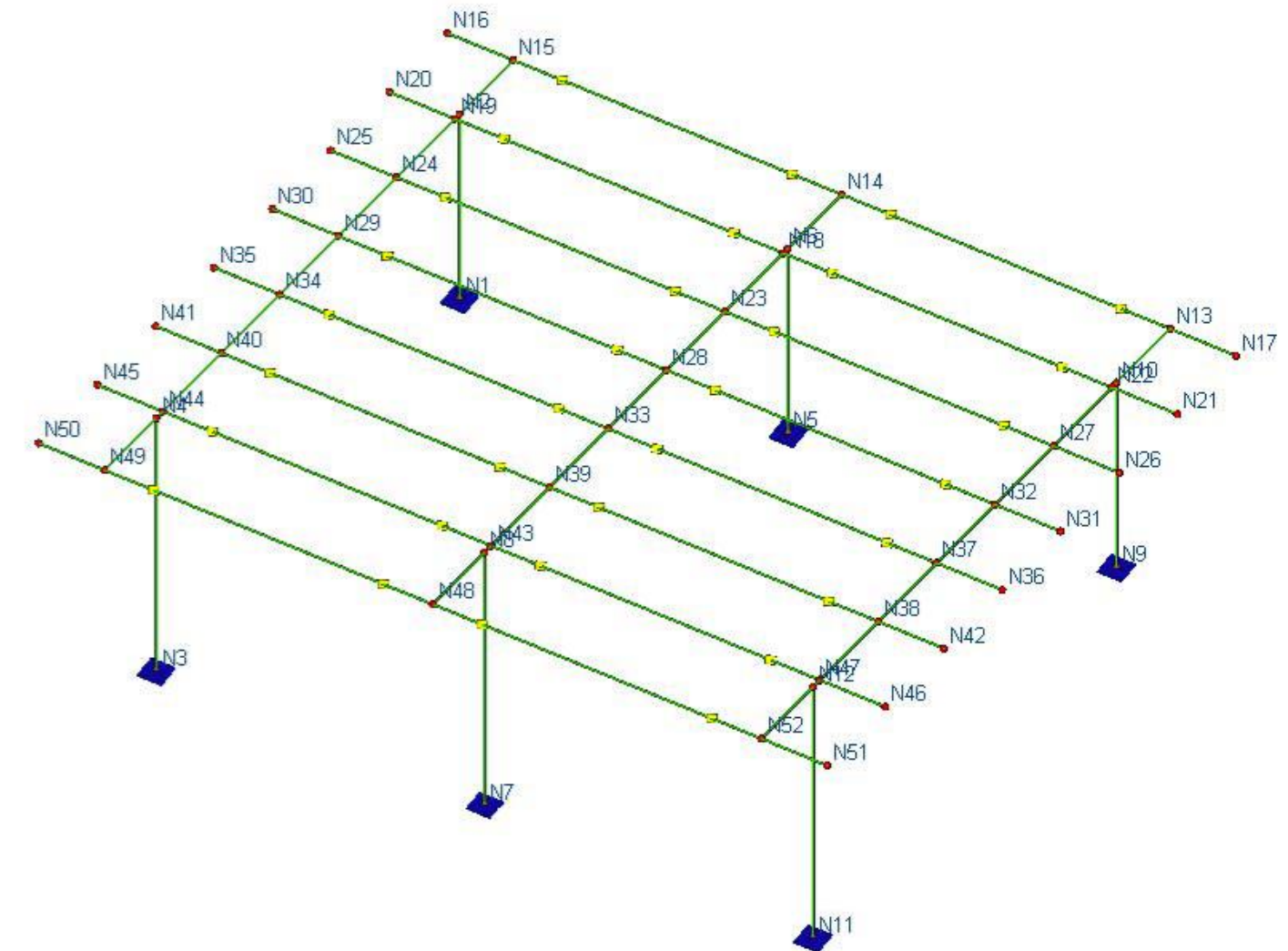
Load Combination 118: ASD_ASCE7-10_0.6D+0.7E+Z

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	-141.367	2759.259	10.725	-1779.404	-38.110	644.959
3	-103.463	3188.931	-743.672	-6053.152	-35.318	648.706
5	0.000	3703.351	1.086	-2407.917	-0.000	-0.000
7	0.000	4202.454	-975.392	-7954.624	-0.000	-0.000
9	141.367	2759.259	10.725	-1779.404	38.110	-644.959
11	103.463	3188.931	-743.672	-6053.152	35.318	-648.706

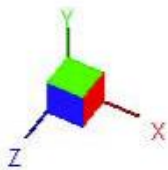
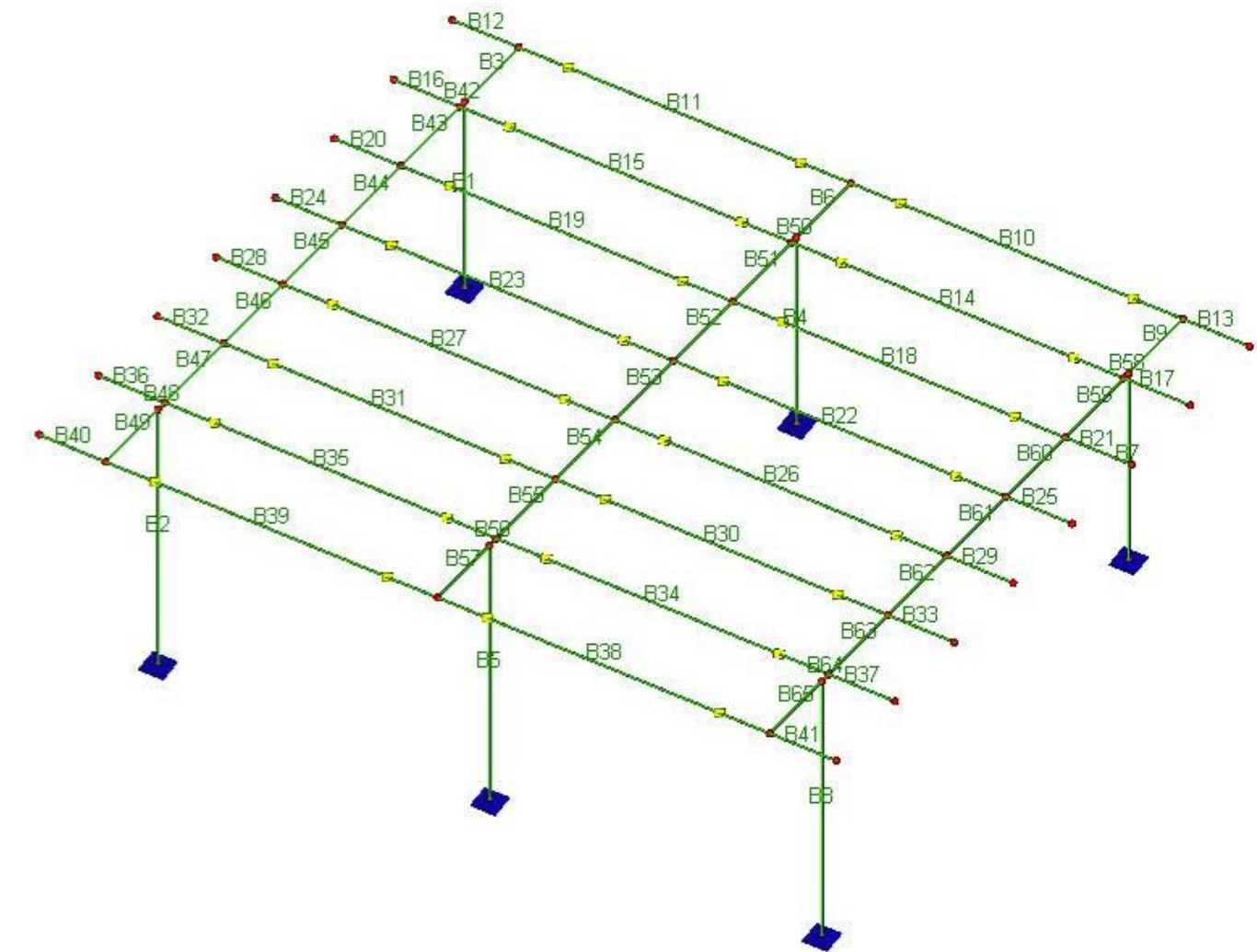
Load Combination 119: ASD_ASCE7-10_0.6D+0.7E-X

Node	Rx	Ry	Rz	Rox	Roy	Roz
1	262.606	2932.065	470.093	1868.635	-13.919	-5233.565
3	307.573	3016.126	-470.098	-3166.789	-19.064	-6974.678
5	401.814	3929.541	613.037	2440.247	22.410	-5875.208
7	408.369	3976.263	-613.023	-4130.164	18.202	-7616.188
9	545.346	2932.064	470.090	1868.613	62.306	-6523.611
11	514.492	3016.127	-470.100	-3166.807	51.567	-8271.914

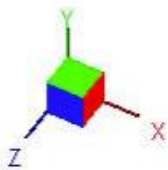
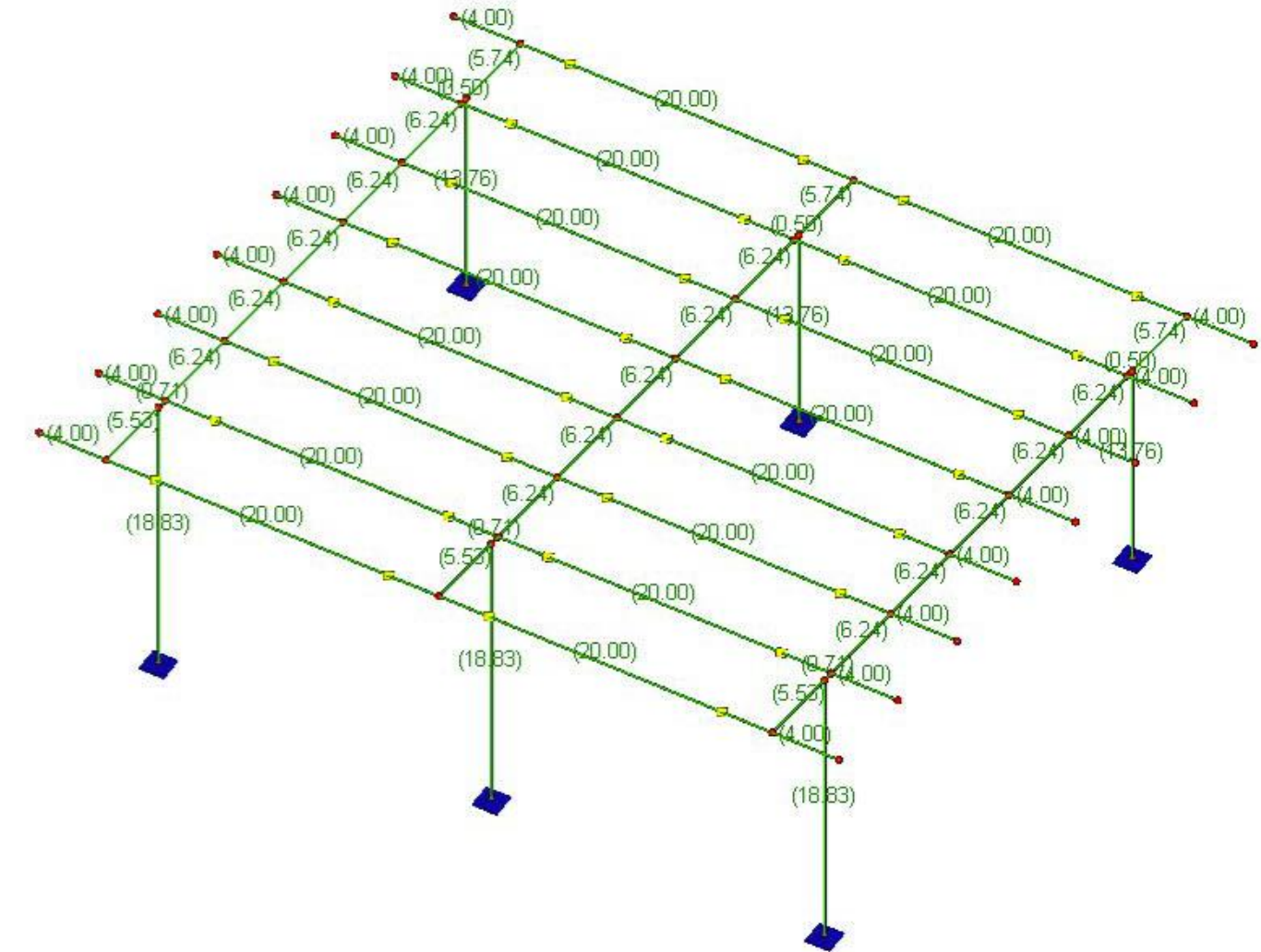
STRUCTURAL GEOMETRY AND COMPUTER MODEL



Node Numbers



Member Numbers



Member Lengths

STRUCTURAL ANALYSIS AND DESIGN

Member End Forces and Moments

Units: Force Fx, Fy, Fz [lb]; Moment Mx, My, Mz [lb-ft]

Load Combination 66: ASCE7-10, 1.4D		Fx (Axial)		Fy (Major)		Fz (Minor)		Mx (Torsion)		My (Minor)		Mz (Major)	
Member	Node												
1	1	-6840.616	330.144	1095.992	89.055	-4365.176	-1508.971						
	2	-6381.123	330.144	1095.992	89.055	10713.418	3033.128						
2	3	-7038.500	241.656	-1099.734	82.554	7420.266	-1518.421						
	4	-6117.550	241.656	-1099.734	82.554	-13282.245	3030.766						
3	15	136.617	-863.307	-42.282	-493.073	-78.069	92.844						
	2	174.426	-1102.105	-42.282	-493.073	-320.612	-5544.249						
4	5	-9167.413	-0.000	1428.588	0.000	-5702.115	0.000						
	6	-8707.920	-0.000	1428.588	0.000	13952.304	-0.000						
5	7	-9279.455	-0.000	-1434.990	0.000	9688.894	0.000						
	8	-8358.505	-0.000	-1434.990	0.000	-17324.811	0.000						
6	14	195.177	-1233.476	-0.000	-0.000	-0.000	-185.688						
	6	232.986	-1472.274	-0.000	-0.000	-0.000	-7946.181						
7	9	-6840.616	-330.144	1095.992	-89.055	-4365.176	1508.971						
	10	-6381.123	-330.144	1095.992	-89.055	10713.418	-3033.128						
8	11	-7038.500	-241.656	-1099.734	-82.554	7420.266	1518.421						
	12	-6117.550	-241.656	-1099.734	-82.554	-13282.245	-3030.766						
9	13	136.617	-863.307	42.282	493.073	78.069	92.844						
	10	174.426	-1102.105	42.282	493.073	320.612	-5544.249						
10	13	42.284	615.515	-102.671	0.000	0.000	0.000						
	14	42.284	-615.515	-102.671	0.000	0.000	-0.000						
11	14	42.284	615.515	-102.671	0.000	0.000	0.000						
	15	42.284	-615.515	-102.671	0.000	0.000	-0.000						
12	15	0.000	246.206	-41.068	0.000	82.136	-492.412						
	16	0.000	0.000	-0.000	0.000	-0.000	-0.000						
13	17	-0.000	-0.000	-0.000	0.000	-0.000	0.000						
	13	-0.000	-246.206	41.068	0.000	82.136	-492.412						
14	22	288.184	1046.362	-174.538	0.000	0.000	0.000						
	18	288.184	-1046.362	174.538	0.000	-0.000	-0.000						
15	18	288.184	1046.362	-174.538	0.000	0.000	0.000						
	19	288.184	-1046.362	174.538	0.000	-0.000	0.000						
16	19	-0.000	418.545	-69.815	-0.000	139.630	-837.090						
	20	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000						
17	21	0.000	-0.000	0.000	0.000	0.000	-0.000						
	22	0.000	-418.545	69.815	0.000	139.630	-837.090						
18	27	-19.702	1046.362	-174.538	0.000	0.000	0.000						
	23	-19.702	-1046.362	174.538	0.000	0.000	0.000						
19	23	-19.702	1046.362	-174.538	0.000	0.000	0.000						
	24	-19.702	-1046.362	174.538	0.000	0.000	-0.000						
20	24	0.000	418.545	-69.815	-0.000	139.630	-837.090						
	25	0.000	0.000	-0.000	-0.000	-0.000	0.000						
21	26	0.000	-0.000	0.000	0.000	0.000	-0.000						
	27	0.000	-418.545	69.815	0.000	139.630	-837.090						
22	32	-0.555	1046.362	-174.538	0.000	0.000	0.000						
	28	-0.555	-1046.362	174.538	0.000	0.000	0.000						

23	28	-0.555	1046.362	-174.538	0.000	0.000	0.000						
	29	-0.555	-1046.362	174.538	0.000	0.000	0.000						
24	29	0.000	418.545	-69.815	0.000	139.630	-837.090						
	30	0.000	0.000	0.000	0.000	0.000	0.000						
25	31	0.000	-0.000	0.000	0.000	0.000	-0.000						
	32	0.000	-418.545	69.815	0.000	139.630	-837.090						
26	37	-11.701	1046.362	-174.538	0.000	0.000	0.000						
	33	-11.701	-1046.362	174.538	0.000	0.000	0.000						
27	33	-11.701	1046.362	-174.538	0.000	0.000	0.000						
	34	-11.701	-1046.362	174.538	0.000	-0.000	-0.000						
28	34	-0.000	418.545	-69.815	0.000	139.630	-837.090						
	35	-0.000	0.000	-0.000	0.000	-0.000	0.000						
29	36	0.000	0.000	-0.000	0.000	0.000	-0.000						
	37	0.000	-418.545	69.815	0.000	139.630	-837.090						
30	38	40.215	1046.362	-174.538	0.000	0.000	0.000						
	39	40.215	-1046.362	174.538	0.000	0.000	0.000						
31	39	40.215	1046.362	-174.538	0.000	0.000	0.000						
	40	40.215	-1046.362	174.538	0.000	0.000	0.000						
32	40	-0.000	418.545	-69.815	-0.000	139.630	-837.090						
	41	-0.000	0.000	-0.000	-0.000	0.000	0.000						
33	42	-0.000	-0.000	0.000	-0.000	0.000	-0.000						
	38	-0.000	-418.545	69.815	-0.000	139.630	-837.090						
34	47	224.345	1046.362	-174.538	0.000	0.000	0.000						
	43	224.345	-1046.362	174.538	0.000	0.000	-0.000						
35	43	224.345	1046.362	-174.538	0.000	0.000	0.000						
	44	224.345	-1046.362	174.538	0.000	0.000	0.000						
36	44	0.000	418.545	-69.815	-0.000	139.630	-837.090						
	45	0.000	0.000	0.000	-0.000	0.000	-0.000						
37	46	0.000	0.000	0.000	0.000	0.000	-0.000						
	47	0.000	-418.545	69.815	0.000	139.630	-837.090						
38	52	8.774	615.515	-102.671	0.000	0.000	0.000						
	48	8.774	-615.515	102.671	0.000	0.000	0.000						
39	48	8.774	615.515	-102.671	0.000	0.000	0.000						
	49	8.774	-615.515	102.671	0.000	0.000	0.000						
40	49	-0.000	246.206	-41.068	0.000	82.136	-492.412						
	50	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000						
41	51	0.000	-0.000	0.000	0.000	0.000	-0.000						
	52	0.000	-246.206	41.068	0.000	82.136	-492.412						
42	2	-1883.356	5044.545	287.942	2516.955	53.372	-16257.659						
	19	-1880.137	5023.546	287.942	2516.955	198.507	-13720.290						
43	19	-1673.980	3546.998	-0.279	1677.702	78.842	-13592.057						
	24	-1632.760	3287.328	-0.279	1677.702	77.099	7724.479						
44	24	-1399.203	1818.636	19.407	839.519	-56.283	7877.840						
	29	-1358.093	1558.993	19.407	839.519	64.762	18411.042						
45	29	-1125.817	88.559	19.964	1.285	-67.954	18474.048						
	34	-1084.781	-171.096	19.964	1.285	56.562	18216.653						
46	34	-852.015	-1640.811	31.663	-836.923	-76.390	18152.437						
	40	-810.825	-1900.487	31.663	-836.923	121.129	7106.985						

47	40	-579.115	-3366.884	-8.553	-1675.102	-11.349	6954.901						
	44	-538.006	-3626.527	-8.553	-1675.102	-64.694	-14854.181						
48	44	-305.768	-5092.229	-232.893	-2513.316	-197.410	-14976.220						
	4	-301.085	-5121.807	-232.893	-2513.316	-362.880	-18604.751						
49	4	-173.071	1092.712	8.775	493.073	29.542	-5322.495						
	49	-136.620	862.488	8.775	493.073	78.069	83.978						
50	6	-2509.554	6928.150	-0.000	-0.000	-0.000	-21898.467						
	18	-2506.336	6920.151	-0.000	-0.000	-0.000	-18411.684						
51	18	-2210.321	4798.935	-0.000	-0.000	-0.000	-18668.147						
	23	-2169.101	4539.265	-0.000	-0.000	-0.000	10458.070						
52	23	-1835.515	2440.249	0.000	-0.000	-0.000	10151.338						
	28	-1794.406	2180.606	0.000	-0.000	-0.000	24561.564						

	37	0.000	-1157.726	224.109	0.000	448.219	-2315.453		
30	38	105.975	2894.316	-560.274	0.000	0.000	0.000		
	39	105.975	-2894.316	560.274	0.000	0.000	0.000		
31	39	105.975	2894.316	-560.274	0.000	0.000	0.000		
	40	105.975	-2894.316	560.274	0.000	0.000	-0.000		
32	40	0.000	1157.726	-224.109	0.000	448.219	-2315.453		
	41	0.000	-0.000	0.000	0.000	0.000	-0.000		
33	42	-0.000	-0.000	0.000	0.000	-0.000	0.000		
	38	-0.000	-1157.726	224.109	0.000	448.219	-2315.453		
34	47	602.668	2894.316	-560.274	0.000	0.000	0.000		
	43	602.668	-2894.316	560.274	0.000	0.000	-0.000		
35	43	602.668	2894.316	-560.274	0.000	-0.000	0.000		
	44	602.668	-2894.316	560.274	0.000	0.000	0.000		
36	44	0.000	1157.726	-224.109	-0.000	448.219	-2315.453		
	45	0.000	0.000	0.000	-0.000	0.000	0.000		
37	46	0.000	-0.000	0.000	0.000	-0.000	0.000		
	47	0.000	-1157.726	224.109	0.000	448.219	-2315.453		
38	52	31.544	1526.276	-293.338	0.000	0.000	0.000		
	48	31.544	-1526.276	293.338	0.000	0.000	0.000		
39	48	31.544	1526.276	-293.338	0.000	0.000	0.000		
	49	31.544	-1526.276	293.338	0.000	0.000	0.000		
40	49	-0.000	610.511	-117.335	-0.000	234.671	-1221.021		
	50	-0.000	0.000	-0.000	-0.000	0.000	-0.000		
41	51	0.000	-0.000	0.000	0.000	0.000	0.000		
	52	0.000	-610.511	117.335	0.000	234.671	-1221.021		
42	2	-5088.437	11984.167	740.684	6493.427	170.402	-41470.897		
	19	-5085.677	11966.168	740.684	6493.427	543.738	-35434.914		
43	19	-4393.439	8267.056	15.497	4390.693	146.531	-35114.550		
	24	-4358.107	8044.482	15.497	4390.693	243.205	15761.786		
44	24	-3600.858	4357.184	64.339	2290.868	-189.438	16169.420		
	29	-3565.621	4134.633	64.339	2290.868	211.844	42651.313		
45	29	-2811.426	437.048	65.365	190.884	-219.108	42833.829		
	34	-2776.252	214.487	65.365	190.884	188.576	44865.653		
46	34	-2024.319	-3858.982	96.344	-2128.176	-241.063	44709.133		
	40	-1989.013	-4081.560	96.344	-2128.176	359.936	19942.260		
47	40	-1239.250	-8137.499	-9.640	-4447.147	-68.548	19534.813		
	44	-1204.014	-8360.050	-9.640	-4447.147	-128.674	-31913.103		
48	44	-453.035	-12410.774	-612.285	-6766.222	-557.764	-32266.279		
	4	-449.021	-12436.126	-612.285	-6766.222	-992.792	-41093.129		
49	4	-424.268	2334.725	31.550	1222.917	50.099	-12109.282		
	49	-393.024	2137.390	31.550	1222.917	224.583	256.904		
50	6	-6991.573	16889.671	-0.000	0.000	0.000	-57415.655		
	18	-6988.813	16871.672	-0.000	0.000	0.000	-48907.093		
51	18	-5998.929	11590.335	-0.000	0.000	0.000	-49547.743		
	23	-5963.598	11367.760	-0.000	0.000	-0.000	22059.472		
52	23	-4881.849	6093.761	0.000	0.000	-0.000	21244.038		
	28	-4846.612	5871.210	0.000	0.000	-0.000	58557.029		
53	28	-3769.203	579.034	0.000	0.000	-0.000	58191.935		
	33	-3734.029	356.473	0.000	0.000	-0.000	61109.331		

54	33	-2659.854	-5467.874	-0.000	0.000	-0.000	0.000	61422.418	
	39	-2624.548	-5690.452	-0.000	0.000	-0.000	0.000	26619.148	
55	39	-1553.462	-11482.646	-0.000	0.000	-0.000	0.000	27434.206	
	43	-1518.225	-11705.197	-0.000	0.000	-0.000	0.000	-44877.515	
56	43	-445.649	-17488.305	0.000	0.000	-0.000	0.000	-41471.222	
	8	-441.635	-17513.657	0.000	0.000	-0.000	0.000	-56605.654	
57	8	-592.693	3249.589	-0.000	-0.000	0.000	-0.000	-17939.513	
	48	-561.449	3052.253	-0.000	-0.000	-0.000	-0.000	-513.808	
58	10	-5088.437	11984.167	-740.684	-6493.427	-170.402	-41470.897		
	22	-5085.677	11966.168	-740.684	-6493.427	-543.738	-35434.914		
59	22	-4393.439	8267.056	-15.497	-4390.693	-146.531	-35114.550		
	27	-4358.107	8044.482	-15.497	-4390.693	-243.205	15761.786		
60	27	-3600.858	4357.184	-64.339	-2290.868	189.438	16169.420		
	32	-3565.621	4134.633	-64.339	-2290.868	211.844	42651.313		
61	32	-2811.426	437.048	-65.365	-190.884	219.108	42833.829		
	37	-2776.252	214.487	-65.365	-190.884	-188.576	44865.653		
62	37	-2024.319	-3858.982	-96.344	2128.176	241.063	44709.133		
	38	-1989.013	-4081.560	-96.344	2128.176	-359.936	19942.260		
63	38	-1239.250	-8137.499	9.640	4447.147	68.548	19534.813		
	47	-1204.014	-8360.050	9.640	4447.147	128.674	-31913.103		
64	47	-453.035	-12410.774	612.285	6766.222	557.764	-32266.279		
	12	-449.021	-12436.126	612.285	6766.222	992.792	-41093.129		
65	12	-424.268	2334.725	-31.550	-1222.917	-50.099	-12109.282		
	52	-393.024	2137.390	-31.550	-1222.917	-224.583	256.904		

Load Combination 68: ASCE7-10_1.2D+1.6LrOrS+0.5WB-Z		Fx(Axial)		Fy (Major)		Fz (Minor)		Mx (Torsion)		My (Minor)		Mz (Major)	
Member	Node												
1	1	-17798.503	964.904	3443.179	259.853	-15905.934	-4432.492						
	2	-17404.652	964.904	3288.264	259.853	30399.447	8842.594						
2	3	-13492.033	584.211	-2228.463	198.593	14246.756	-3684.699						
	4	-12702.647	584.211	-2440.433	198.593	-29699.262	7313.078						
3	15	390.339	-2467.916	-121.842	-1408.750	-223.049	247.677						
	2	422.746	-2672.600	-121.842	-1408.750	921.971	-14496.087						
4	5	-24880.165	-0.000	4608.297	0.000	-21434.374	0.000						
	6	-24486.314	-0.000	4453.383	0.000	40900.631	-0.000						
5	7	-18637.306	-0.000	-3028.809	0.000	19290.704	0.000						
	8	-17847.921	-0.000	-3240.779	0.000	-39721.841	0.000						
6	14	557.614	-3527.038	0.000	0.000	0.000	-495.355						
	6	590.022	-3731.722	0.000	0.000	0.000	-21314.553						
7	9	-17798.503	-964.904	3443.179	-259.853	-15905.934	4432.492						
	10	-17404.652	-964.904	3288.264	-259.853	30399.447	-8842.594						
8	11	-13492.033	-584.211	-2228.463	-198.593	14246.756	3684.699						
	12	-12702.647	-584.211	-2440.433	-198.593	-29699.262	-7313.078						
9	13	390.339	-2467.916	121.842	1408.750	223.049	247.677						
	10	422.746	-2672.600	121.842	1408.750	921.971	-14496.087						
10	13	121.854	1758.576	-293.338	0.000	0.000	0.000						
	14	121.854	-1758.576	293.338	0.000	0.000	0.000						
11	14	121.854	1758.576	-293.338	0.000	0.000	0.000						
	15	121.854	-1758.576	293.338	0.000	-0.000	0.000						

12	15	0.000	703.431	-117.335	-0.000	234.671	-1406.861
	16	0.000	0.000	-0.000	-0.000	0.000	0.000
13	17	-0.000	-0.000	0.000	0.000	-0.000	-0.000
	13	-0.000	-703.431	117.335	0.000	234.671	-1406.861
14	22	837.087	3358.866	-560.274	0.000	0.000	-0.000
	18	837.087	-3358.866	560.274	0.000	0.000	0.000
15	18	837.087	3358.866	-560.274	0.000	-0.000	0.000
	19	837.087	-3358.866	560.274	0.000	0.000	-0.000
16	19	-0.000	1343.546	-224.109	-0.000	448.219	-2687.093
	20	-0.000	0.000	-0.000	-0.000	-0.000	0.000
17	21	0.000	-0.000	0.000	0.000	0.000	-0.000
	22	0.000	-1343.546	224.109	0.000	448.219	-2687.093
18	27	-56.408	3358.866	-560.274	0.000	0.000	0.000
	23	-56.408	-3358.866	560.274	0.000	0.000	-0.000
19	23	-56.408	3358.866	-560.274	0.000	0.000	0.000
	24	-56.408	-3358.866	560.274	0.000	-0.000	0.000
20	24	0.000	1343.546	-224.109	-0.000	448.219	-2687.093
	25	0.000	0.000	0.000	-0.000	0.000	0.000
21	26	0.000	-0.000	0.000	0.000	0.000	-0.000
	27	0.000	-1343.546	224.109	0.000	448.219	-2687.093
22	32	-3.128	3358.866	-560.274	0.000	0.000	0.000
	28	-3.128	-3358.866	560.274	0.000	-0.000	0.000
23	28	-3.128	3358.866	-560.274	0.000	-0.000	0.000
	29	-3.128	-3358.866	560.274	0.000	0.000	0.000
24	29	-0.000	1343.546	-224.109	-0.000	448.219	-2687.093
	30	-0.000	0.000	-0.000	0.000	-0.000	0.000
25	31	0.000	-0.000	0.000	0.000	0.000	-0.000
	32	0.000	-1343.546	224.109	0.000	448.219	-2687.093
26	37	-29.043	2310.566	-560.274	0.000	0.000	0.000
	33	-29.043	-2310.566	560.274	0.000	0.000	0.000
27	33	-29.043	2310.566	-560.274	0.000	0.000	0.000
	34	-29.043	-2310.566	560.274	0.000	0.000	0.000
28	34	0.000	924.226	-224.109	-0.000	448.219	-1848.453
	35	0.000	-0.000	0.000	-0.000	0.000	-0.000
29	36	0.000	-0.000	0.000	0.000	0.000	0.000
	37	0.000	-924.226	224.109	0.000	448.219	-1848.453
30	38	96.562	2310.566	-560.274	0.000	0.000	-0.000
	39	96.562	-2310.566	560.274	0.000	0.000	0.000
31	39	96.562	2310.566	-560.274	0.000	0.000	0.000
	40	96.562	-2310.566	560.274	0.000	0.000	-0.000
32	40	0.000	924.226	-224.109	-0.000	448.219	-1848.453
	41	0.000	0.000	-0.000	-0.000	-0.000	0.000
33	42	0.000	-0.000	0.000	-0.000	0.000	-0.000
	38	0.000	-924.226	224.109	-0.000	448.219	-1848.453
34	47	546.946	2310.566	-560.274	0.000	0.000	0.000
	43	546.946	-2310.566	560.274	0.000	-0.000	-0.000
35	43	546.946	2310.566	-560.274	0.000	0.000	0.000
	44	546.946	-2310.566	560.274	0.000	0.000	-0.000

43	19	-5259.409	11734.825	-14.970	6733.447	346.525	-40915.901
	24	-5224.078	11512.251	-14.970	6733.447	253.139	31592.654
44	24	-4481.889	5812.090	60.311	3492.505	-171.015	32232.846
	29	-4446.653	5589.538	60.311	3492.505	205.144	67789.041
45	29	-3709.102	-127.242	61.932	251.401	-216.404	68039.103
	34	-3673.929	-349.804	61.932	251.401	-169.867	66551.426
46	34	-2938.479	-6551.618	109.257	-3274.930	-250.114	66771.829
	40	-2903.173	-6774.196	109.257	-3274.930	-431.439	24708.074
47	40	-2171.743	-12943.188	-52.620	-6801.160	-13.248	24069.112
	46	-2136.506	-13165.740	-52.620	-6801.160	-314.943	-57352.066
48	44	-1403.704	-19322.642	-970.890	10327.513	734.066	-57848.023
	44	-1399.690	-19347.995	-970.890	10327.513	-1423.882	-71585.751
49	4	-415.536	3390.312	-10.865	-1826.576	-159.512	-17860.151
	49	-384.291	3192.976	-10.865	-1826.576	-219.599	343.803
50	6	-8096.915	24751.504	0.000	0.000	0.000	-69881.407
	18	-8094.156	24733.505	0.000	0.000	0.000	-57410.155
51	18	-7166.311	16589.758	-0.000	0.000	0.000	-58582.275
	23	-7130.980	16367.184	-0.000	0.000	0.000	-44211.741
52	23	-6070.944	8210.121	-0.000	0.000	0.000	42931.087
	28	-6035.708	7987.569	-0.000	0.000	0.000	93443.892
53	28	-4982.072	-198.928	-0.000	0.000	0.000	92943.682
	33	-4946.899	-421.490	-0.000	0.000	-0.000	91008.898
54	33	-3896.419	-9292.799	-0.000	0.000	0.000	91568.198
	39	-3861.113	-9555.378	-0.000	0.000	-0.000	32904.730
55	39	-2815.760	-18325.459	-0.000	0.000	-0.000	34182.960
	43	-2780.523	-18548.010	-0.000	0.000	-0.000	-80807.640
56	43	-1731.396	-27336.281	0.000	0.000	-0.000	-79815.875
	8	-1727.382	-27361.633	0.000	0.000	-0.000	-99247.287
57	8	-580.256	4757.139	-0.000	0.000	0.000	-26450.595
	48	-549.012	4559.803	-0.000	0.000	-0.000	-687.606
58	10	-5908.399	17455.868	-1099.191	-9978.273	-162.197	-50295.946
	22	-5906.180	17437.869	-1099.191	-9978.273	-716.234	-4051.991
59	22	-5259.409	11734.825	14.970	-6733.447	-346.525	-40915.901
	27	-5224.078	11512.251	14.970	-6733.447	-253.139	31592.654
60	27	-4481.889	5812.090	-60.311	-3492.505	171.015	32232.846
	32	-4446.653	5589.538	-60.311	-3492.505	-205.144	67789.041
61	32	-3709.102	-127.242	-61.932	-251.401	216.404	68039.103
	37	-3673.929	-349.804	-61.932	-251.401	-169.867	66551.426
62	37	-2938.479	-6551.618	-109.257	3274.930	250.114	66771.829
	38	-2903.173	-6774.196	-109.257	3274.930	-431.439	24708.074
63	38	-2171.743	-12943.188	52.620	6801.160	-13.248	24069.112
	47	-2136.506	-13165.740	52.620	6801.160	-314.943	-57352.066
64	47	-1403.704	-19322.642	970.890	10327.513	734.066	-57848.023
	12	-1399.690	-19347.995	970.890	10327.513	-1423.882	-71585.751
65	12	-415.536	3390.312	-10.865	-1826.576	-159.512	-17860.151
	52	-384.291	3192.976	-10.865	-1826.576	-219.599	343.803

1	1	-22574.445	1328.190	2097.928	359.678	-8217.562	-6115.368
	2	-22580.594	1328.190	3064.928	359.678	32800.111	12157.786
2	3	-20102.191	870.890	-4514.811	298.194	32297.889	-5514.695
	4	-19312.805	870.890	-4286.181	298.194	-50541.515	10879.828
3	15	383.669	-3261.223	-194.438	-1861.135	-219.314	433.016
	2	416.077	-3465.907	-194.438	-1861.135	-1334.669	-18861.389
4	5	-32298.407	-0.000	3889.538	0.000	-10954.471	0.000
	6	-31904.556	-0.000	4056.628	0.000	43706.946	-0.000
5	7	-28056.317	0.000	-6074.531	0.000	43802.208	0.000
	8	-27266.931	0.000	-5845.902	0.000	-68398.960	0.000
6	14	548.546	-4661.520	0.000	0.000	-0.000	-866.033
	6	580.953	-4866.204	0.000	0.000	0.000	-28192.960
7	9	-22974.445	-1328.190	2897.838	-359.678	-8217.562	6115.368
	10	-22580.594	-1328.190	3064.928	-359.678	32800.111	-12157.786
8	11	-20102.191	-870.890	-4514.811	-298.194	32297.889	5514.695
	12	-19312.805	-870.890	-4286.181	-298.194	-50541.515	-10879.828
9	13	383.669	-3261.223	194.438	1861.135	219.314	433.016
	10	416.077	-3465.907	194.438	1861.135	1334.669	-18861.389
10	13	194.454	2324.076	-293.338	0.000	0.000	0.000
	14	194.454	-2324.076	293.338	0.000	0.000	0.000
11	14	194.454	2324.076	-293.338	0.000	0.000	0.000
	15	194.454	-2324.076	293.338	0.000	-0.000	0.000
12	15	-0.000	929.631	-117.335	0.000	234.671	-1859.261
	16	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
13	17	-0.000	-0.000	0.000	0.000	0.000	-0.000
	13	-0.000	-929.631	117.335	0.000	234.671	-1859.261
14	22	1152.689	4489.866	-560.274	0.000	0.000	0.000
	18	1152.689	-4489.866	560.274	0.000	-0.000	0.000
15	18	1152.689	4489.866	-560.274	0.000	0.000	0.000
	19	1152.689	-4489.866	560.274	0.000	-0.000	0.000
16	19	0.000	1795.946	-224.109	-0.000	448.219	-3591.893
	20	0.000	0.000	-0.000	-0.000	-0.000	-0.000
17	21	0.000	-0.000	0.000	0.000	-0.000	0.000
	22	0.000	-1795.946	224.109	0.000	448.219	-3591.893
18	27	-77.919	4489.866	-560.274	0.000	0.000	0.000
	23	-77.919	-4489.866	560.274	0.000	0.000	-0.000
19	23	-77.919	4489.866	-560.274	0.000	0.000	0.000
	24	-77.919	-4489.866	560.274	0.000	-0.000	0.000
20	24	-0.000	1795.946	-224.109	-0.000	448.219	-3591.893
	25	-0.000	0.000	0.000	-0.000	0.000	0.000
21	26	0.000	-0.000	-0.000	0.000	0.000	-0.000
	27	0.000	-1795.946	224.109	0.000	448.219	-3591.893
22	32	-3.455	4489.866	-560.274	0.000	0.000	0.000
	28	-3.455	-4489.866	560.274	0.000	0.000	-0.000
23	28	-3.455	4489.866	-560.274	0.000	0.000	0.000
	29	-3.455	-4489.866	560.274	0.000	0.000	0.000

25	31	0.000	0.000	-0.000	0.000	0.000	-0.000
	32	0.000	-1795.946	224.109	0.000	448.219	-3591.893
26	37	-42.857	3618.116	-560.274	0.000	0.000	0.000
	33	-42.857	-3618.116	560.274	0.000	0.000	-0.000
27	33	-42.857	3618.116	-560.274	0.000	0.000	0.000
	34	-42.857	-3618.116	560.274	0.000	-0.000	0.000
28	34	-0.000	1447.246	-224.109	0.000	448.219	-2894.493
	35	-0.000	-0.000	-0.000	0.000	0.000	-0.000
29	36	0.000	0.000	-0.000	0.000	0.000	-0.000
	37	0.000	-1447.246	224.109	0.000	448.219	-2894.493
30	38	144.003	3618.116	-560.274	0.000	0.000	0.000
	39	144.003	-3618.116	560.274	0.000	0.000	0.000
31	39	144.003	3618.116	-560.274	0.000	0.000	0.000
	40	144.003	-3618.116	560.274	0.000	-0.000	0.000
32	40	-0.000	1447.246	-224.109	0.000	448.219	-2894.493
	41	-0.000	0.000	-0.000	0.000	0.000	-0.000
33	42	-0.000	-0.000	-0.000	-0.000	0.000	-0.000
	38	-0.000	-1447.246	224.109	-0.000	448.219	-2894.493
34	47	814.843	3618.116	-560.274	0.000	0.000	0.000
	43	814.843	-3618.116	560.274	0.000	0.000	0.000
35	43	814.843	3618.116	-560.274	0.000	0.000	0.000
	44	814.843	-3618.116	560.274	0.000	0.000	0.000
36	44	0.000	1447.246	-224.109	0.000	448.219	-2894.493
	45	0.000	0.000	-0.000	0.000	0.000	-0.000
37	46	0.000	0.000	0.000	0.000	-0.000	-0.000
	47	0.000	-1447.246	224.109	0.000	448.219	-2894.493
38	52	17.875	1888.226	-293.338	0.000	-0.000	0.000
	48	17.875	-1888.226	293.338	0.000	0.000	0.000
39	48	17.875	1888.226	-293.338	0.000	0.000	0.000
	49	17.875	-1888.226	293.338	0.000	-0.000	-0.000
40	49	0.000	755.291	-117.335	-0.000	234.671	-1510.581
	50	0.000	0.000	-0.000	-0.000	0.000	0.000
41	51	0.000	-0.000	0.000	0.000	-0.000	-0.000
	52	0.000	-755.291	117.335	0.000	234.671	-1510.581
42	2	-6112.271	18457.757	1134.825	10204.067	161.111	-51660.941
	19	-6109.512	18439.758	1134.825	10204.067	733.109	-42361.999
43	19	-5472.899	12116.169	-18.352	6604.720	367.386	-41792.422
	24	-5437.568	11893.594	-18.352	6604.720	252.902	33094.985
44	24	-4700.351	5572.024	59.372	3009.349	-168.275	33715.978
	29	-4665.115	5349.473	59.372	3009.349	202.028	67774.877
45	29	-3932.928	-988.882	62.840	-586.183	-216.356	67997.849
	34	-3897.754	-1211.443	62.840	-586.183	175.582	61136.093
46	34	-3153.058	-6313.512	105.677	-3484.256	-249.883	60851.522
	40	-3117.752	-6536.090	105.677	-3484.256	409.341	20773.091
47	40	-2377.155	-11605.195	-38.353	-6382.234	-13.977	20169.075
	44	-2341.918	-11827.746	-38.353	-6382.234	-253.188	-52906.987
48	44	-1599.916	-16885.343	-853.115	-9280.329	-677.497	-53370.795
	4	-1595.902	-16910.695	-853.115	-9280.329	-1283.634	-65376.823
49	4	-420.069	2840.743	17.884	1512.467	123.289	-14834.500

49	6	-388.825	2643.408	17.884	1512.467	222.192	330.143
	18	-8403.701	26182.394	-0.000	-0.000	-0.000	-71898.523
50	18	-8400.942	26164.395	-0.000	-0.000	-0.000	-58706.042
	51	18	-7487.740	17134.549	0.000	-0.000	-59845.093
51	23	-7452.409	16911.975	0.000	-0.000	-0.000	46347.372
	23	-6399.467	7866.449	0.000	-0.000	-0.000	45105.004
52	28	-6364.231	7643.898	0.000	-0.000	0.000	93474.319
	53	28	-5318.262	-1431.586	-0.000	-0.000	93028.280
53	33	-5283.088	-1654.147	-0.000	-0.000	0.000	83405.363
	54	33	-4219.378	-8954.465	0.000	-0.000	83974.670
54	39	-4184.072	-9177.044	0.000	-0.000	0.000	27421.757
	55	39	-3125.699	-16416.015	0.000	-0.000	28630.185
55	43	-3090.462	-16638.566	0.000	-0.000	0.000	-74451.141
	56	43	-2028.615	-23856.538	-0.000	-0.000	-73523.726
56	8	-2024.601	-23881.890	-0.000	-0.000	0.000	-90482.783
	57	8	-586.748	3972.115	-0.000	-0.000	-22081.818
57	48	-555.503	3774.780	-0.000	-0.000	0.000	-660.286
	58	10	-6112.271	18457.757	-1134.825	-10204.067	-51660.941
58	22	-6109.512	18439.758	-1134.825	-10204.067	-733.109	-42361.999
	59	22	-5472.899	12116.169	18.352	-6604.720	-367.386
59	27	-5437.568	11893.594	18.352	-6604.720	-252.902	33094.985
	60	27	-4700.351	5572.024	-59.372	-3009.349	168.275
60	32	-4665.115	5349.473	-59.372	-3009.349	-202.028	67774.877
	61	32	-3932.928	-988.882	-62.840	586.183	216.356
61	37	-3897.754	-1211.443	-62.840	586.183	-175.582	61136.093
	62	37	-3153.058	-6313.512	-105.677	3484.256	249.883
62	38	-3117.752	-6536.090	-105.677	3484.256	-409.341	20773.091
	63	38	-2377.155	-11605.195	38.353	6382.234	13.977
63	47	-2341.918	-11827.746	38.353	6382.234	-253.188	-52906.987
	64	47	-1599.916	-16885.343	853.115	9280.329	677.497
64	12	-1595.902	-16910.695	853.115	9280.329	1283.634	-65376.823
	65	12	-420.069	2840.743	-17.884	-1512.467	-123.289
65	52	-388.825	2643.408	-17.884	-1512.467	-222.192	330.143

Load Combination 71: ASCE7-10, 1.2D+1.6L+0.5S+0.5W-A-X		Member		Node		Fx (Axial)		Fy (Major)		Fz (Minor)		Mx (Torsion)		My (Minor)		Mz (Major)	
1	1	1	-16485.989	563.882	3253.931	19.557	-14662.745	39.218									
	2	2	-16092.138	684.608	3253.931	19.557	30104.632	8627.538									
2	3	3	-15902.205	276.649	-2596.343	440.755	16673.030	1408.515									
	4	4	-15112.820	441.839	-2596.343	440.755	-32203.166	8171.284									
3	15	2	392.721	-2180.683	-108.522	-1244.516	-224.404	225.866									
	2	2	425.129	-2385.367	-58.186	-1244.516	-702.549	-12870.241									
4	5	5	-22572.436	-351.128	4432.284	-226.581	-20529.711	4225.075									
	6	6	-22178.585	-230.402	4432.284	-226.581	40449.368	224.747									
5	7	7	-21567.368	-392.621	-3328.235	212.248	21086.315	5613.578									
	8	8	-20777.983	-227.432	-3328.235	212.248	-41567.757	-222.679									
6	14	6	561.568	-3048.068	2.439	0.000	-505.076										
	6	6	593.976	-3252.752	52.775	0.000	158.362	-18576.762									
7	9	9	-15861.502	-1227.321	3278.760	-462.028	-15305.627	8263.132									

8	10	-15467.651	-1106.596	3278.760	-462.028	29803.343	-7791.809
	11	-15202.804	-1034.594	-2393.503	-6.023	14983.181	9691.764
	12	-14413.418	-869.405	-2393.503	-6.023	-30074.556	-8229.644
9	13	393.494	-2084.604	107.018	1189.718	224.857	279.210
	10	425.902	-2289.288	157.354	1189.718	983.118	-12265.760
10	13	106.755	1484.776	-293.338	0.000	0.000	0.000
	14	106.755	-1484.776	293.338	0.000	0.000	0.000
11	14	108.807	1553.276	-293.338	0.000	0.000	0.000
	15	108.807	-1553.276	293.338	0.000	0.000	0.000
12	15	0.000	621.311	-117.335	0.000	234.671	-1242.621
	16	0.000	0.000	-0.000	0.000	-0.000	-0.000
13	17	0.000	-0.000	-0.000	-0.000	0.000	-0.000
	13	0.000	-593.911	117.335	-0.000	234.671	-1187.821
14	22	773.458	2811.316	-560.274	0.000	0.000	0.000
	18	773.458	-2811.316	560.274	0.000	0.000	0.000
15	18	780.856	2948.266	-560.274	0.000	0.000	0.000
	19	780.856	-2948.266	560.274	0.000	0.000	0.000
16	19	0.000	1179.306	-224.109	0.000	448.219	-2358.613
	20	0.000	0.000	-0.000	0.000	0.000	-0.000
17	21	0.000	-0.000	0.000	0.000	0.000	-0.000
	22	0.000	-1124.526	224.109	0.000	448.219	-2249.053
18	27	-51.403	2811.316	-560.274	0.000	0.000	-0.000
	23	-51.403	-2811.316	560.274	0.000	0.000	0.000
19	23	-53.425	2948.266	-560.274	0.000	0.000	0.000
	24	-53.425	-2948.266	560.274	0.000	0.000	0.000
20	24	0.000	1179.306	-224.109	-0.000	448.219	-2358.613
	25	0.000	0.000	0.000	-0.000	-0.000	0.000
21	26	0.000	0.000	-0.000	0.000	0.000	-0.000
	27	0.000	-1124.526	224.109	0.000	448.219	-2249.053
22	32	-1.602	2811.316	-560.274	0.000	-0.000	0.000
	28	-1.602	-2811.316	560.274	0.000	0.000	0.000
23	28	-1.414	2948.266	-560.274	0.000	0.000	0.000
	29	-1.414	-2948.266	560.274	0.000	0.000	0.000
24	29	-0.000	1179.306	-224.109	-0.000	448.219	-2358.613
	30	-0.000	-0.000	-0.000	-0.000	0.000	-0.000
25	31	0.000	-0.000	0.000	0.000	0.000	0.000
	32	0.000	-1124.526	224.109	0.000	448.219	-2249.053
26	37	-31.407	2811.316	-560.274	0.000	0.000	0.000
	33	-31.407	-2811.316	560.274	0.000	-0.000	0.000
27	33	-32.115	2948.266	-560.274	0.000	0.000	0.000
	34	-32.115	-2948.266	560.274	0.000	0.000	-0.000
28	34	0.000	1179.306	-224.109	-0.000	448.219	-2358.613
	35	0.000	0.000	0.000	-0.000	0.000	-0.000
29	36	0.000	0.000	-0.000	0.000	0.000	-0.000
	37	0.000	-1124.526	224.109	0.000	448.219	-2249.053
30	38	107.318	2811.316	-560.274	0.000	0.000	0.000
	39	107.318	-2811.316	560.274	0.000	0.000	-0.000
31	39	108.767	2948.266	-560.274	0.000	0.000	0.000
	40	108.767	-2948.266	560.274	0.000	0.000	0.000

56	43	-635.408	-17783.744	139.650	186.721	-0.000	0.000	14	22	1037.833	3906.416	-560.274	0.000	0.000	0.000
	8	-631.394	-17809.096	145.885	186.721	370.210	-59439.644		18	1037.833	-3906.416	560.274	0.000	-0.000	-0.000
57	8	-592.818	3234.979	-47.004	0.000	0.000	-0.000	15	18	1010.999	3701.116	-560.274	0.000	0.000	0.000
	48	-561.574	3037.644	1.525	0.000	0.000	-526.739		19	1010.999	-3701.116	560.274	0.000	0.000	0.000
58	10	-5168.671	12541.896	-932.274	-6577.304	0.000	-0.000	16	19	0.000	1480.446	-224.109	0.000	448.219	-2960.893
	22	-5165.912	12523.896	-927.851	-6577.304	-215.465	-35751.943		20	0.000	-0.000	-0.000	0.000	-0.000	-0.000
59	22	-4478.849	8556.826	-153.779	-4323.560	180.091	-35375.772	17	21	0.000	-0.000	0.000	0.000	-0.000	0.000
	27	-4443.518	8334.251	-99.404	-4323.560	-608.462	17308.171		22	0.000	-1562.566	224.109	0.000	448.219	-3125.133
60	27	-3688.353	4378.476	-149.393	-2071.125	-177.106	17763.799	18	27	-70.722	3906.416	-560.274	0.000	-0.000	-0.000
	32	-3653.116	4155.925	-94.663	-2071.125	-938.202	44378.492		23	-70.722	-3906.416	560.274	0.000	-0.000	-0.000
61	32	-2901.198	189.698	-95.172	181.407	-508.616	44570.025	19	23	-68.100	3701.116	-560.274	0.000	0.000	0.000
	37	-2866.024	-32.863	-40.442	181.407	-931.531	45059.117		24	-68.100	-3701.116	560.274	0.000	0.000	-0.000
62	37	-2113.019	-3990.771	-71.076	2434.491	0.000	0.000	20	24	0.000	1480.446	-224.109	0.000	448.219	-2960.893
	38	-2077.713	-4213.350	-16.337	2434.491	-773.797	19284.809		25	0.000	0.000	0.000	0.000	0.000	-0.000
63	38	-1327.045	-8153.027	91.270	4686.947	-0.000	0.000	21	26	0.000	0.000	-0.000	0.000	0.000	-0.000
	47	-1291.809	-8375.579	146.000	4686.947	395.081	-32711.389		27	0.000	-1562.566	224.109	0.000	448.219	-3125.133
64	47	-539.971	-12309.865	758.781	6939.624	-0.000	0.000	22	32	-1.473	3906.416	-560.274	0.000	0.000	-0.000
	12	-535.957	-12335.217	765.016	6939.624	1366.046	-41844.918		28	-1.473	-3906.416	560.274	0.000	-0.000	0.000
65	12	-424.742	2276.607	-80.296	-1189.718	0.000	-0.000	23	28	-2.445	3701.116	-560.274	0.000	0.000	0.000
	52	-393.498	2079.271	-31.767	-1189.718	-224.857	274.489		29	-2.445	-3701.116	560.274	0.000	0.000	0.000

Load Combination 72: ASCE7-10_1.2D+1.6Lr+S+0.5WB-X															
Member	Node	Fx(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)	Member	Node	Fx(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-19909.446	830.028	3173.515	64.651	-11278.434	-1473.945	25	31	0.000	-0.000	-0.000	0.000	0.000	-0.000
	2	-19515.594	950.753	3173.515	64.651	32382.576	10775.991		32	0.000	-1562.566	224.109	0.000	448.219	-3125.133
2	3	-19756.215	464.586	-3783.068	481.449	26511.941	-22.533	26	37	-42.200	3906.416	-560.274	0.000	0.000	0.000
	4	-18966.829	629.775	-3783.068	481.449	-44704.364	10278.147		33	-42.200	-3906.416	560.274	0.000	-0.000	0.000
3	15	388.255	-2708.662	-162.499	-1545.666	-221.918	432.736	27	33	-41.677	3701.116	-560.274	0.000	0.000	0.000
	2	420.662	-2913.345	-112.163	-1545.666	-1009.691	-15692.014		34	-41.677	-3701.116	560.274	0.000	0.000	0.000
4	5	-28574.806	-317.230	4191.586	-245.417	-14228.693	3781.022	28	34	0.000	1480.446	-224.109	0.000	448.219	-2960.893
	6	-28180.955	-196.504	4191.586	-245.417	43438.876	247.066		35	0.000	0.000	-0.000	0.000	-0.000	0.000
5	7	-28324.479	-374.630	-5340.804	193.520	37914.981	5258.567	29	36	0.000	0.000	-0.000	0.000	0.000	-0.000
	8	-27535.093	-209.440	-5340.804	193.520	-62625.732	-238.994		37	0.000	-1562.566	224.109	0.000	448.219	-3125.133
6	14	554.110	-3974.681	-3.775	-0.000	0.000	-784.695	30	38	143.434	3906.416	-560.274	0.000	-0.000	0.000
	6	586.518	-4179.365	46.561	-0.000	122.719	-24171.708		39	143.434	-3906.416	560.274	0.000	0.000	0.000
7	9	-20844.189	-1532.347	3132.754	-573.828	-10290.846	9388.447	31	39	141.941	3701.116	-560.274	0.000	0.000	0.000
	10	-20450.338	-1411.621	3132.754	-573.828	32809.382	-10863.016		40	141.941	-3701.116	560.274	0.000	-0.000	0.000
8	11	-20805.995	-1265.145	-4089.826	-110.883	29075.592	10927.949	32	40	0.000	1480.446	-224.109	0.000	448.219	-2960.893
	12	-20016.609	-1099.956	-4089.826	-110.883	-47915.452	-11333.584		41	0.000	0.000	-0.000	0.000	-0.000	0.000
9	13	387.111	-2852.643	167.200	1627.783	221.240	351.959	33	42	-0.000	0.000	0.000	-0.000	-0.000	0.000
	10	419.519	-3057.326	217.536	1627.783	1324.719	-16598.709		38	-0.000	-1562.566	224.109	-0.000	448.219	-3125.133
10	13	166.943	2032.376	-293.338	0.000	0.000	0.000	34	47	820.986	3906.416	-560.274	0.000	0.000	0.000
	14	166.943	-2032.376	293.338	0.000	0.000	0.000		43	820.986	-3906.416	560.274	0.000	0.000	-0.000
11	14	162.785	1929.726	-293.338	0.000	0.000	0.000	35	43	796.124	3701.116	-560.274	0.000	0.000	0.000
	15	162.785	-1929.726	293.338	0.000	0.000	0.000		44	796.124	-3701.116	560.274	0.000	0.000	-0.000
12	15	0.000	771.891	-117.335	0.000	234.671	-1543.781	36	44	0.000	1480.446	-224.109	0.000	448.219	-2960.893
	16	0.000	0.000	-0.000	0.000	0.000	0.000		45	0.000	0.000	0.000	0.000	0.000	0.000
13	17	-0.000	-0.000	0.000	0.000	-0.000	-0.000	37	46	0.000	-0.000	0.000	0.000	0.000	-0.000
	13	-0.000	-812.951	117.335	0.000	234.671	-1625.901		47	0.000	-1562.566	224.109	0.000	448.219	-3125.133

14	22	1037.833	3906.416	-560.274	0.000	0.000	0.000	15	18	1037.833	-3906.416	560.274	0.000	-0.000	-0.000
	18	1010.999	3701.116	-560.274	0.000	0.000	0.000		19	1010.999	-3701.116	560.274	0.000	0.000	0.000
16	19	0.000	1480.446	-224.109	0.000	448.219	-2960.893	17	21	0.000	-0.000	0.000	0.000	-0.000	0.000
	20	0.000	-0.000	-0.000	0.000	-0.000	-0.000		22	0.000	-1562.566	224.109	0.000	448.219	-3125.133
18	27	-70.722	3906.416	-560.274	0.000	-0.000	-0.000	19	23	-70.722	-3906.416	560.274	0.000	-0.000	0.000
	23	-68.100	3701.116	-560.274	0.000	0.000	0.000		24	-68.100	-3701.116	560.274	0.000	0.000	-0.000
20	24	0.000	1480.446	-224.109	0.000	448.219	-2960.893	21	25	0.000	0.000	0.000	0.000	0.000	-0.000
	25	0.000	0.000	-0.000	0.000	-0.000	-0.000		26	0.000	-1562.566	224.109	0.000	448.219	-3125.133
22	32	-1.473	3906.416	-560.274	0.000	0.000	-0.000	23	28	-1.473	-3906.416	560.274	0.000	-0.000	0.000
	28	-2.445	3701.116	-560.274	0.000	0.000	0.000		29	-2.445	-3701.116	560.274	0.000	0.000	0.000
24	29	0.000	1480.446	-224.109	0.000	448.219	-2960.893	25	30	0.000	0.000	-0.000	0.000	-0.000	0.000
	30	0.000	0.000	-0.000	0.000	-0.000	-0.000		31	0.000	-0.000	-0.000	0.000	0.000	-0.000
26	31	0.000	-1562.566	224.109	0.000	448.219	-3125.133	27	32	0.000	-1562.566	224.109	0.000	448.219	-3125.133
	33	-42.200	3906.416	-560.274	0.000	0.000	0.000		37	-42.200	-3906.416	560.274	0.000	-0.000	0.000
27	33	-41.677	3701.116	-560.274	0.000	0.000	0.000	28	34	-41.677	-3701.116	560.274	0.000	0.000	0.000
	34	0.000	1480.446	-224.109	0.000	448.219	-2960.893		35	0.000	0.000	-0.000	0.000	-0.000	0.000
28	34	0.000	0.000	-0.000	0.000	-0.000	-0.000	29	36	0.000	0.000	-0.000	0.000	0.000	-0.000
	35	0.000	-1562.566	224.109	0.000	448.219	-3125.133		37	0.000	-1562.566	224.109	0.000	448.219	-3125.133
30	38	143.434	3906.416	-560.274	0.000	-0.000	0.000	31	39	143.434	-3906.416	560.274	0.000	0.000	0.000
	39	141.941	3701.116	-560.274	0.000	0.000	0.000		40	141.941	-3701.116	560.274	0.000	-0.000	0.000
32	40	0.000	1480.446	-224.109	0.000	448.219	-2960.893	33	41	0.000	0.000	-0.000	0.000	0.000	-0.000
	41	0.000	0.000	-0.000	0.000	-0.000	-0.000		42	-0.000	0.000	0.000	-0.000	-0.000	0.000
33	42	-0.000	0.000	0.000	-0.000	-0.000	0.000	34	43	-0.000	-1562.566	224.109	-0.000	448.219	-3125.133
	38	820.986	3906.416	-560.274	0.000	0.000	0.000		47	820.986	-3906.416	560.274	0.000	0.000	-0.000
35	43	796.124	3701.116	-560.274	0.000	0.000	0.000	36	44	796.124	-3701.116	560.274	0.000	0.000	0.000
	44	0.000	1480.446	-224.109	0.000	448.219	-2960.893		45	0.000	0.000	-0.000	0.000	-0.000	0.000
37	46	0.000	-0.000	0.000	0.000	0.000	-0.000	38	52	17.644	2032.376	-293.338	0.000	0.000	0.000
	47	0.000	-1562.566	224.109	0.000	448.219	-3125.133								

21	26	0.000	-0.000	-0.000	0.000	0.000	0.000	
	27	0.000	-75.701	111.175	0.000	222.351	-151.402	
22	32	0.538	189.252	-277.938	0.000	0.000	0.000	
	28	0.538	-189.252	277.938	0.000	-0.000	0.000	
23	28	0.538	189.252	-277.938	0.000	0.000	0.000	
	29	0.538	-189.252	277.938	0.000	0.000	-0.000	
24	29	-0.000	75.701	-111.175	-0.000	222.351	-151.402	
	30	-0.000	0.000	0.000	-0.000	0.000	0.000	
25	31	0.000	-0.000	0.000	0.000	-0.000	-0.000	
	32	0.000	-75.701	111.175	0.000	222.351	-151.402	
26	37	-6.395	737.152	-277.938	0.000	0.000	0.000	
	33	-6.395	-737.152	277.938	0.000	0.000	-0.000	
27	33	-6.395	737.152	-277.938	0.000	0.000	0.000	
	34	-6.395	-737.152	277.938	0.000	0.000	0.000	
28	34	0.000	294.861	-111.175	0.000	222.351	-589.722	
	35	0.000	-0.000	-0.000	0.000	-0.000	0.000	
29	36	0.000	-0.000	-0.000	0.000	0.000	-0.000	
	37	0.000	-294.861	111.175	0.000	222.351	-589.722	
30	38	22.984	737.152	-277.938	0.000	0.000	0.000	
	39	22.984	-737.152	277.938	0.000	0.000	0.000	
31	39	22.984	737.152	-277.938	0.000	0.000	0.000	
	40	22.984	-737.152	277.938	0.000	0.000	0.000	
32	40	0.000	294.861	-111.175	0.000	222.351	-589.722	
	41	0.000	0.000	-0.000	0.000	0.000	-0.000	
33	42	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	
	38	-0.000	-294.861	111.175	-0.000	222.351	-589.722	
34	47	131.690	737.152	-277.938	0.000	0.000	0.000	
	43	131.690	-737.152	277.938	0.000	0.000	0.000	
35	43	131.690	737.152	-277.938	0.000	0.000	0.000	
	44	131.690	-737.152	277.938	0.000	-0.000	0.000	
36	44	-0.000	294.861	-111.175	0.000	222.351	-589.722	
	45	-0.000	-0.000	-0.000	0.000	-0.000	0.000	
37	46	0.000	0.000	0.000	0.000	-0.000	-0.000	
	47	0.000	-294.861	111.175	0.000	222.351	-589.722	
38	52	27.555	447.669	-152.171	0.000	0.000	0.000	
	48	27.555	-447.669	152.171	0.000	-0.000	0.000	
39	48	27.555	447.669	-152.171	0.000	0.000	0.000	
	49	27.555	-447.669	152.171	0.000	0.000	0.000	
40	49	-0.000	179.068	-60.868	0.000	121.736	-358.135	
	50	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	
41	51	0.000	-0.000	-0.000	0.000	0.000	0.000	
	52	0.000	-179.068	60.868	0.000	121.736	-358.135	
42	2	-2002.881	2229.409	121.975	832.640	89.947	-15086.146	
	19	-2000.122	2211.410	121.975	832.640	151.427	-13966.968	
43	19	-1624.782	1934.200	28.812	678.679	-65.301	-13973.246	
	24	-1589.451	1711.625	28.812	678.679	114.433	-2601.774	
44	24	-1201.862	1444.224	34.883	525.493	-106.930	-2545.055	
	29	-1166.625	1221.672	34.883	525.493	110.637	5768.593	

45	29	-779.441	952.370	34.346	372.229	-110.562	5823.465	
	34	-744.268	729.808	34.346	372.229	103.653	11069.370	
46	34	-363.811	-306.555	40.741	-219.305	-113.778	11072.864	
	40	-328.505	-529.134	40.741	-219.305	140.365	8466.315	
47	40	51.938	-1563.744	17.758	-810.802	-77.047	8403.055	
	44	87.175	-1786.295	17.758	-810.802	33.707	-2044.104	
48	44	467.828	-2820.553	-113.933	-1402.339	-183.768	-2134.421	
	4	471.842	-2845.905	-113.933	-1402.339	-264.717	-4147.428	
49	4	-239.117	825.340	27.556	359.128	-33.617	-3947.921	
	49	-207.873	628.005	27.556	359.128	118.776	70.835	
50	6	-2713.251	2915.876	-0.000	0.000	-0.000	-20162.053	
	18	-2710.492	2897.877	-0.000	0.000	-0.000	-18696.866	
51	18	-2173.082	2503.242	0.000	0.000	-0.000	-18684.300	
	23	-2137.751	2280.668	0.000	0.000	-0.000	-3763.093	
52	23	-1584.105	1898.780	0.000	0.000	-0.000	-3876.539	
	28	-1548.869	1676.229	0.000	0.000	-0.000	7272.196	
53	28	-995.770	1291.109	0.000	0.000	-0.000	7162.446	
	33	-960.596	1068.547	0.000	0.000	0.000	14521.078	
54	33	-417.089	-412.097	-0.000	0.000	0.000	14514.089	
	39	-381.783	-634.675	-0.000	0.000	0.000	11249.165	
55	39	161.698	-2112.403	-0.000	0.000	0.000	11375.691	
	43	196.934	-2334.954	-0.000	0.000	0.000	-2493.474	
56	43	740.476	-3812.096	0.000	0.000	-0.000	-2312.836	
	8	744.490	-3837.448	0.000	0.000	-0.000	-5030.334	
57	8	-328.153	1094.333	-0.000	0.000	0.000	-5648.050	
	48	-296.909	896.997	-0.000	0.000	-0.000	-141.671	
58	10	-2002.881	2229.409	-121.975	-832.640	-89.947	-15086.146	
	22	-2000.122	2211.410	-121.975	-832.640	-151.427	-13966.968	
59	22	-1624.782	1934.200	-28.812	-678.679	65.301	-13973.246	
	27	-1589.451	1711.625	-28.812	-678.679	-114.433	-2601.774	
60	27	-1201.862	1444.224	-34.883	-525.493	106.930	-2545.055	
	32	-1166.625	1221.672	-34.883	-525.493	-110.637	5768.593	
61	32	-779.441	952.370	-34.346	-372.229	110.562	5823.465	
	37	-744.268	729.808	-34.346	-372.229	-103.653	11069.370	
62	37	-363.811	-306.555	-40.741	219.305	113.778	11072.864	
	38	-328.505	-529.134	-40.741	219.305	-140.365	8466.315	
63	38	51.938	-1563.744	-17.758	810.802	77.047	8403.055	
	47	87.175	-1786.295	-17.758	810.802	-33.707	-2044.104	
64	47	467.828	-2820.553	113.933	1402.339	183.768	-2134.421	
	12	471.842	-2845.905	113.933	1402.339	264.717	-4147.428	
65	12	-239.117	825.340	-27.556	-359.128	33.617	-3947.921	
	52	-207.873	628.005	-27.556	-359.128	-118.776	70.835	

Load Combination 74: ASCE7-10_1.2D+1.0WB-Z+0.5LroS									
Member	Node	Px(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)		
1	1	-8647.199	363.705	2091.246	97.374	-12560.771	-1663.894		
	2	-8253.348	363.705	1781.417	97.374	14079.152	3339.939		
2	3	-759.840	23.004	346.961	6.232	-4054.022	-143.698		
	4	29.546	23.004	-76.978	6.232	-1512.800	289.353		

3	15	202.502	-1279.039	-36.885	-730.796	-115.707	5.903
	2	234.910	-1483.723	-36.885	-730.796	-327.290	-7918.108
4	5	-11801.132	-0.000	2734.978	0.000	-16694.134	0.000
	6	-11407.281	-0.000	2425.149	0.000	18802.215	-0.000
5	7	-454.303	-0.000	438.519	0.000	-5533.106	0.000
	8	335.082	-0.000	14.580	0.000	-1268.305	0.000
6	14	289.240	-1827.244	0.000	0.000	-0.000	-11.806
	6	321.648	-2031.928	0.000	0.000	0.000	-11080.485
7	9	-8647.199	-363.705	2091.246	-97.374	-12560.771	1663.894
	10	-8253.348	-363.705	1781.417	-97.374	14079.152	-3339.939
8	11	-759.840	-23.004	346.961	-6.232	-4054.022	143.698
	12	29.546	-23.004	-76.978	-6.232	-1512.800	-289.353
9	13	202.502	-1279.039	36.885	730.796	115.707	5.903
	10	234.910	-1483.723	36.885	730.796	327.290	-7918.108
10	13	36.887	912.269	-152.171	0.000	0.000	0.000
	14	36.887	-912.269	152.171	0.000	0.000	0.000
11	14	36.887	912.269	-152.171	0.000	0.000	0.000
	15	36.887	-912.269	152.171	0.000	0.000	0.000
12	15	-0.000	364.908	-60.868	-0.000	121.736	-729.815
	16	-0.000	0.000	0.000	-0.000	0.000	0.000
13	17	0.000	-0.000	0.000	0.000	0.000	-0.000
	13	0.000	-364.908	60.868	0.000	121.736	-729.815
14	22	316.556	1666.252	-277.938	0.000	0.000	0.000
	18	316.556	-1666.252	277.938	0.000	0.000	0.000
15	18	316.556	1666.252	-277.938	0.000	0.000	0.000
	19	316.556	-1666.252	277.938	0.000	-0.000	0.000
16	19	-0.000	666.501	-111.175	0.000	222.351	-1333.002
	20	-0.000	0.000	0.000	0.000	0.000	0.000
17	21	0.000	-0.000	-0.000	0.000	0.000	-0.000
	22	0.000	-666.501	111.175	0.000	222.351	-1333.002
18	27	-21.138	1666.252	-277.938	0.000	0.000	0.000
	23	-21.138	-1666.252	277.938	0.000	-0.000	0.000
19	23	-21.138	1666.252	-277.938	0.000	0.000	0.000
	24	-21.138	-1666.252	277.938	0.000	0.000	-0.000
20	24	0.000	666.501	-111.175	0.000	222.351	-1333.002
	25	0.000	0.000	-0.000	0.000	-0.000	0.000
21	26	0.000	-0.000	0.000	0.000	-0.000	0.000
	27	0.000	-666.501	111.175	0.000	222.351	-1333.002
22	32	-3.640	1666.252	-277.938	0.000	0.000	0.000
	28	-3.640	-1666.252	277.938	0.000	0.000	-0.000
23	28	-3.640	1666.252	-277.938	0.000	0.000	0.000
	29	-3.640	-1666.252	277.938	0.000	0.000	-0.000
24	29	0.000	666.501	-111.175	0.000	222.351	-1333.002
	30	0.000	-0.000	-0.000	0.000	-0.000	0.000
25	31	0.000	-0.000	-0.000	0.000	0.000	0.000
	32	0.000	-666.501	111.175	0.000	222.351	-1333.002
26	37	-2.504	-430.348	-277.938	0.000	0.000	-0.000
	33	-2.504	430.348	277.938	0.000	0.000	0.000
27	33	-2.504	-430.348	-277.938	0.000	0.000	0.000

52	23	-2738.078	1951.354	0.000	-0.000	-0.000	7995.725
	28	-2702.841	1728.802	0.000	-0.000	-0.000	19472.361
53	28	-2174.951	-1614.574	0.000	-0.000	-0.000	19430.995
	33	-2139.777	-1837.136	0.000	-0.000	-0.000	8666.769
54	33	-1576.012	-984.328	0.000	-0.000	-0.000	8766.479
	39	-1540.706	-1206.906	0.000	-0.000	0.000	1931.932
55	39	-978.088	-349.600	0.000	-0.000	0.000	2070.039
	43	-942.852	-572.151	0.000	-0.000	0.000	-804.457
56	43	-379.905	285.401	0.000	-0.000	0.000	-659.529
	8	-375.891	260.049	0.000	-0.000	0.000	-465.758
57	8	-337.793	-73.026	-0.000	-0.000	0.000	802.540
	48	-306.549	-270.362	-0.000	-0.000	0.000	-146.987
58	10	-2770.386	6408.887	-326.939	-2583.735	-86.131	-21997.265
	22	-2767.627	6390.888	-326.939	-2583.735	-250.922	-18771.456
59	22	-2430.664	4042.364	-10.327	-1247.656	-52.790	-18721.608
	27	-2395.333	3819.790	-10.327	-1247.656	-117.214	5800.762
60	27	-2023.982	1482.830	-31.441	87.089	94.621	5897.809
	32	-1988.745	1260.279	-31.441	87.089	-101.481	14452.247
61	32	-1619.210	-1079.048	-35.082	1421.912	109.454	14472.930
	37	-1584.037	-1301.609	-35.082	1421.912	-109.354	7048.807
62	37	-1189.395	-704.494	-37.586	1079.479	116.541	6998.948
	38	-1154.089	-927.072	-37.586	1079.479	-117.923	1910.027
63	38	-760.276	-327.109	-33.508	737.014	106.956	1840.971
	47	-725.039	-549.661	-33.508	737.014	-102.035	-893.252
64	47	-330.957	50.417	-12.732	394.583	123.150	-965.716
	12	-326.943	25.064	-12.732	394.583	114.104	-938.901
65	12	-245.862	8.185	-35.737	107.816	75.010	573.895
	52	-214.618	-189.150	-35.737	107.816	-122.631	73.494

Load Combination 75: ASCE7-10_1.2D+1.0W+Z+0.5Lrors

Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-16365.167	998.312	1069.707	271.348	3192.953	-4582.551
	2	-15971.316	998.312	1378.298	271.348	20032.697	9152.157
2	3	-19922.926	814.349	-4722.935	-280.491	35611.709	-5156.454
	4	-19133.541	814.349	-4300.690	-280.491	-49323.231	10173.671
3	15	194.361	-2244.124	-163.449	-1281.177	-111.164	413.194
	2	226.769	-2448.808	-163.449	-1281.177	-1048.755	-13046.833
4	5	-22880.101	-0.000	1375.323	0.000	4904.630	0.000
	6	-22486.250	-0.000	1683.913	0.000	25949.018	-0.000
5	7	-27776.660	-0.000	-6338.639	0.000	48345.522	0.000
	8	-26987.274	-0.000	-5916.394	0.000	-67005.077	0.000
6	14	278.260	-3207.294	-0.000	-0.000	-0.000	-826.389
	6	310.668	-3411.978	-0.000	-0.000	-0.000	-19811.445
7	9	-16365.167	-998.312	1069.707	-271.348	3192.953	4582.551
	10	-15971.316	-998.312	1378.298	-271.348	20032.697	-9152.157
8	11	-19922.926	-814.349	-4722.935	-280.491	35611.709	5156.454
	12	-19133.541	-814.349	-4300.690	-280.491	-49323.231	-10173.671
9	13	194.361	-2244.124	163.449	1281.177	111.164	413.194
	10	226.769	-2448.808	163.449	1281.177	1048.755	-13046.833

10	13	163.455	1600.269	-152.171	0.000	0.000	0.000
	14	163.455	-1600.269	152.171	0.000	-0.000	0.000
11	14	163.455	1600.269	-152.171	0.000	0.000	0.000
	15	163.455	-1600.269	152.171	0.000	0.000	0.000
12	15	0.000	640.108	-60.868	0.000	121.736	-1280.215
	16	0.000	0.000	-0.000	0.000	-0.000	0.000
13	17	0.000	0.000	-0.000	0.000	-0.000	-0.000
	13	0.000	-640.108	60.868	0.000	121.736	-1280.215
14	22	867.480	3042.152	-277.938	0.000	0.000	0.000
	18	867.480	-3042.152	277.938	0.000	0.000	0.000
15	18	867.480	3042.152	-277.938	0.000	0.000	0.000
	19	867.480	-3042.152	277.938	0.000	0.000	0.000
16	19	-0.000	1216.861	-111.175	-0.000	222.351	-2433.722
	20	-0.000	0.000	0.000	-0.000	0.000	0.000
17	21	0.000	-0.000	-0.000	0.000	0.000	0.000
	22	0.000	-1216.861	111.175	0.000	222.351	-2433.722
18	27	-59.320	3042.152	-277.938	0.000	0.000	0.000
	23	-59.320	-3042.152	277.938	0.000	0.000	0.000
19	23	-59.320	3042.152	-277.938	0.000	0.000	0.000
	24	-59.320	-3042.152	277.938	0.000	-0.000	-0.000
20	24	-0.000	1216.861	-111.175	-0.000	222.351	-2433.722
	25	-0.000	-0.000	0.000	-0.000	0.000	-0.000
21	26	0.000	-0.000	0.000	0.000	-0.000	0.000
	27	0.000	-1216.861	111.175	0.000	222.351	-2433.722
22	32	-0.567	3042.152	-277.938	0.000	0.000	0.000
	28	-0.567	-3042.152	277.938	0.000	-0.000	0.000
23	28	-0.567	3042.152	-277.938	0.000	0.000	0.000
	29	-0.567	-3042.152	277.938	0.000	-0.000	0.000
24	29	-0.000	1216.861	-111.175	0.000	222.351	-2433.722
	30	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
25	31	0.000	0.000	-0.000	0.000	0.000	-0.000
	32	0.000	-1216.861	111.175	0.000	222.351	-2433.722
26	37	-39.048	3755.452	-277.938	0.000	-0.000	0.000
	33	-39.048	-3755.452	277.938	0.000	0.000	0.000
27	33	-39.048	3755.452	-277.938	0.000	0.000	0.000
	34	-39.048	-3755.452	277.938	0.000	-0.000	0.000
28	34	0.000	1502.181	-111.175	0.000	222.351	-3004.362
	35	0.000	-0.000	-0.000	0.000	-0.000	-0.000
29	36	0.000	-0.000	0.000	0.000	-0.000	-0.000
	37	0.000	-1502.181	111.175	0.000	222.351	-3004.362
30	38	134.809	3755.452	-277.938	0.000	0.000	0.000
	39	134.809	-3755.452	277.938	0.000	0.000	0.000
31	39	134.809	3755.452	-277.938	0.000	0.000	0.000
	40	134.809	-3755.452	277.938	0.000	0.000	0.000
32	40	0.000	1502.181	-111.175	-0.000	222.351	-3004.362
	41	0.000	-0.000	-0.000	-0.000	-0.000	-0.000
33	42	-0.000	0.000	0.000	-0.000	0.000	-0.000
	38	-0.000	-1502.181	111.175	-0.000	222.351	-3004.362

34	47	760.509	3755.452	-277.938	0.000	0.000	0.000
	43	760.509	-3755.452	277.938	0.000	0.000	-0.000
35	43	760.509	3755.452	-277.938	0.000	0.000	0.000
	44	760.509	-3755.452	277.938	0.000	-0.000	0.000
36	44	0.000	1502.181	-111.175	0.000	222.351	-3004.362
	45	0.000	-0.000	-0.000	0.000	-0.000	-0.000
37	46	0.000	-0.000	-0.000	0.000	0.000	-0.000
	47	0.000	-1502.181	111.175	0.000	222.351	-3004.362
38	52	-14.312	1956.869	-152.171	0.000	0.000	0.000
	48	-14.312	-1956.869	152.171	0.000	0.000	0.000
39	48	-14.312	1956.869	-152.171	0.000	0.000	0.000
	49	-14.312	-1956.869	152.171	0.000	-0.000	0.000
40	49	-0.000	782.748	-60.868	-0.000	121.736	-1565.495
	50	-0.000	0.000	0.000	-0.000	0.000	-0.000
41	51	0.000	-0.000	0.000	0.000	-0.000	0.000
	52	0.000	-782.748	60.868	0.000	121.736	-1565.495
42	2	-3634.536	13161.138	835.389	7801.149	76.068	-33079.060
	19	-3631.777	13143.139	835.389	7801.149	497.139	-26449.834
43	19	-3346.701	8860.793	-32.317	5363.001	335.401	-25938.109
	24	-3311.370	8638.218	-32.317	5363.001	133.806	28642.005
44	24	-2953.946	4360.760	26.913	2927.580	70.579	29157.277
	29	-2918.710	4138.208	26.913	2927.580	-97.279	55661.470
45	29	-2564.810	-148.218	27.488	492.076	-105.113	55851.683
	34	-2529.637	-370.779	27.488	492.076	66.328	54233.181
46	34	-2182.194	-5650.142	66.522	-2514.001	-131.787	53995.645
	40	-2146.888	-5872.720	66.522	-2514.001	283.185	18055.370
47	40	-1802.998	-11133.330	-68.307	-5520.015	86.358	17535.280
	44	-1767.761	-11355.881	-68.307	-5520.015	-339.677	-52597.744
48	44	-1422.875	-16608.563	-828.747	-8526.110	-537.218	-52970.702
	4	-1418.861	-16633.915	-828.747	-8526.110	-1126.042	-64780.079
49	4	-221.676	2937.289	-14.308	1566.447	187.935	-15456.076
	19	-190.431	2739.953	-14.308	1566.447	-108.809	-15456.076
50	6	-4907.323	18617.009	-0.000	-0.000	-0.000	0.000
	18	-4904.564	18599.010	-0.000	-0.000	-0.000	0.000

	20	-0.000	0.000	0.000	-0.000	-0.000	-0.000
17	21	0.000	-0.000	0.000	0.000	-0.000	-0.000
	22	0.000	-1571.301	111.175	0.000	222.351	-3142.602
18	27	-64.263	3928.252	-277.938	0.000	0.000	0.000
	23	-64.263	-3928.252	277.938	0.000	0.000	0.000
19	23	-64.263	3928.252	-277.938	0.000	0.000	0.000
	24	-64.263	-3928.252	277.938	0.000	0.000	0.000
20	24	-0.000	1571.301	-111.175	0.000	222.351	-3142.602
	25	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
21	26	0.000	-0.000	0.000	0.000	-0.000	0.000
	27	0.000	-1571.301	111.175	0.000	222.351	-3142.602
22	32	-4.253	3928.252	-277.938	0.000	0.000	0.000
	28	-4.253	-3928.252	277.938	0.000	0.000	-0.000
23	28	-4.253	3928.252	-277.938	0.000	0.000	0.000
	29	-4.253	-3928.252	277.938	0.000	0.000	0.000
24	29	0.000	1571.301	-111.175	0.000	222.351	-3142.602
	30	0.000	-0.000	-0.000	0.000	-0.000	-0.000
25	31	0.000	-0.000	0.000	0.000	0.000	-0.000
	32	0.000	-1571.301	111.175	0.000	222.351	-3142.602
26	37	-30.076	2184.752	-277.938	0.000	0.000	0.000
	33	-30.076	-2184.752	277.938	0.000	0.000	0.000
27	33	-30.076	2184.752	-277.938	0.000	0.000	0.000
	34	-30.076	-2184.752	277.938	0.000	-0.000	0.000
28	34	-0.000	873.901	-111.175	-0.000	222.351	-1747.802
	35	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
29	36	0.000	0.000	0.000	0.000	-0.000	-0.000
	37	0.000	-873.901	111.175	0.000	222.351	-1747.802
30	38	99.078	2184.752	-277.938	0.000	0.000	0.000
	39	99.078	-2184.752	277.938	0.000	0.000	0.000
31	39	99.078	2184.752	-277.938	0.000	0.000	0.000
	40	99.078	-2184.752	277.938	0.000	0.000	0.000
32	40	0.000	873.901	-111.175	0.000	222.351	-1747.802
	41	0.000	-0.000	-0.000	0.000	-0.000	-0.000
33	42	-0.000	0.000	0.000	0.000	0.000	-0.000
	38	-0.000	-873.901	111.175	0.000	222.351	-1747.802
34	47	553.958	2184.752	-277.938	0.000	0.000	0.000
	43	553.958	-2184.752	277.938	0.000	0.000	-0.000
35	43	553.958	2184.752	-277.938	0.000	0.000	0.000
	44	553.958	-2184.752	277.938	0.000	0.000	-0.000
36	44	-0.000	873.901	-111.175	0.000	222.351	-1747.802
	45	-0.000	-0.000	-0.000	0.000	0.000	0.000
37	46	0.000	-0.000	0.000	0.000	-0.000	-0.000
	47	0.000	-873.901	111.175	0.000	222.351	-1747.802
38	52	-0.146	1171.569	-152.171	0.000	0.000	0.000
	48	-0.146	-1171.569	152.171	0.000	0.000	0.000
39	48	-0.146	1171.569	-152.171	0.000	0.000	0.000
	49	-0.146	-1171.569	152.171	0.000	0.000	0.000
40	49	-0.000	468.628	-60.868	0.000	121.736	-937.255
	50	-0.000	0.000	0.000	0.000	-0.000	0.000

41	51	0.000	0.000	0.000	0.000	-0.000	-0.000
	52	0.000	-468.628	60.868	0.000	121.736	-937.255
42	2	-4046.468	15166.155	906.564	8254.816	74.092	-35813.260
	19	-4043.709	15148.156	906.564	8254.816	-531.039	-28173.422
43	19	-3779.002	9623.975	-39.112	5107.623	377.282	-27694.616
	24	-3743.671	9401.401	-39.112	5107.623	-133.301	31646.290
44	24	-3396.189	3881.309	25.041	1963.345	-65.129	32123.288
	29	-3360.952	3658.757	25.041	1963.345	91.052	55637.127
45	29	-3017.779	-1870.649	29.302	-1181.015	-105.012	55773.270
	34	-2982.605	-2093.211	29.302	-1181.015	77.746	43411.897
46	34	-2616.669	-5173.304	59.366	-2930.577	-131.336	43164.449
	40	-2581.364	-5395.909	59.366	-2930.577	238.996	10198.563
47	40	-2219.135	-8456.304	-39.730	4680.087	31.914	9748.253
	44	-2183.898	-8678.856	-39.730	4680.087	-215.885	-43688.064
48	44	-1820.573	-11732.512	593.628	-6429.664	-423.799	-43997.153
	4	-1816.559	-11757.865	593.628	-6429.664	845.571	-52342.100
49	4	-230.736	1838.018	-0.143	938.228	114.784	-9403.594
	49	-199.492	1640.683	-0.143	938.228	113.995	215.627
50	6	-5530.939	21480.908	-0.000	-0.000	-0.000	-49798.406
	18	-5528.180	21462.909	-0.000	-0.000	-0.000	-38975.670
51	18	-5145.906	13573.951	0.000	-0.000	-0.000	-39933.258
	23	-5110.575	13351.376	0.000	-0.000	-0.000	44047.908
52	23	-4614.421	5457.019	0.000	-0.000	-0.000	43093.703
	28	-4579.185	5234.467	0.000	-0.000	-0.000	76435.307
53	28	-4088.952	-2676.518	0.000	-0.000	-0.000	76162.993
	33	-4053.778	-2899.080	0.000	-0.000	-0.000	58775.383
54	33	-3531.164	-7306.156	0.000	-0.000	-0.000	59270.393
	39	-3495.858	-7528.735	0.000	-0.000	0.000	12999.768
55	39	-2978.011	-11899.688	0.000	-0.000	0.000	13900.606
	43	-2942.774	-12122.239	0.000	-0.000	0.000	-61012.220
56	43	-2421.939	-16480.467	0.000	-0.000	0.000	-60394.177
	8	-2417.925	-16505.819	0.000	-0.000	0.000	-72112.542
57	8	-216.231	2540.653	0.000	-0.000	-0.000	-13936.295
	48	-284.986	2343.317	0.000	-0.000	-0.000	-431.255
58	10	-4046.468	15166.155	-906.564	-8254.816	-74.092	-35813.260
	22	-4043.709	15148.156	-906.564	-8254.816	-531.039	-28173.422
59	22	-3779.002	9623.975	39.112	-5107.623	-377.282	-27694.616
	27	-3743.671	9401.401	39.112	-5107.623	-133.301	31646.290
60	27	-3396.189	3881.309	-25.041	-1963.345	65.129	32123.288
	32	-3360.952	3658.757	-25.041	-1963.345	-91.052	55637.127
61	32	-3017.779	-1870.649	29.302	1181.015	105.012	55773.270
	37	-2982.605	-2093.211	29.302	1181.015	-77.746	43411.897
62	37	-2616.669	-5173.304	-59.366	2930.577	131.336	43164.449
	38	-2581.364	-5395.909	-59.366	2930.577	-238.996	10198.563
63	38	-2219.135	-8456.304	39.730	4680.087	-31.914	9748.253
	47	-2183.898	-8678.856	39.730	4680.087	215.885	-43688.064
64	47	-1820.573	-11732.512	593.628	-6429.664	-423.799	-43997.153
	12	-1816.559	-11757.865	593.628	-6429.664	845.571	-52342.100

65	12	-230.736	1838.018	0.143	-938.228	-114.784	-9403.594
	52	-199.492	1640.683	0.143	-938.228	-113.995	215.627
Load Combination 77: ASCE7-10_1.2D+1.0WA-X+0.5Lrors							
Member	Node	Fx(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-6023.987	-403.779	1720.763	-368.820	-10147.026	6751.756
	2	-5630.136	-162.327	1720.763	-368.820	13527.125	2857.530
2	3	-5578.311	-549.287	-385.922	493.620	725.316	9285.980
	4	-4788.925	-218.908	-385.922	493.620	-6539.678	2055.340
3	15	207.240	-704.387	-10.828	-402.327	-118.419	-36.279
	2	239.648	-909.071	89.844	-402.327	108.211	-4663.913
4	5	-7185.798	-670.648	2390.270	-439.572	-14972.637	7966.494
	6	-6791.946	-429.196	2390.270	-439.572	17912.546	400.697
5	7	-6314.417	-744.509	-161.578	427.888	-2005.235	10506.454
	8	-5525.032	-414.130	-161.578	427.888	-5046.946	-399.247
6	14	297.171	-869.183	5.085	0.000	-32.141	0.000
	6	329.579	-1073.867	105.757	0.000	317.909	-5605.096
7	9	-4772.078	-854.958	1763.861	-487.843	-11391.668	8818.900
	10	-4378.227	-613.506	1763.861	-487.843	12875.424	-1282.613
8	11	-4182.445	-879.675	13.735	383.015	-2582.450	11369.129
	12	-3393.059	-549.296	13.735	383.015	-2323.881	-2081.078
9	13	208.818	-512.401	6.708	292.730	119.324	68.420
	10	241.226	-717.085	107.380	292.730	446.547	-3457.929
10	13	6.425	364.669	-152.171	0.000	0.000	0.000
	14	6.425	-364.669	152.171	0.000	-0.000	0.000
11	14	11.113	501.669	-152.171	0.000	0.000	0.000
	15	11.113	-501.669	152.171	0.000	0.000	-0.000
12	15	0.000	200.668	-60.868	-0.000	121.736	-401.335
	16	0.000	-0.000	-0.000	-0.000	0.000	-0.000
13	17	-0.000	0.000	0.000	-0.000	-0.000	-0.000
	13	-0.000	-145.868	60.868	-0.000	121.736	-291.735
14	22	185.985	571.152	-277.938	0.000	0.000	0.000
	18	185.985	-571.152	277.938	0.000	-0.000	-0.000
15	18	209.611	845.052	-277.938	0.000	0.000	0.000
	19	209.611	-845.052	277.938	0.000	0.000	-0.000
16	19	0.000	338.021	-111.175	-0.000	222.351	-676.042
	20	0.000	0.000	-0.000	-0.000	0.000	-0.000
17	21	0.000	0.000	0.000	0.000	-0.000	0.000
	22	0.000	-228.461	111.175	0.000	222.351	-456.922
18	27	-11.077	571.152	-277.938	0.000	0.000	0.000
	23	-11.077	-571.152	277.938	0.000	0.000	0.000
19	23	-14.974	845.052	-277.938	0.000	0.000	0.000
	24	-14.974	-845.052	277.938	0.000	-0.000	0.000
20	24	0.000	338.021	-111.175	-0.000	222.351	-676.042
	25	0.000	0.000	-0.000	-0.000	-0.000	-0.000
21	26	0.000	0.000	-0.000	0.000	0.000	-0.000
	27	0.000	-228.461	111.175	0.000	222.351	-456.922
22	32	-0.768	571.152	-277.938	0.000	0.000	0.000
	18	-0.768	-571.152	277.938	0.000	0.000	0.000

		44	-258.313	-2678.880	283.606	-1027.057	539.964	-8086.497				8	-19008.886	-395.707	-4124.442	388.073	-46741.488	-451.614
48	44	121.116	-3863.899	119.296	-1704.911	-0.000	0.000		6	14	282.069	-2719.921	-7.567	0.000	0.000	-573.374		
	4	125.130	-3889.251	131.765	-1704.911	412.392	-10914.218			6	314.477	-2924.605	93.105	0.000	245.335	-16762.711		
49	4	-238.492	900.838	-71.646	402.327	0.000	-0.000		7	9	-14755.811	-1476.906	1507.120	-715.437	-1585.039	11255.325		
	49	-207.248	703.502	25.412	402.327	118.419	61.734			10	-14361.959	-1235.454	1507.120	-715.437	19149.816	-7402.916		
50	6	-3054.131	5283.121	-310.195	331.042	0.000	-0.000		8	11	-15370.454	-1356.791	-3340.378	172.250	25144.590	14121.618		
	18	-3051.372	5265.122	-301.349	331.042	658.995	-20859.283			12	-14581.069	-1026.412	-3340.378	172.250	-37738.083	-8310.308		
51	18	-2534.737	3830.564	-277.163	327.533	660.747	-20943.281		9	13	196.116	-2047.152	126.865	1168.861	112.091	206.644		
	23	-2499.406	3607.989	-167.685	327.533	-726.752	2257.862			10	228.524	-2251.836	227.537	1168.861	1128.570	-12123.490		
52	23	-1953.797	2186.404	-170.397	327.244	-726.882	2061.868		10	13	126.594	1459.869	-152.171	0.000	0.000	0.000		
	28	-1918.560	1963.852	-60.937	327.244	-1448.303	15004.522			14	126.594	-1459.869	152.171	0.000	0.000	0.000		
53	28	-1374.241	538.867	-59.007	326.832	-1448.396	14889.493		11	14	118.639	1254.569	-152.171	0.000	0.000	0.000		
	33	-1339.067	316.306	50.453	326.832	-1475.070	17556.366			15	118.639	-1254.569	152.171	0.000	0.000	-0.000		
54	33	-794.670	-1107.420	50.047	327.670	-0.000	0.000		12	15	0.000	501.828	-60.868	0.000	121.736	-1003.655		
	39	-759.364	-1329.999	159.525	327.670	-821.221	10003.616			16	0.000	0.000	0.000	0.000	0.000	0.000		
55	39	-215.598	-2749.522	162.239	327.437	-0.000	0.000		13	17	0.000	-0.000	0.000	0.000	-0.000	0.000		
	43	-180.361	-2972.073	271.699	327.437	531.929	-7645.053			13	0.000	-583.948	60.868	0.000	121.736	-1167.895		
56	43	363.677	-4390.861	289.036	327.437	-0.000	0.000		14	22	712.672	2761.352	-277.938	0.000	0.000	0.000		
	8	367.691	-4416.213	301.506	327.437	741.719	-10559.919			18	712.672	-2761.352	277.938	0.000	0.000	0.000		
57	8	-328.402	1065.215	-94.938	0.000	0.000	-0.000		15	18	664.096	2350.752	-277.938	0.000	0.000	0.000		
	48	-297.158	867.880	2.120	0.000	0.000	-167.643			19	664.096	-2350.752	277.938	0.000	-0.000	0.000		
58	10	-2161.980	3345.169	-497.726	-1046.792	0.000	-0.000		16	19	0.000	940.301	-111.175	-0.000	222.351	-1880.602		
	22	-2159.221	3327.170	-488.880	-1046.792	484.324	-14651.792			20	0.000	-0.000	0.000	-0.000	0.000	-0.000		
59	22	-1794.015	2514.271	-302.476	-590.699	697.504	-14549.599		17	21	0.000	0.000	-0.000	0.000	0.000	0.000		
	27	-1758.684	2291.696	-192.998	-590.699	-847.899	440.404			22	0.000	-1104.541	111.175	0.000	222.351	-2209.082		
60	27	-1375.277	1488.978	-203.219	-132.294	-629.093	591.695		18	27	-49.973	2761.352	-277.938	0.000	0.000	0.000		
	32	-1340.041	1266.427	-93.759	-132.294	-1555.223	9184.478			23	-49.973	-2761.352	277.938	0.000	-0.000	0.000		
61	32	-957.411	461.844	-93.650	326.067	-1336.744	9257.577		19	23	-44.546	2350.752	-277.938	0.000	0.000	0.000		
	37	-922.237	239.282	15.810	326.067	-1579.489	11444.052			24	-44.546	-2350.752	277.938	0.000	-0.000	0.000		
62	37	-539.647	-565.013	8.962	785.644	-0.000	0.000		20	24	0.000	940.301	-111.175	0.000	222.351	-1880.602		
	38	-504.342	-787.592	118.441	785.644	-963.226	7172.364			25	0.000	-0.000	0.000	0.000	0.000	-0.000		
63	38	-122.060	-1589.797	144.450	1244.112	-0.000	0.000		21	26	0.000	-0.000	0.000	0.000	0.000	-0.000		
	47	-86.823	-1812.349	253.910	1244.112	497.415	-3587.181			27	0.000	-1104.541	111.175	0.000	222.351	-2209.082		
64	47	295.710	-2614.197	400.895	1702.854	-0.000	0.000		22	32	-0.444	2761.352	-277.938	0.000	0.000	0.000		
	12	299.724	-2639.550	413.365	1702.854	1005.252	-5593.998			28	-0.444	-2761.352	277.938	0.000	0.000	0.000		
65	12	-240.067	709.123	-124.623	-292.730	0.000	-0.000		23	28	-2.122	2350.752	-277.938	0.000	0.000	0.000		
	52	-208.823	511.788	-27.565	-292.730	-119.324	105.908			29	-2.122	-2350.752	277.938	0.000	0.000	0.000		
Load Combination 78: ASCE7-10_1.2D+1.0WB-X+0.5IrrorS									24	29	0.000	940.301	-111.175	0.000	222.351	-1880.602		
	Member	Node	Fx(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)	30	30	0.000	0.000	0.000	0.000	0.000	0.000		
1	1	-12884.451	111.383	1585.381	-284.742	-3542.481	3980.614		25	31	0.000	-0.000	-0.000	0.000	0.000	-0.000		
	2	-12490.600	352.835	1585.381	-284.742	18269.083	7173.950			32	0.000	-1104.541	111.175	0.000	222.351	-2209.082		
2	3	-13272.766	-194.328	-2730.890	571.492	20068.103	6799.640		26	37	-28.860	2761.352	-277.938	0.000	0.000	0.000		
	4	-12483.381	136.051	-2730.890	571.492	-31340.943	6251.098			37	-28.860	-2761.352	277.938	0.000	0.000	-0.000		
3	15	198.428	-1759.448	-118.355	-1004.626	-113.447	366.729		27	33	-27.620	2350.752	-277.938	0.000	0.000	0.000		
	2	230.836	-1964.132	-17.683	-1004.626	-503.623	-10313.052			34	-27.620	-2350.752	277.938	0.000	-0.000	0.000		
4	5	-19220.929	-616.647	1972.691	-482.195	-2763.879	7289.090		28	34	0.000	940.301	-111.175	-0.000	222.351	-1880.602		
	6	-18827.078	-375.195	1972.691	-482.195	24376.279	466.244			35	0.000	-0.000	0.000	-0.000	0.000	-0.000		
5	7	-19798.272	-726.086	-4124.442	388.073	30901.199	10107.271		29	36	0.000	-0.000	0.000	0.000	0.000	0.000		
										37	0.000	-1104.541	111.175	0.000	222.351	-2209.082		

30	38	98.013	2761.352	-277.938	0.000	0.000	0.000		54	33	-2471.655	-5818.253	54.901	385.463	-0.000	0.000
	39	98.013	-2761.352	277.938	0.000	-0.000	0.000			39	-2436.349	-6040.832	164.380	385.463	-784.666	17975.260
31	39	94.802	2350.752	-277.938	0.000	0.000	0.000		55	39	-1924.288	-11155.717	161.750	385.240	-0.000	0.000
	40	94.802	-2350.752	277.938	0.000	0.000	0.000		43	43	-1889.052	-11378.268	271.210	385.240	565.418	-51530.673
32	40	0.000	940.301	-111.175	-0.000	222.351	-1880.602		56	43	-1374.754	-16484.752	228.183	385.240	-0.000	0.000
	41	0.000	0.000	-0.000	-0.000	-0.000	0.000		8	8	-1370.740	-16510.104	240.653	385.240	731.972	-62685.090
33	42	-0.000	0.000	-0.000	0.000	0.000	-0.000		57	8	-313.167	2912.163	-98.810	0.000	0.000	-0.000
	38	-0.000	-1104.541	111.175	0.000	222.351	-2209.082		48	48	-281.923	2714.828	-1.752	0.000	-0.000	-383.355
34	47	561.480	2761.352	-277.938	0.000	0.000	0.000		58	10	-3486.400	11741.422	-979.221	-6251.442	0.000	-0.000
	43	561.480	-2761.352	277.938	0.000	0.000	-0.000		22	22	-3483.641	11723.423	-970.375	-6251.442	216.948	-25359.461
35	43	518.463	2350.752	-277.938	0.000	0.000	0.000		59	22	-3187.292	7835.988	-257.258	-4041.747	388.683	-25083.882
	44	518.463	-2350.752	277.938	0.000	0.000	-0.000		27	27	-3151.961	7613.413	-147.779	-4041.747	-874.644	23103.416
36	44	0.000	940.301	-111.175	0.000	222.351	-1880.602		60	27	-2791.743	3732.974	-196.542	-1831.253	-668.930	23409.552
	45	0.000	0.000	-0.000	0.000	-0.000	0.000		32	32	-2756.507	3510.423	-87.081	-1831.253	-1553.413	45998.224
37	46	0.000	0.000	-0.000	0.000	0.000	-0.000		61	32	-2399.427	-377.194	-86.040	379.206	-1349.415	46116.290
	47	0.000	-1104.541	111.175	0.000	222.351	-2209.082		37	37	-2364.254	-599.755	23.420	379.206	-1544.697	43069.656
38	52	-1.092	1459.869	-152.171	0.000	0.000	0.000		62	37	-2005.619	-4482.691	-4.283	2590.867	0.000	0.000
	48	-1.092	-1459.869	152.171	0.000	0.000	0.000		38	38	-1970.313	-4705.269	105.196	2590.867	-1024.994	14277.140
39	48	0.634	1254.569	-152.171	0.000	0.000	0.000		63	38	-1614.492	-8573.684	203.692	4801.418	-0.000	0.000
	49	0.634	-1254.569	152.171	0.000	0.000	0.000		47	47	-1579.255	-8796.236	313.152	4801.418	790.164	-40194.903
40	49	-0.000	501.828	-60.868	0.000	121.736	-1003.655		64	47	-1222.255	-12659.235	874.577	7012.260	-0.000	0.000
	50	-0.000	-0.000	-0.000	0.000	0.000	-0.000		12	12	-1218.241	-12684.587	887.046	7012.260	1620.086	-49431.496
41	51	0.000	-0.000	0.000	0.000	-0.000	0.000		65	12	-227.404	2241.688	-95.987	-1168.861	0.000	-0.000
	52	0.000	-583.948	60.868	0.000	121.736	-1167.895		52	52	-196.160	2044.353	1.071	-1168.861	-112.091	158.578
42	2	-3261.664	10162.889	360.511	6040.811	-0.000	-0.000									
	19	-3258.905	10144.890	369.357	6040.811	1053.713	-23464.026									
43	19	-2950.028	6833.505	-294.595	4152.830	878.259	-23004.953									
	24	-2914.696	6610.930	-185.117	4152.830	-617.983	18928.776									
44	24	-2550.107	3308.035	-139.538	2270.211	-826.451	19395.926									
	29	-2514.870	3085.483	-30.078	2270.211	-1355.403	39334.234									
45	29	-2153.000	-223.169	-26.564	387.394	-1562.331	39498.773									
	34	-2117.827	-445.730	82.896	387.394	-1386.656	37412.799									
46	34	-1754.683	-3750.620	111.550	-1494.132	-0.000	0.000									
	40	-1719.377	-3973.199	221.029	-1494.132	-556.462	13101.804									
47	40	-1358.653	-7266.699	126.628	-3376.663	-0.000	0.000									
	44	-1323.416	-7489.250	236.088	-3376.663	368.283	-33377.931									
48	44	-961.942	-10778.864	-282.349	-5259.036	0.000	0.000									
	4	-957.928	-10804.216	-269.880	-5259.036	-34.714	-41379.126									
49	4	-229.775	1954.385	-96.439	1004.626	0.000	-0.000									
	49	-198.531	1757.050	0.619	1004.626	113.447	224.777									
50	6	-4561.600	15428.282	-244.074	388.919	0.000	-0.000									
	18	-4558.841	15410.283	-235.228	388.919	671.797	-33366.622									
51	18	-4123.957	10270.247	-283.413	385.340	673.856	-34101.263									
	23	-4088.625	10047.672	-173.935	385.340	-752.631	29271.136									
52	23	-3571.050	4911.906	-166.986	385.041	-752.783	28497.797									
	28	-3535.814	4689.355	-57.526	385.041	-1452.928	54609.512									
53	28	-3022.290	-457.527	-57.262	384.628	-1453.037	58156.893									
	33	-2987.116	-680.088	52.198	384.628	-1468.830	54609.219									

12	15	-0.000	272.583	-45.468	0.000	90.936	-545.167	
	16	-0.000	0.000	0.000	0.000	0.000	-0.000	
13	17	-0.000	-0.000	-0.000	0.000	0.000	0.000	
	13	-0.000	-272.583	45.468	0.000	90.936	-545.167	
14	22	329.037	1204.630	-200.938	0.000	0.000	0.000	
	18	329.037	-1204.630	200.938	0.000	-0.000	-0.000	
15	18	329.037	1204.630	-200.938	0.000	0.000	0.000	
	19	329.037	-1204.630	200.938	0.000	0.000	0.000	
16	19	-0.000	481.852	-80.375	-0.000	160.750	-963.704	
	20	-0.000	0.000	0.000	-0.000	0.000	0.000	
17	21	0.000	-0.000	0.000	0.000	0.000	0.000	
	22	0.000	-481.852	80.375	0.000	160.750	-963.704	
18	27	-22.445	1204.630	-200.938	0.000	0.000	0.000	
	23	-22.445	-1204.630	200.938	0.000	0.000	-0.000	
19	23	-22.445	1204.630	-200.938	0.000	0.000	0.000	
	24	-22.445	-1204.630	200.938	0.000	0.000	0.000	
20	24	-0.000	481.852	-80.375	-0.000	160.750	-963.704	
	25	-0.000	0.000	-0.000	-0.000	-0.000	0.000	
21	26	0.000	0.000	0.000	0.000	0.000	-0.000	
	27	0.000	-481.852	80.375	0.000	160.750	-963.704	
22	32	-0.628	1204.630	-200.938	0.000	0.000	0.000	
	28	-0.628	-1204.630	200.938	0.000	0.000	0.000	
23	28	-0.628	1204.630	-200.938	0.000	-0.000	0.000	
	29	-0.628	-1204.630	200.938	0.000	0.000	0.000	
24	29	-0.000	481.852	-80.375	-0.000	160.750	-963.704	
	30	-0.000	-0.000	0.000	-0.000	0.000	-0.000	
25	31	0.000	-0.000	0.000	0.000	0.000	-0.000	
	32	0.000	-481.852	80.375	0.000	160.750	-963.704	
26	37	-13.400	1204.630	-200.938	0.000	0.000	0.000	
	33	-13.400	-1204.630	200.938	0.000	0.000	0.000	
27	33	-13.400	1204.630	-200.938	0.000	0.000	0.000	
	34	-13.400	-1204.630	200.938	0.000	-0.000	-0.000	
28	34	0.000	481.852	-80.375	0.000	160.750	-963.704	
	35	0.000	0.000	0.000	0.000	0.000	0.000	
29	36	0.000	-0.000	0.000	0.000	-0.000	-0.000	
	37	0.000	-481.852	80.375	0.000	160.750	-963.704	
30	38	45.921	1204.630	-200.938	0.000	0.000	0.000	
	39	45.921	-1204.630	200.938	0.000	0.000	-0.000	
31	39	45.921	1204.630	-200.938	0.000	0.000	0.000	
	40	45.921	-1204.630	200.938	0.000	-0.000	-0.000	
32	40	0.000	481.852	-80.375	0.000	160.750	-963.704	
	41	0.000	0.000	-0.000	0.000	0.000	0.000	
33	42	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	
	38	-0.000	-481.852	80.375	-0.000	160.750	-963.704	
34	47	257.402	1204.630	-200.938	0.000	0.000	-0.000	
	43	257.402	-1204.630	200.938	0.000	-0.000	0.000	
35	43	257.402	1204.630	-200.938	0.000	-0.000	0.000	
	44	257.402	-1204.630	200.938	0.000	0.000	0.000	
36	44	0.000	481.852	-80.375	-0.000	160.750	-963.704	

45	0.000	0.000	-0.000	-0.000	0.000	-0.000	
	46	0.000	-0.000	0.000	0.000	-0.000	-0.000
37	47	0.000	-481.852	80.375	0.000	160.750	-963.704
	52	9.558	681.458	-113.670	0.000	0.000	0.000
38	48	9.558	-681.458	113.670	0.000	0.000	0.000
	48	9.558	681.458	-113.670	0.000	0.000	0.000
39	48	9.558	-681.458	113.670	0.000	0.000	0.000
	49	9.558	681.458	-113.670	0.000	-0.000	0.000
40	49	0.000	272.583	-45.468	0.000	90.936	-545.167
	50	0.000	0.000	0.000	0.000	-0.000	0.000
41	51	0.000	-0.000	0.000	0.000	-0.000	0.000
	52	0.000	-272.583	45.468	0.000	90.936	-545.167
42	2	-2275.700	5835.211	329.019	2897.677	61.074	-21829.341
	19	-2272.941	5817.212	329.019	2897.677	226.913	-18892.688
43	19	-2035.707	4117.670	-0.069	1931.492	89.148	-18766.366
	24	-2000.376	3895.095	-0.069	1931.492	88.718	6225.767
44	24	-1731.453	2204.678	22.355	966.529	-64.839	6400.552
	29	-1696.216	1982.127	22.355	966.529	74.589	19457.184
45	29	-1428.754	288.647	22.985	1.508	-78.200	19537.938
	34	-1393.581	66.086	22.985	1.508	65.156	20644.180
46	34	-1125.760	-1626.916	36.382	-963.483	-87.907	20579.605
	40	-1090.454	-1849.495	36.382	-963.483	139.050	9736.538
47	40	-823.590	-3538.117	-9.541	-1928.442	-13.465	9563.256
	44	-788.353	-3760.669	-9.541	-1928.442	-72.973	-13198.143
48	44	-520.931	-5447.893	-266.934	-2893.440	-225.762	-13353.480
	4	-516.917	-5473.245	-266.934	-2893.440	-415.418	-17233.210
49	4	-182.503	1152.119	9.559	545.899	33.567	-5711.977
	49	-151.259	954.784	9.559	545.899	86.433	113.982
50	6	-3054.689	8073.641	-0.000	-0.000	-0.000	-29552.148
	18	-3051.930	8055.642	-0.000	-0.000	-0.000	-25487.232
51	18	-2711.840	5629.260	0.000	-0.000	-0.000	-25739.865
	23	-2676.509	5406.685	0.000	-0.000	-0.000	8681.688
52	23	-2292.385	2990.789	0.000	-0.000	-0.000	8332.099
	28	-2257.149	2768.238	0.000	-0.000	0.000	26291.734
53	28	-1875.078	347.148	0.000	-0.000	0.000	26130.216
	33	-1839.904	124.587	0.000	-0.000	0.000	27601.331
54	33	-1457.313	-2295.029	-0.000	-0.000	0.000	27730.487
	39	-1422.007	-2517.608	-0.000	-0.000	0.000	12719.678
55	39	-1040.763	-4929.780	-0.000	-0.000	0.000	13066.261
	43	-1005.526	-5152.331	-0.000	-0.000	-0.000	-18374.989
56	43	-623.638	-7562.024	0.000	-0.000	-0.000	-18064.321
	8	-619.624	-7587.376	0.000	-0.000	-0.000	-23446.139
57	8	-247.323	1561.117	0.000	0.000	-0.000	-8315.824
	48	-216.078	1363.782	0.000	0.000	0.000	-227.964
58	10	-2275.700	5835.211	-329.019	-2897.677	-61.074	-21829.341
	22	-2272.941	5817.212	-329.019	-2897.677	-226.913	-18892.688
59	22	-2035.707	4117.670	0.069	-1931.492	-89.148	-18766.366
	27	-2000.376	3895.095	0.069	-1931.492	-88.718	6225.767
60	27	-1731.453	2204.678	-22.355	-966.529	64.839	6400.552
	32	-1696.216	1982.127	-22.355	-966.529	-74.589	19457.184

61	32	-1428.754	288.647	-22.985	-1.508	78.200	19537.938	
	37	-1393.581	66.086	-22.985	-1.508	-65.156	20644.180	
62	37	-1125.760	-1626.916	-36.382	963.483	87.907	20579.605	
	38	-1090.454	-1849.495	-36.382	963.483	-139.050	9736.538	
63	38	-823.590	-3538.117	9.541	1928.442	13.465	9563.256	
	47	-788.353	-3760.669	9.541	1928.442	72.973	-13198.143	
64	47	-520.931	-5447.893	266.934	2893.440	225.762	-13353.480	
	12	-516.917	-5473.245	266.934	2893.440	415.418	-17233.210	
65	12	-182.503	1152.119	-9.559	-545.899	-33.567	-5711.977	
	52	-151.259	954.784	-9.559	-545.899	-86.433	113.982	
Combination 80: ASCE7-10, 1.2D+1.0E+Z+0.2L+0.5R								
Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)	
1	1	-7176.707	377.750	558.798	101.835	379.279	-1726.877	
	2	-6782.856	377.750	558.798	101.835	8067.188	3470.184	
2	3	-7777.278	276.508	-1623.725	94.410	12439.166	-1738.210	
	4	-6987.893	276.508	-1623.725	94.410	-18127.479	3467.055	
3	15	151.242	-955.949	-48.863	-545.899	-86.433	133.322	
	2	183.649	-1160.633	-48.863	-545.899	-366.723	-5937.349	
4	5	-9761.405	0.000	721.924	0.000	566.124	-0.000	
	6	-9367.554	0.000	721.924	0.000	10498.311	-0.000	
5	7	-10418.197	0.000	-2145.500	-0.000	16449.192	-0.000	
	8	-9628.811	0.000	-2145.500	-0.000	-23939.874	0.000	
6	14	216.112	-1365.924	-0.000	-0.000	-0.000	-266.644	
	6	248.520	-1570.608	-0.000	-0.000	-0.000	-8689.054	
7	9	-7176.707	-377.750	558.798	-101.835	379.279	1726.877	
	10	-6782.856	-377.750	558.798	-101.835	8067.188	-3470.184	
8	11	-7777.278	-276.508	-1623.725	-94.410	12439.166	1738.210	
	12	-6987.893	-276.508	-1623.725	-94.410	-18127.479	-3467.055	
9	13	151.242	-955.949	48.863	545.899	86.433	133.322	
	13	183.649	-1160.633	48.863	545.899	366.723	-5937.349	
10	13	48.865	681.458	-113.670	0.000	0.000	0.000	
	14	48.865	-681.458	113.670	0.000	0.000	0.000	
11	14	48.865	681.458	-113.670	0.000	0.000	0.000	
	15	48.865	-681.458	113.670	0.000	0.000	0.000	
12	15	-0.000	272.583	-45.468	0.000	90.936	-545.167	
	16	-0.000	-0.000	0.000	0.000	0.000	-0.000	
13	17	0.000	0.000	0.000	0.000	-0.000	-0.000	
	13	0.000	-272.583	45.468	0.000	90.936	-545.167	
14	22	329.011	1204.630	-200.938	0.000	0.000	0.000	
	18	329.011	-1204.630	200.938	0.000	-0.000	0.000	
15	18	329.011	1204.630	-200.938	0.000	0.000	0.000	
	19	329.011	-1204.630	200.938	0.000	-0.000	0.000	
16	19	-0.000	481.852	-80.375	0.000	160.750	-963.704	
	20	-0.000	-0.000	-0.000	0.000	0.000	0.000	
17	21	0.000	-0.000	0.000	0.000	-0.000	-0.000	
	22	0.000	-481.852	80.375	0.000	160.750	-963.704	
18	27	-22.446	1204.630	-200.938	0.000	0.000	0.000	
	23	-22.446	-1204.630	200.938	0.000	-0.000	0.000	

Load Combination 81: ASCE7-10_1.2D+1.0E-X+0.2LrOrS							
Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)

24	29	0.000	481.852	-80.375	0.000	160.750	-963.704
	30	0.000	0.000	0.000	0.000	0.000	0.000
25	31	0.000	0.000	-0.000	0.000	0.000	-0.000

42	2	-2099.161	5611.377	268.428	3257.474	176.715	-17916.785
	19	-2096.401	5593.378	268.428	3257.474	312.014	-15092.953

Load Combination 82: ASCE7-10_0.9D+1.0WA-Z							
Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)

8	11	712.825	83.292	1369.772	29.349	-11819.782	-521.182
	12	1304.864	83.292	1071.207	29.349	11155.945	1046.792
9	13	96.329	479.434	-55.919	-273.804	55.064	-111.550
	10	120.635	325.921	-55.919	-273.804	-265.701	2198.327
10	13	-55.919	-342.812	-66.003	0.000	0.000	0.000
	14	-55.919	342.812	66.003	0.000	-0.000	-0.000
11	14	-55.919	-342.812	-66.003	0.000	0.000	0.000
	15	-55.919	342.812	66.003	0.000	0.000	0.000
12	15	0.000	-137.125	-26.401	-0.000	52.802	274.249
	16	0.000	-0.000	0.000	-0.000	0.000	-0.000
13	17	-0.000	0.000	-0.000	0.000	0.000	-0.000
	13	-0.000	137.125	26.401	0.000	52.802	274.249
14	22	-173.050	-804.339	-112.203	0.000	0.000	0.000
	18	-173.050	804.339	112.203	0.000	0.000	0.000
15	18	-173.050	-804.339	-112.203	0.000	0.000	0.000
	19	-173.050	804.339	112.203	0.000	0.000	0.000
16	19	0.000	-321.735	-44.881	-0.000	89.762	643.471
	20	0.000	0.000	0.000	-0.000	0.000	0.000
17	21	0.000	-0.000	0.000	0.000	-0.000	0.000
	22	0.000	321.735	44.881	0.000	89.762	643.471
18	27	12.083	-804.339	-112.203	0.000	0.000	0.000
	23	12.083	804.339	112.203	0.000	0.000	0.000
19	23	12.083	-804.339	-112.203	0.000	0.000	0.000
	24	12.083	804.339	112.203	0.000	-0.000	0.000
20	24	-0.000	-321.735	-44.881	-0.000	89.762	643.471
	25	-0.000	0.000	-0.000	-0.000	-0.000	0.000
21	26	0.000	0.000	-0.000	0.000	0.000	-0.000
	27	0.000	321.735	44.881	0.000	89.762	643.471
22	32	1.022	-804.339	-112.203	0.000	0.000	0.000
	28	1.022	804.339	112.203	0.000	0.000	0.000
23	28	1.022	-804.339	-112.203	0.000	0.000	0.000
	29	1.022	804.339	112.203	0.000	0.000	0.000
24	29	-0.000	-321.735	-44.881	0.000	89.762	643.471
	30	-0.000	0.000	0.000	0.000	-0.000	0.000
25	31	0.000	-0.000	0.000	0.000	-0.000	0.000
	32	0.000	321.735	44.881	0.000	89.762	643.471
26	37	4.528	-256.439	-112.203	0.000	0.000	0.000
	33	4.528	256.439	112.203	0.000	0.000	0.000
27	33	4.528	-256.439	-112.203	0.000	0.000	0.000
	34	4.528	256.439	112.203	0.000	0.000	0.000
28	34	0.000	-102.575	-44.881	0.000	89.762	205.151
	35	0.000	-0.000	0.000	0.000	-0.000	-0.000
29	36	0.000	0.000	-0.000	0.000	0.000	0.000
	37	0.000	102.575	44.881	0.000	89.762	205.151
30	38	-14.266	-256.439	-112.203	0.000	0.000	0.000
	39	-14.266	256.439	112.203	0.000	0.000	0.000
31	39	-14.266	-256.439	-112.203	0.000	0.000	0.000
	40	-14.266	256.439	112.203	0.000	0.000	0.000

32	40	-0.000	-102.575	-44.881	0.000	89.762	205.151
	41	-0.000	-0.000	-0.000	0.000	-0.000	0.000
33	42	-0.000	0.000	-0.000	0.000	0.000	-0.000
	38	-0.000	102.575	44.881	0.000	89.762	205.151
34	47	-78.804	-256.439	-112.203	0.000	0.000	0.000
	43	-78.804	256.439	112.203	0.000	-0.000	0.000
35	43	-78.804	-256.439	-112.203	0.000	0.000	0.000
	44	-78.804	256.439	112.203	0.000	0.000	0.000
36	44	-0.000	-102.575	-44.881	0.000	89.762	205.151
	45	-0.000	-0.000	-0.000	0.000	0.000	-0.000
37	46	0.000	0.000	-0.000	0.000	0.000	-0.000
	47	0.000	102.575	44.881	0.000	89.762	205.151
38	52	20.636	-68.912	-66.003	0.000	0.000	0.000
	48	20.636	68.912	66.003	0.000	-0.000	0.000
39	48	20.636	-68.912	-66.003	0.000	0.000	0.000
	49	20.636	68.912	66.003	0.000	0.000	0.000
40	49	-0.000	-27.565	-26.401	0.000	52.802	55.129
	50	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
41	51	0.000	0.000	0.000	0.000	-0.000	-0.000
	52	0.000	27.565	26.401	0.000	52.802	55.129
42	2	-387.535	-2070.395	-144.567	-1557.765	39.675	-1554.915
	19	-385.466	-2083.895	-144.567	-1557.765	-33.193	-2601.883
43	19	-208.559	-960.560	28.490	-914.821	-136.293	-2731.629
	24	-182.060	-1127.491	28.490	-914.821	41.427	-9244.341
44	24	-16.126	-2.259	16.407	-272.097	-53.281	-9334.574
	29	10.301	-169.173	16.407	-272.097	49.052	-9869.186
45	29	176.948	955.381	15.385	370.598	-46.124	-9875.032
	34	203.328	788.460	15.385	370.598	49.834	-4436.829
46	34	362.824	1145.933	10.857	574.999	-41.351	-4372.466
	40	389.303	978.999	10.857	574.999	26.379	2255.285
47	40	549.615	1336.572	25.122	779.409	-65.238	2337.748
	44	576.043	1169.658	25.122	779.409	91.452	10153.472
48	44	736.038	1527.734	103.931	983.812	-0.001	10182.614
	4	739.049	1508.719	103.931	983.812	73.842	11261.313
49	4	-116.642	52.302	20.636	-54.692	-60.870	105.363
	49	-93.209	-95.699	20.636	-54.692	53.255	-14.638
50	6	-491.751	-3172.546	-0.000	-0.000	-0.000	-1296.710
	18	-489.682	-3186.045	-0.000	-0.000	-0.000	-2899.207
51	18	-235.493	-1580.620	-0.000	-0.000	-0.000	-2639.714
	23	-208.995	-1747.551	-0.000	-0.000	-0.000	-13020.413
52	23	27.975	-139.983	0.000	-0.000	-0.000	-12839.946
	28	54.402	-306.896	0.000	-0.000	-0.000	-14233.548
53	28	292.448	1299.440	0.000	-0.000	-0.000	-14221.857
	33	318.829	1132.519	0.000	-0.000	-0.000	-6637.745
54	33	546.666	1642.929	0.000	-0.000	-0.000	-6766.473
	39	573.146	1475.995	0.000	-0.000	0.000	2961.575
55	39	802.214	1986.784	-0.000	-0.000	-0.000	2796.648
	43	828.642	1819.871	-0.000	-0.000	-0.000	14667.773
56	43	1057.368	2331.654	0.000	-0.000	0.000	14609.492

	8	1060.379	2312.640	0.000	-0.000	0.000	16259.375
57	8	-156.547	11.310	0.000	-0.000	-0.000	375.978
	48	-133.114	-136.692	0.000	-0.000	-0.000	29.276
58	10	-387.535	-2070.395	144.567	1557.765	-39.675	-1554.915
	22	-385.466	-2083.895	144.567	1557.765	33.193	-2601.883
59	22	-208.559	-960.560	-28.490	914.821	136.293	-2731.629
	27	-182.060	-1127.491	-28.490	914.821	-41.427	-9244.341
60	27	-16.126	-2.259	-16.407	272.097	53.281	-9334.574
	32	10.301	-169.173	-16.407	272.097	-49.052	-9869.186
61	32	176.948	955.381	-15.385	-370.598	46.124	-9875.032
	37	203.328	788.460	-15.385	-370.598	-49.834	-4436.829
62	37	362.824	1145.933	-10.857	-574.999	41.351	-4372.466
	38	389.303	978.999	-10.857	-574.999	-26.379	2255.285
63	38	549.615	1336.572	-25.122	-779.409	65.238	2337.748
	47	576.043	1169.658	-25.122	-779.409	-91.452	10153.472
64	47	736.038	1527.734	-103.931	-983.812	0.001	10182.614
	12	739.049	1508.719	-103.931	-983.812	-73.842	11261.313
65	12	-116.642	52.302	-20.636	54.692	60.870	105.363
	52	-93.209	-95.699	-20.636	54.692	-53.255	-14.638
Load Combination 83: ASCE7-10, 0.9D+1.0WB-Z							
Member	Node	Px(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-3272.081	56.168	1135.760	14.552	-8713.781	-256.395
	2	-2976.692	56.168	825.931	14.552	4780.632	516.364
2	3	4483.121	-201.519	1287.498	-70.138	-10355.323	1258.002
	4	5075.160	-201.519	863.559	-70.138	9891.516	-2535.593
3	15	87.826	-554.532	3.687	-316.976	-50.187	-87.161
	2	112.131	-708.045	3.687	-316.976	-29.035	-3708.419
4	5	-4254.385	-0.000	1442.153	-0.000	-11457.440	0.000
	6	-3958.997	-0.000	1132.325	-0.000	6252.312	0.000
5	7	6871.884	-0.000	1703.509	0.000	-13988.868	0.000
	8	7463.923	-0.000	1279.570	0.000	14089.384	-0.000
6	14	125.471	-792.107	-0.000	-0.000	0.000	174.322
	6	149.777	-945.620	-0.000	-0.000	-0.000	-4809.738
7	9	-3272.081	-56.168	1135.760	-14.552	-8713.781	256.395
	10	-2976.692	-56.168	825.931	-14.552	4780.632	-516.364
8	11	4483.121	201.519	1287.498	70.138	-10355.323	-1258.002
	12	5075.160	201.519	863.559	70.138	9891.516	2535.593
9	13	87.826	-554.532	-3.687	316.976	50.187	-87.161
	10	112.131	-708.045	-3.687	316.976	29.035	-3708.419
10	13	-3.687	395.688	-66.003	0.000	0.000	0.000
	14	-3.687	-395.688	66.003	0.000	0.000	0.000
11	14	-3.687	395.688	-66.003	0.000	0.000	0.000
	15	-3.687	-395.688	66.003	0.000	0.000	-0.000
12	15	-0.000	158.275	-26.401	0.000	52.802	-316.551
	16	-0.000	-0.000	-0.000	0.000	0.000	-0.000
13	17	0.000	-0.000	-0.000	0.000	0.000	0.000
	13	0.000	-158.275	26.401	0.000	52.802	-316.551
14	22	49.912	672.661	-112.203	0.000	0.000	0.000

39	48	28.900	-652.612	-66.003	0.000	0.000	-0.000
	49	28.900	652.612	66.003	0.000	0.000	0.000
40	49	-0.000	-261.045	-26.401	0.000	52.802	522.089
	50	-0.000	0.000	0.000	0.000	-0.000	-0.000
41	51	0.000	0.000	-0.000	0.000	0.000	-0.000
	52	0.000	261.045	26.401	0.000	52.802	522.089
42	2	-1153.008	2107.553	59.862	195.493	36.381	-8489.051
	19	-1150.939	2094.053	59.862	195.493	66.554	-7430.159
43	19	-1012.367	1145.700	9.947	-343.682	-17.938	-7504.880
	24	-985.869	978.770	9.947	-343.682	44.113	-878.574
44	24	-836.176	36.624	12.983	-882.516	-41.067	-929.048
	29	-809.749	-130.289	12.983	-882.516	39.908	-1221.145
45	29	-660.750	-1072.719	16.120	-1421.381	-45.005	-1261.097
	34	-634.370	-1239.640	16.120	-1421.381	55.533	-8472.236
46	34	-460.692	752.757	7.701	-283.013	-44.115	-8460.693
	40	-434.213	585.823	7.701	-283.013	3.923	-4285.609
47	40	-260.526	2578.024	40.909	855.359	-95.160	-4208.417
	44	-234.098	2411.111	40.909	855.359	199.990	11350.293
48	44	-60.646	4402.978	230.412	1993.730	60.826	11397.232
	4	-57.636	4383.964	230.412	1993.730	224.534	14518.790
49	4	-123.389	-764.843	28.900	-521.636	-102.715	4627.271
	49	-99.956	-912.845	28.900	-521.636	57.110	-11.834
50	6	-1563.774	2793.279	-0.000	0.000	-0.000	-11062.051
	18	-1561.705	2779.780	-0.000	0.000	-0.000	-9657.524
51	18	-1362.701	1425.687	0.000	0.000	-0.000	-9508.095
	23	-1336.203	1258.756	0.000	0.000	-0.000	-1135.209
52	23	-1122.406	-86.999	-0.000	0.000	-0.000	-1034.254
	28	-1095.979	-253.913	-0.000	0.000	-0.000	-2097.392
53	28	-883.138	-1600.011	0.000	0.000	-0.000	-2017.498
	33	-856.758	-1766.932	0.000	0.000	-0.000	-12517.375
54	33	-608.662	1079.688	-0.000	0.000	-0.000	-12540.464
	39	-582.183	912.754	-0.000	0.000	-0.000	-6325.955
55	39	-333.986	3758.743	-0.000	0.000	-0.000	-6480.315
	43	-307.558	3591.829	-0.000	0.000	-0.000	16442.583
56	43	-59.482	6437.259	0.000	0.000	-0.000	16348.690
	8	-56.472	6418.245	0.000	0.000	-0.000	20915.603
57	8	-166.183	-1156.037	0.000	-0.000	-0.000	6826.209
	48	-142.750	-1304.038	0.000	-0.000	-0.000	23.667
58	10	-1153.008	2107.553	-59.862	-195.493	-36.381	-8489.051
	22	-1150.939	2094.053	-59.862	-195.493	-66.554	-7430.159
59	22	-1012.367	1145.700	-9.947	343.682	17.938	-7504.880
	27	-985.869	978.770	-9.947	343.682	-44.113	-878.574
60	27	-836.176	36.624	-12.983	882.516	41.067	-929.048
	32	-809.749	-130.289	-12.983	882.516	-39.908	-1221.145
61	32	-660.750	-1072.719	-16.120	1421.381	45.005	-1261.097
	37	-634.370	-1239.640	-16.120	1421.381	-55.533	-8472.236
62	37	-460.692	752.757	-7.701	283.013	44.115	-8460.693
	38	-434.213	585.823	-7.701	283.013	-3.923	-4285.609

63	38	-260.526	2578.024	-40.909	-855.359	95.160	-4208.417
	47	-234.098	2411.111	-40.909	-855.359	-159.990	11350.293
64	47	-60.646	4402.978	-230.412	-1993.730	-60.826	11397.232
	12	-57.636	4383.964	-230.412	-1993.730	-224.534	14518.790
65	12	-123.389	-764.843	-28.900	521.636	102.715	4627.271
	52	-99.956	-912.845	-28.900	521.636	-57.110	-11.834
Load Combination 84: ASCE7-10_0.9D+1.0W+Z							
Member	Node	Fx(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-11004.394	689.094	144.886	187.851	6830.926	-3155.427
	2	-10709.005	689.094	453.476	187.851	10947.039	6325.089
2	3	-14665.575	587.637	-3752.479	202.789	28932.546	-3709.704
	4	-14073.536	587.637	-3330.234	202.789	-37733.547	7352.563
3	15	79.756	-1518.531	-122.724	-867.357	-45.643	312.868
	2	104.061	-1672.044	-122.724	-867.357	-749.623	-8838.172
4	5	-15359.553	-0.000	142.874	0.000	9743.508	-0.000
	6	-15064.164	-0.000	451.464	0.000	13831.942	-0.000
5	7	-20424.363	0.000	-5020.002	0.000	39195.402	-0.000
	8	-19832.324	0.000	-4597.757	0.000	-51331.823	0.000
6	14	114.349	-2169.865	0.000	0.000	0.000	-625.736
	6	138.654	-2323.378	0.000	0.000	0.000	-13513.022
7	9	-11004.394	-689.094	144.886	-187.851	6830.926	3155.427
	10	-10709.005	-689.094	453.476	-187.851	10947.039	-6325.089
8	11	-14665.575	-587.637	-3752.479	-202.789	28932.546	3709.704
	12	-14073.536	-587.637	-3330.234	-202.789	-37733.547	-7352.563
9	13	79.756	-1518.531	122.724	867.357	45.643	312.868
	10	104.061	-1672.044	122.724	867.357	749.623	-8838.172
10	13	122.726	1083.688	-66.003	0.000	0.000	0.000
	14	122.726	-1083.688	66.003	0.000	-0.000	0.000
11	14	122.726	1083.688	-66.003	0.000	0.000	0.000
	15	122.726	-1083.688	66.003	0.000	0.000	0.000
12	15	0.000	433.475	-26.401	0.000	52.802	-866.951
	16	0.000	0.000	0.000	0.000	0.000	0.000
13	17	0.000	-0.000	0.000	-0.000	-0.000	0.000
	13	0.000	-433.475	26.401	-0.000	52.802	-866.951
14	22	599.260	2048.561	-112.203	0.000	0.000	-0.000
	18	599.260	-2048.561	112.203	0.000	0.000	0.000
15	18	599.260	2048.561	-112.203	0.000	0.000	0.000
	19	599.260	-2048.561	112.203	0.000	-0.000	-0.000
16	19	-0.000	819.425	-44.881	0.000	89.762	-1638.849
	20	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
17	21	0.000	-0.000	0.000	0.000	-0.000	-0.000
	22	0.000	-819.425	44.881	0.000	89.762	-1638.849
18	27	-41.280	2048.561	-112.203	0.000	0.000	0.000
	23	-41.280	-2048.561	112.203	0.000	0.000	0.000
19	23	-41.280	2048.561	-112.203	0.000	0.000	0.000
	24	-41.280	-2048.561	112.203	0.000	-0.000	0.000
20	24	-0.000	819.425	-44.881	0.000	89.762	-1638.849
	25	-0.000	0.000	0.000	0.000	0.000	0.000

21	26	0.000	-0.000	-0.000	0.000	0.000	0.000
	27	0.000	-819.425	44.881	0.000	89.762	-1638.849
22	32	-0.040	2048.561	-112.203	0.000	0.000	0.000
	28	-0.040	-2048.561	112.203	0.000	0.000	0.000
23	28	-0.040	2048.561	-112.203	0.000	0.000	0.000
	29	-0.040	-2048.561	112.203	0.000	-0.000	0.000
24	29	0.000	819.425	-44.881	-0.000	89.762	-1638.849
	30	0.000	0.000	0.000	-0.000	0.000	-0.000
25	31	0.000	-0.000	-0.000	0.000	0.000	-0.000
	32	0.000	-819.425	44.881	0.000	89.762	-1638.849
26	37	-28.083	2761.861	-112.203	0.000	0.000	0.000
	33	-28.083	-2761.861	112.203	0.000	0.000	0.000
27	33	-28.083	2761.861	-112.203	0.000	0.000	0.000
	34	-28.083	-2761.861	112.203	0.000	0.000	-0.000
28	34	-0.000	1104.745	-44.881	-0.000	89.762	-2209.489
	35	-0.000	0.000	-0.000	-0.000	-0.000	0.000
29	36	0.000	-0.000	-0.000	0.000	0.000	-0.000
	37	0.000	-1104.745	44.881	0.000	89.762	-2209.489
30	38	97.620	2761.861	-112.203	0.000	0.000	0.000
	39	97.620	-2761.861	112.203	0.000	0.000	0.000
31	39	97.620	2761.861	-112.203	0.000	0.000	0.000
	40	97.620	-2761.861	112.203	0.000	0.000	-0.000
32	40	-0.000	1104.745	-44.881	0.000	89.762	-2209.489
	41	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
33	42	0.000	-0.000	-0.000	0.000	0.000	0.000
	38	0.000	-1104.745	44.881	0.000	89.762	-2209.489
34	47	548.271	2761.861	-112.203	0.000	0.000	0.000
	43	548.271	-2761.861	112.203	0.000	0.000	0.000
35	43	548.271	2761.861	-112.203	0.000	0.000	0.000
	44	548.271	-2761.861	112.203	0.000	-0.000	0.000
36	44	0.000	1104.745	-44.881	-0.000	89.762	-2209.489
	45	0.000	-0.000	-0.000	-0.000	0.000	-0.000
37	46	0.000	-0.000	0.000	0.000	0.000	0.000
	47	0.000	-1104.745	44.881	0.000	89.762	-2209.489
38	52	-21.575	1440.288	-66.003	0.000	0.000	0.000
	48	-21.575	-1440.288	66.003	0.000	0.000	0.000
39	48	-21.575	1440.288	-66.003	0.000	0.000	0.000
	49	-21.575	-1440.288	66.003	0.000	-0.000	0.000
40	49	-0.000	576.115	-26.401	0.000	52.802	-1152.231
	50	-0.000	0.000	-0.000	0.000	0.000	-0.000
41	51	0.000	-0.000	-0.000	0.000	0.000	0.000
	52	0.000	-576.115	26.401	0.000	52.802	-1152.231
42	2	-2016.340	8855.632	566.595	5409.432	27.345	-19785.011
	19	-2014.271	8842.133	566.595	5409.432	312.932	-15324.806
43	19	-1927.219	5961.801	-32.754	3768.187	264.815	-14945.075
	24	-1900.721	5794.870	-32.754	3768.187	60.494	21724.450
44	24	-1764.980	2919.492	8.490	2128.677	-17.234	22088.657
	29	-1738.553	2752.578	8.490	2128.677	35.718	39777.116
45	29	-1605.186	-126.937	8.533	489.131	-40.651	39906.790

4	2	98.939	-2292.102	-141.174	-1221.745	-852.531	-12441.742
	5	-19154.435	0.000	141.408	-0.000	8618.106	-0.000
	6	-18859.047	0.000	475.588	-0.000	12862.406	0.000
5	7	-11902.708	-0.000	-4264.035	-0.000	33492.125	0.000
	8	-11310.668	-0.000	-3806.776	-0.000	-42474.446	-0.000
6	14	107.038	-3055.605	-0.000	-0.000	-532.275	0.000
	6	131.344	-3209.118	-0.000	-0.000	-18500.428	0.000
7	9	-13658.526	-778.512	114.025	-212.436	6200.575	3569.149
	10	-13363.138	-778.512	448.205	-212.436	10068.143	-7141.575
8	11	-8702.561	-367.296	-3216.556	-126.334	24912.117	2310.506
	12	-8110.522	-367.296	-2759.297	-126.334	-31335.644	-4603.848
9	13	74.634	-2138.589	141.174	1221.745	42.718	266.137
	10	98.939	-2292.102	141.174	1221.745	852.531	-12441.742
10	13	141.176	1526.688	-66.003	0.000	0.000	0.000
	14	141.176	-1526.688	66.003	0.000	-0.000	-0.000
11	14	141.176	1526.688	-66.003	0.000	0.000	0.000
	15	141.176	-1526.688	66.003	0.000	0.000	-0.000
12	15	-0.000	610.675	-26.401	0.000	52.802	-1221.351
	16	-0.000	0.000	0.000	0.000	-0.000	0.000
13	17	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
	13	-0.000	-610.675	26.401	-0.000	52.802	-1221.351
14	22	677.113	2934.661	-112.203	0.000	0.000	0.000
	18	677.113	-2934.661	112.203	0.000	0.000	0.000
15	18	677.113	2934.661	-112.203	0.000	0.000	0.000
	19	677.113	-2934.661	112.203	0.000	0.000	0.000
16	19	0.000	1173.865	-44.881	-0.000	89.762	-2347.729
	20	0.000	0.000	0.000	-0.000	0.000	0.000
17	21	0.000	-0.000	-0.000	0.000	0.000	0.000
	22	0.000	-1173.865	44.881	0.000	89.762	-2347.729
18	27	-46.258	2934.661	-112.203	0.000	-0.000	0.000
	23	-46.258	-2934.661	112.203	0.000	0.000	0.000
19	23	-46.258	2934.661	-112.203	0.000	0.000	0.000
	24	-46.258	-2934.661	112.203	0.000	-0.000	0.000
20	24	0.000	1173.865	-44.881	-0.000	89.762	-2347.729
	25	0.000	0.000	0.000	-0.000	0.000	0.000
21	26	0.000	-0.000	-0.000	0.000	0.000	-0.000
	27	0.000	-1173.865	44.881	0.000	89.762	-2347.729
22	32	-3.716	2934.661	-112.203	0.000	0.000	0.000
	28	-3.716	-2934.661	112.203	0.000	0.000	0.000
23	28	-3.716	2934.661	-112.203	0.000	0.000	0.000
	29	-3.716	-2934.661	112.203	0.000	-0.000	0.000
24	29	-0.000	1173.865	-44.881	-0.000	89.762	-2347.729
	30	-0.000	0.000	0.000	-0.000	0.000	0.000
25	31	0.000	0.000	-0.000	0.000	0.000	-0.000
	32	0.000	-1173.865	44.881	0.000	89.762	-2347.729
26	37	-19.118	1191.161	-112.203	0.000	0.000	-0.000
	33	-19.118	-1191.161	112.203	0.000	0.000	0.000
27	33	-19.118	1191.161	-112.203	0.000	0.000	0.000
	34	-19.118	-1191.161	112.203	0.000	0.000	-0.000

28	34	0.000	476.465	-44.881	-0.000	89.762	-952.929
	35	0.000	-0.000	-0.000	-0.000	-0.000	-0.000
29	36	0.000	0.000	0.000	0.000	0.000	-0.000
	37	0.000	-476.465	44.881	0.000	89.762	-952.929
30	38	61.846	1191.161	-112.203	0.000	0.000	0.000
	39	61.846	-1191.161	112.203	0.000	0.000	0.000
31	39	61.846	1191.161	-112.203	0.000	0.000	0.000
	40	61.846	-1191.161	112.203	0.000	0.000	0.000
32	40	0.000	476.465	-44.881	0.000	89.762	-952.929
	41	0.000	-0.000	-0.000	0.000	-0.000	-0.000
33	42	-0.000	-0.000	-0.000	0.000	0.000	0.000
	38	-0.000	-476.465	44.881	0.000	89.762	-952.929
34	47	342.212	1191.161	-112.203	0.000	-0.000	0.000
	43	342.212	-1191.161	112.203	0.000	0.000	0.000
35	43	342.212	1191.161	-112.203	0.000	0.000	0.000
	44	342.212	-1191.161	112.203	0.000	-0.000	0.000
36	44	-0.000	476.465	-44.881	0.000	89.762	-952.929
	45	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
37	46	0.000	-0.000	0.000	0.000	-0.000	-0.000
	47	0.000	-476.465	44.881	0.000	89.762	-952.929
38	52	-7.276	654.988	-66.003	0.000	-0.000	0.000
	48	-7.276	-654.988	66.003	0.000	0.000	-0.000
39	48	-7.276	654.988	-66.003	0.000	0.000	0.000
	49	-7.276	-654.988	66.003	0.000	-0.000	-0.000
40	49	0.000	261.995	-26.401	0.000	52.802	-523.991
	50	0.000	0.000	0.000	0.000	0.000	0.000
41	51	0.000	-0.000	0.000	0.000	-0.000	0.000
	52	0.000	-261.995	26.401	0.000	52.802	-523.991
42	2	-2426.816	10860.537	637.650	5865.330	25.596	-22509.733
	19	-2424.747	10847.038	637.650	5865.330	346.998	-17038.973
43	19	-2358.090	6724.422	-39.583	3515.040	306.874	-16691.841
	24	-2331.591	6557.491	-39.583	3515.040	59.953	24734.972
44	24	-2205.790	2440.011	6.625	1166.673	-11.823	25061.079
	29	-2179.362	2273.097	6.625	1166.673	29.499	39758.995
45	29	-2056.722	-1848.813	10.345	-1181.729	-40.543	39834.679
	34	-2030.342	-2015.735	10.345	-1181.729	23.976	27783.012
46	34	-1885.396	-3693.565	29.457	-2135.357	-58.859	27599.636
	40	-1858.916	-3860.499	29.457	-2135.357	124.897	4038.204
47	40	-1716.751	-5528.523	32.398	-3088.959	43.611	3737.341
	44	-1690.323	-5695.437	32.398	-3088.959	-158.454	-31264.788
48	44	-1547.306	-7360.410	-374.577	-4042.596	-240.347	-31453.011
	4	-1544.295	-7379.425	-374.577	-4042.596	-506.483	-36689.331
49	4	-108.270	1065.384	-7.275	524.409	88.707	-5353.456
	49	-84.837	917.382	-7.275	524.409	48.475	129.241
50	6	-3301.795	15381.053	0.000	0.000	0.000	-31362.476
	18	-3299.726	15367.553	0.000	0.000	0.000	-312613.187
51	18	-3201.779	9479.840	0.000	0.000	0.000	-24307.450
	23	-3175.281	9312.909	0.000	0.000	0.000	34307.884

52	23	-2995.727	3426.964	-0.000	0.000	0.000	33655.581
	28	-2969.299	3260.050	-0.000	0.000	0.000	54509.163
53	28	-2794.108	-2633.846	-0.000	0.000	0.000	54357.790
	33	-2767.727	-2800.767	-0.000	0.000	-0.000	37409.845
54	33	-2560.763	-5200.922	-0.000	0.000	-0.000	37776.653
	39	-2534.284	-5367.856	-0.000	0.000	-0.000	4812.207
55	39	-2330.965	-7750.344	0.000	0.000	-0.000	5414.026
	43	-2304.537	-7917.257	0.000	0.000	-0.000	-43445.680
56	43	-2099.218	-10293.789	0.000	0.000	-0.000	-43069.301
	8	-2096.207	-10312.803	0.000	0.000	-0.000	-50389.784
57	8	-144.607	1458.415	0.000	0.000	-0.000	-7914.782
	48	-121.174	1310.413	0.000	0.000	0.000	-258.483
58	10	-2426.816	10860.537	-637.650	-5865.330	-25.596	-22509.733
	22	-2424.747	10847.038	-637.650	-5865.330	-346.998	-17038.973
59	22	-2358.090	6724.422	39.583	-3515.040	-306.874	-16691.841
	27	-2331.591	6557.491	39.583	-3515.040	-59.953	24734.972
60	27	-2205.790	2440.011	-6.625	-1166.673	11.823	25061.079
	32	-2179.362	2273.097	-6.625	-1166.673	-29.499	39758.995
61	32	-2056.722	-1848.813	-10.345	1181.729	40.543	39834.679
	37	-2030.342	-2015.735	-10.345	1181.729	-23.976	27783.012
62	37	-1885.396	-3693.565	-29.457	2135.357	58.859	27599.636
	38	-1858.916	-3860.499	-29.457	2135.357	-124.897	4038.204
63	38	-1716.751	-5528.523	32.398	3088.959	-43.611	3737.341
	47	-1690.323	-5695.437	32.398	3088.959	158.454	-31264.788
64	47	-1547.306	-7360.410	374.577	4042.596	240.347	-31453.011
	12	-1544.295	-7379.425	374.577	4042.596	506.483	-36689.331
65	12	-108.270	1065.384	7.275	-524.409	-88.707	-5353.456
	52	-84.837	917.382	7.275	-524.409	-48.475	129.241
Load Combination 86: ASCE7-10_0.9D+1.0WA-X							
Member	Node	Fx(Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-649.488	-696.302	768.681	-445.634	-6330.435	7931.355
	2	-354.100	-454.850	768.681	-445.634	4245.028	12.614
2	3	-334.707	-755.773	556.071	417.714	-5611.775	10368.463
	4	257.332	-425.394	556.071	417.714	4856.268	-749.286
3	15	92.554	20.227	29.487	11.493	-52.899	-128.689
	2	116.860	-133.286	130.159	11.493	404.991	-452.961
4	5	361.217	-656.821	1100.586	-433.896	-9772.864	7756.628
	6	656.605	-415.370	1100.586	-433.896	5368.931	381.061
5	7	1011.454	-727.192	1103.247	428.520	-10494.878	10199.088
	8	1603.493	-396.813	1103.247	428.520	10273.760	-380.623
14	133.406	166.025	5.117	0.000	0.000	153.546	
	157.712	12.512	105.789	0.000	318.096	665.616	
7	9	603.629	-532.762	809.282	-399.242	-7560.108	7192.097
	10	899.017	-291.310	809.282	-399.242	3573.943	1252.333
8	11	1059.951	-636.405	953.200	460.312	-8888.650	9631.085
	12	1651.990	-306.026	953.200	460.312	9055.357	760.439
9	13	94.146	212.107	-34.164	-121.089	53.803	-24.857
	10	118.452	58.594	66.508	-121.089	146.571	751.555

	43	-65.984	422.439	112.203	0.000	0.000	-0.000
35	43	-44.050	-148.539	-112.203	0.000	0.000	0.000
	44	-44.050	148.539	112.203	0.000	0.000	0.000
36	44	-0.000	-59.415	-44.881	0.000	89.762	118.831
	45	-0.000	0.000	0.000	0.000	0.000	-0.000
37	46	0.000	0.000	0.000	0.000	-0.000	-0.000
	47	0.000	168.975	44.881	0.000	89.762	337.951
38	52	20.422	-151.912	-66.003	0.000	0.000	0.000
	48	20.422	151.912	66.003	0.000	-0.000	-0.000
39	48	18.679	-14.912	-66.003	0.000	0.000	0.000
	49	18.679	14.912	66.003	0.000	-0.000	0.000
40	49	0.000	-5.965	-26.401	-0.000	52.802	11.929
	50	0.000	0.000	-0.000	-0.000	0.000	-0.000
41	51	0.000	0.000	-0.000	0.000	-0.000	-0.000
	52	0.000	60.765	26.401	0.000	52.802	121.529
42	2	-696.585	98.996	-324.478	-41.568	0.000	-0.000
	19	-694.515	85.497	-315.632	-41.568	686.008	-4651.493
43	19	-536.287	288.881	-260.364	72.906	595.084	-4793.592
	24	-509.788	121.951	-150.885	72.906	-687.617	-3512.191
44	24	-350.942	329.108	-153.780	190.718	-778.387	-3614.635
	29	-324.515	162.195	-44.320	190.718	-1396.165	-2082.497
45	29	-165.614	368.944	-44.548	308.382	-1486.993	-2101.239
	34	-139.234	202.023	64.912	308.382	-1423.486	-320.668
46	34	19.390	408.579	62.536	427.302	-0.000	-0.000
	40	45.869	241.645	172.015	427.302	-782.443	1771.670
47	40	204.727	448.286	180.918	545.165	-0.000	-0.000
	44	231.155	281.372	290.378	545.165	596.439	4148.681
48	44	389.921	488.144	334.430	663.251	-0.000	-0.000
	4	392.931	469.129	346.899	663.251	747.741	4534.770
49	4	-116.017	127.852	-78.381	-11.493	0.000	-0.000
	49	-92.584	-20.149	18.677	-11.493	52.899	-23.681
50	6	-831.766	-806.271	-312.033	312.480	0.000	0.000
	18	-829.697	-819.770	-303.187	312.480	649.669	-5113.111
51	18	-596.389	-254.151	-275.654	309.021	651.321	-4948.439
	23	-569.891	-421.082	-166.175	309.021	-726.762	-7054.520
52	23	-340.950	149.014	-169.576	308.732	-726.885	-6955.780
	28	-314.523	-17.900	-60.116	308.732	-1443.186	-6546.899
53	28	-85.254	551.431	-58.954	308.322	-1443.274	-6540.579
	33	-58.874	384.510	50.506	308.322	-1469.620	-3621.830
54	33	169.855	953.416	49.573	309.157	-0.000	-0.000
	39	196.334	786.482	159.052	309.157	-818.735	1732.194
55	39	425.678	1355.427	161.382	308.924	-0.000	-0.000
	43	452.106	1188.513	270.842	308.924	529.073	9567.527
56	43	681.266	1757.927	292.777	308.924	-0.000	-0.000
	8	684.277	1738.913	305.247	308.924	741.521	10784.518
57	8	-156.794	-17.743	-95.316	-0.000	0.000	0.000
	48	-133.360	-165.745	1.741	-0.000	0.000	3.379
58	10	-546.360	-954.701	-227.431	1324.882	0.000	0.000
	22	-544.290	-968.201	-218.585	1324.882	660.208	-3307.003

59	22	-377.436	-380.442	-300.710	984.117	759.660	-3329.577
	27	-350.938	-547.373	-191.232	984.117	-774.728	-6223.471
60	27	-189.193	43.321	-183.940	646.611	-682.570	-6219.767
	32	-162.765	-123.593	-74.480	646.611	-1488.457	-6470.096
61	32	-0.672	466.600	-74.637	309.016	-1395.996	-6457.674
	37	25.709	299.679	34.823	309.016	-1520.154	-4068.017
62	37	187.333	889.637	38.359	-0.000	-0.000	-0.000
	38	213.812	722.703	147.837	-27.345	-846.774	969.465
63	38	375.975	1312.644	136.487	-364.784	-0.000	-0.000
	47	402.403	1145.730	245.947	-364.784	438.413	8632.384
64	47	564.344	1736.030	179.963	-701.982	-0.000	-0.000
	12	567.355	1717.016	192.433	-701.982	663.256	9838.318
65	12	-117.595	-63.903	-117.481	121.089	0.000	0.000
	52	-94.162	-211.905	-20.424	121.089	-53.803	20.302

Load Combination 87: ASCE7-10_0.9D+1.0WB-X							
Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-7517.823	-182.646	647.962	-360.885	180.240	5177.586
	2	-7222.434	58.806	647.962	-360.885	9094.855	4325.696
2	3	-8021.282	-401.105	-1772.297	496.046	13535.036	7890.770
	4	-7429.243	-70.726	-1772.297	496.046	-19828.487	3449.648
3	15	83.809	-1034.276	-77.968	-590.806	-47.926	268.090
	2	108.115	-1187.789	22.704	-590.806	-206.430	-6105.123
4	5	-11691.481	-603.265	719.625	-475.388	2211.745	7082.454
	6	-11396.092	-361.814	719.625	-475.388	12112.303	443.705
5	7	-12454.852	-708.187	-2823.513	389.724	21974.713	9791.545
	8	-11862.813	-377.808	-2823.513	389.724	-31177.971	-430.398
6	14	118.205	-1683.210	-7.536	0.000	0.000	-377.451
	6	142.511	-1836.723	93.136	0.000	245.511	-10473.141
7	9	-9391.119	-1153.596	573.774	-625.025	2112.839	9611.141
	10	-9095.730	-912.144	573.774	-625.025	10006.791	-4599.019
8	11	-10117.032	-1111.497	-2377.788	251.409	18563.013	12346.941
	12	-9524.993	-781.118	-2377.788	251.409	-26198.887	-5467.315
9	13	81.476	-1321.819	85.910	755.041	46.571	109.361
	10	105.782	-1475.332	186.582	755.041	828.117	-7913.282
10	13	85.792	943.288	-66.003	0.000	0.000	0.000
	14	85.792	-943.288	66.003	0.000	0.000	-0.000
11	14	78.091	737.988	-66.003	0.000	0.000	0.000
	15	78.091	-737.988	66.003	0.000	-0.000	0.000
12	15	0.000	295.195	-26.401	0.000	52.802	-590.391
	16	0.000	0.000	0.000	0.000	0.000	0.000
13	17	0.000	0.000	0.000	0.000	0.000	0.000
	13	0.000	-377.315	26.401	0.000	52.802	-754.631
14	22	443.174	1767.761	-112.203	0.000	0.000	0.000
	18	443.174	-1767.761	112.203	0.000	0.000	-0.000
15	18	398.319	1357.161	-112.203	0.000	-0.000	0.000
	19	398.319	-1357.161	112.203	0.000	0.000	-0.000
16	19	0.000	542.865	-44.881	0.000	89.762	-1085.729
	20	0.000	0.000	0.000	0.000	0.000	0.000

17	21	0.000	0.000	0.000	0.000	-0.000	-0.000
	22	0.000	-707.105	44.881	0.000	89.762	-1414.209
18	27	-31.956	1767.761	-112.203	0.000	0.000	0.000
	23	-31.956	-1767.761	112.203	0.000	0.000	0.000
19	23	-26.431	1357.161	-112.203	0.000	0.000	0.000
	24	-26.431	-1357.161	112.203	0.000	0.000	0.000
20	24	0.000	542.865	-44.881	-0.000	89.762	-1085.729
	25	0.000	0.000	0.000	-0.000	0.000	0.000
21	26	0.000	-0.000	0.000	0.000	-0.000	-0.000
	27	0.000	-707.105	44.881	0.000	89.762	-1414.209
22	32	-0.009	1767.761	-112.203	0.000	0.000	0.000
	28	-0.009	-1767.761	112.203	0.000	0.000	0.000
23	28	-1.523	1357.161	-112.203	0.000	0.000	0.000
	29	-1.523	-1357.161	112.203	0.000	0.000	-0.000
24	29	0.000	542.865	-44.881	0.000	89.762	-1085.729
	30	0.000	0.000	0.000	0.000	0.000	0.000
25	31	0.000	-0.000	0.000	0.000	0.000	-0.000
	32	0.000	-707.105	44.881	0.000	89.762	-1414.209

	52	-81.501	1321.020	8.424	-755.041	-46.571	72.296
Load Combination 88:	ASCE7-10 0.9D+1.0E-Z						
Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-4645.354	212.124	1365.314	57.203	-8028.380	-968.616
	2	-4349.965	212.124	1365.314	57.203	10755.525	1949.773
2	3	-4276.936	155.240	-311.908	53.005	623.690	-973.937
	4	-3684.896	155.240	-311.908	53.005	-5247.982	1948.463
3	15	87.832	-554.819	-27.173	-316.976	-50.187	35.915
	2	112.138	-708.332	-27.173	-316.976	-206.061	-3586.988
4	5	-6218.088	-0.000	1800.713	0.000	-10610.423	0.000
	6	-5922.700	-0.000	1800.713	0.000	14163.674	-0.000
5	7	-5640.612	0.000	-397.504	0.000	725.878	-0.000
	8	-5048.573	0.000	-397.504	0.000	-6757.149	0.000
6	14	125.457	-792.648	-0.000	0.000	0.000	-71.831
	6	149.763	-946.161	-0.000	0.000	-0.000	-5058.993
7	9	-4645.354	-212.124	1365.314	-57.203	-8028.380	968.616
	10	-4349.965	-212.124	1365.314	-57.203	10755.525	-1949.773
8	11	-4276.936	-155.240	-311.908	-53.005	623.690	-973.937
	12	-3684.896	-155.240	-311.908	-53.005	-5247.982	-1948.463
9	13	87.832	-554.819	27.173	316.976	50.187	35.915
	10	112.138	-708.332	27.173	316.976	206.061	-3586.988
10	13	27.174	395.688	-66.003	0.000	0.000	0.000
	14	27.174	-395.688	66.003	0.000	-0.000	0.000
11	14	27.174	395.688	-66.003	0.000	0.000	0.000
	15	27.174	-395.688	66.003	0.000	0.000	0.000
12	15	-0.000	158.275	-26.401	-0.000	52.802	-316.551
	16	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
13	17	0.000	-0.000	-0.000	0.000	0.000	0.000
	13	0.000	-158.275	26.401	0.000	52.802	-316.551
14	22	185.156	672.661	-112.203	0.000	0.000	0.000
	18	185.156	-672.661	112.203	0.000	-0.000	0.000
15	18	185.156	672.661	-112.203	0.000	0.000	0.000
	19	185.156	-672.661	112.203	0.000	-0.000	0.000
16	19	-0.000	269.065	-44.881	-0.000	89.762	-538.129
	20	-0.000	-0.000	0.000	-0.000	0.000	-0.000
17	21	0.000	-0.000	-0.000	0.000	0.000	0.000
	22	0.000	-269.065	44.881	0.000	89.762	-538.129
18	27	-12.671	672.661	-112.203	0.000	0.000	-0.000
	23	-12.671	-672.661	112.203	0.000	-0.000	0.000
19	23	-12.671	672.661	-112.203	0.000	0.000	0.000
	24	-12.671	-672.661	112.203	0.000	0.000	0.000
20	24	0.000	269.065	-44.881	-0.000	89.762	-538.129
	25	0.000	-0.000	0.000	-0.000	-0.000	-0.000
21	26	0.000	-0.000	-0.000	0.000	0.000	0.000
	27	0.000	-269.065	44.881	0.000	89.762	-538.129
22	32	-0.355	672.661	-112.203	0.000	0.000	0.000
	28	-0.355	-672.661	112.203	0.000	0.000	0.000
23	28	-0.355	672.661	-112.203	0.000	0.000	0.000

	29	-0.355	-672.661	112.203	0.000	0.000	-0.000
24	29	-0.000	269.065	-44.881	-0.000	89.762	-538.129
	30	-0.000	0.000	-0.000	-0.000	0.000	-0.000
25	31	0.000	-0.000	0.000	0.000	-0.000	0.000
	32	0.000	-269.065	44.881	0.000	89.762	-538.129
26	33	-7.520	672.661	-112.203	0.000	0.000	0.000
	33	-7.520	-672.661	112.203	0.000	0.000	-0.000
27	33	-7.520	672.661	-112.203	0.000	0.000	0.000
	34	-7.520	-672.661	112.203	0.000	-0.000	-0.000
28	34	0.000	269.065	-44.881	0.000	89.762	-538.129
	35	0.000	0.000	-0.000	0.000	-0.000	0.000
29	36	0.000	-0.000	-0.000	0.000	0.000	-0.000
	37	0.000	-269.065	44.881	0.000	89.762	-538.129
30	38	25.856	672.661	-112.203	0.000	0.000	0.000
	39	25.856	-672.661	112.203	0.000	0.000	0.000
31	39	25.856	672.661	-112.203	0.000	0.000	0.000
	40	25.856	-672.661	112.203	0.000	-0.000	0.000
32	40	0.000	269.065	-44.881	-0.000	89.762	-538.129
	41	0.000	0.000	0.000	-0.000	0.000	0.000
33	42	-0.000	-0.000	-0.000	0.000	0.000	0.000
	38	-0.000	-269.065	44.881	0.000	89.762	-538.129
34	47	144.123	672.661	-112.203	0.000	0.000	0.000
	43	144.123	-672.661	112.203	0.000	0.000	0.000
35	43	144.123	672.661	-112.203	0.000	0.000	0.000
	44	144.123	-672.661	112.203	0.000	0.000	0.000
36	44	0.000	269.065	-44.881	0.000	89.762	-538.129
	45	0.000	0.000	0.000	0.000	-0.000	0.000
37	46	0.000	-0.000	0.000	0.000	-0.000	-0.000
	47	0.000	-269.065	44.881	0.000	89.762	-538.129
38	52	5.620	395.688	-66.003	0.000	0.000	0.000
	48	5.620	-395.688	66.003	0.000	-0.000	-0.000
39	48	5.620	395.688	-66.003	0.000	0.000	0.000
	49	5.620	-395.688	66.003	0.000	0.000	-0.000
40	49	0.000	158.275	-26.401	0.000	52.802	-316.551
	50	0.000	0.000	0.000	0.000	0.000	0.000
41	51	0.000	0.000	-0.000	0.000	0.000	-0.000
	52	0.000	-158.275	26.401	0.000	52.802	-316.551
42	2	-1386.180	3464.834	184.988	1617.943	34.390	-14342.517
	19	-1384.110	3451.335	184.988	1617.943	127.632	-12599.498
43	19	-1252.721	2501.674	-0.185	1078.424	50.704	-12540.103
	24	-1226.222	2334.743	-0.185	1078.424	49.548	2544.876
44	24	-1075.993	1391.593	12.479	539.592	-36.198	2640.527
	29	-1099.565	1224.680	12.479	539.592	41.634	10799.425
45	29	-900.182	280.161	12.834	0.727	-43.683	10847.705
	34	-873.801	113.240	12.834	0.727	36.365	12074.534
46	34	-724.895	-831.555	20.354	-538.121	-49.105	12042.958
	40	-697.815	-998.489	20.354	-538.121	77.862	6334.975
47	40	-548.789	-1901.478	-5.503	-1076.951	-7.302	6240.141
	44	-522.362	-2148.384	-5.503	-1076.951	-41.626	-6389.422

48	44	-373.029	-3050.878	-149.623	-1615.802	-126.942	-6480.839
	4	-370.019	-3069.892	-149.623	-1615.802	-233.249	-8655.240
49	4	-111.262	702.508	5.620	316.976	19.104	-3707.263
	49	-87.828	554.506	5.620	316.976	50.187	-68.602
50	6	-1841.420	4744.089	-0.000	-0.000	-0.000	-19222.678
18	18	-1839.350	4730.590	-0.000	-0.000	-0.000	-16834.861
23	23	-1650.709	3374.890	0.000	-0.000	-0.000	-16953.648
23	23	-1624.210	3207.959	0.000	-0.000	-0.000	3578.522
52	23	-1409.639	1860.323	0.000	-0.000	-0.000	3387.2
28	28	-1383.212	1693.410	0.000	-0.000	-0.000	14469.598
	28	-1169.822	343.504	0.000	-0.000	-0.000	14373.037
	33	-1143.442	756.583	0.000	-0.000	-0.000	15994.941
	33	-929.864	-1173.452	0.000	-0.000	-0.000	16058.094
	39	-903.385	-1340.386	0.000	-0.000	0.000	8217.332
	39	-690.483	-2687.509	0.000	-0.000	0.000	8407.004
	43	-664.056	-2854.422	0.000	-0.000	0.000	-8875.611
	43	-450.819	-4200.647	-0.000	-0.000	0.000	-8692.790
	8	-447.809	-4219.661	-0.000	-0.000	0.000	-11684.101
57	8	-148.899	940.086	0.000	-0.000	-0.000	-4926.964
	48	-125.465	792.085	0.000	-0.000	0.000	-137.204
58	10	-1386.180	3464.834	-184.988	-1617.943	-34.390	-14342.517
22	22	-1384.110	3451.335	-184.988	-1617.943	-127.632	-12599.498
27	27	-1252.721	2501.674	0.185	-1078.424	-50.704	-12540.103
27	27	-1226.222	2334.743	0.185	-1078.424	-49.548	2544.876
60	27	-1075.993	1391.593	-12.479	-539.592	36.198	2640.527
32	32	-1049.556	1224.680	-12.479	-539.592	-41.634	10799.425
61	32	-900.182	280.161	-12.834	-0.727	43.683	10847.705
37	37	-873.801	113.240	-12.834	-0.727	-36.365	12074.534
	37	-724.295	-831.555	-20.354	538.121	49.105	12042.958
	38	-697.815	-998.489	-20.354	538.121	-77.862	6334.975
38	38	-548.789	-1941.474	5.503	1076.951	7.302	6240.141
47	47	-522.362	-2108.388	5.503	1076.951	41.626	-6389.428
47	47	-373.029	-3050.878	149.623	1615.802	126.942	-6480.839
12	12	-370.019	-3069.892	149.623	1615.802	233.249	-8655.240
65	12	-111.262	702.508	-5.620	-316.976	-19.104	-3707.263
52	52	-87.828	554.506	-5.620	-316.976	-50.187	-68.602

Load Combination 89: ASCR7-10.0_9D+1.0E+Z							
Member	Node	Fx (Axial)	Fy (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-4150.376	212.111	43.818	57.195	2420.050	-968.349
	2	-3854.988	212.111	43.818	57.195	3022.901	1949.871
2	3	-4771.909	155.255	-1100.158	53.015	8890.105	-974.315
	4	-4179.870	155.255	-1100.158	53.015	-11820.379	1948.363
3	15	87.820	-554.950	-27.173	-316.976	-50.187	82.948
	2	112.126	-708.463	-27.173	-316.976	-206.062	-3540.706
4	5	-5569.725	0.000	36.266	-0.000	3285.677	-0.000
	6	-5274.336	0.000	36.266	-0.000	3784.627	-0.000
5	7	-6288.983	-0.000	-1444.482	-0.000	11686.896	-0.000
	8	-5696.944	-0.000	-1444.482	-0.000	-15055.498	-0.000

6	14	125.482	-792.884	-0.000	0.000	-0.000	-165.897
	6	149.788	-946.397	-0.000	0.000	-0.000	-5154.413
7	9	-4150.376	-212.111	43.818	-57.195	2420.050	968.340
	10	-3854.988	-212.111	43.818	-57.195	3022.901	-1949.871
8	11	-4771.909	-155.255	-1100.158	-53.015	8890.105	974.315
	12	-4179.870	-155.255	-1100.158	-53.015	-11820.379	-1948.363
9	13	87.820	-554.950	27.173	316.976	50.187	82.948
	10	112.126	-708.463	27.173	316.976	206.062	-3540.706
10	13	27.174	395.688	-66.003	0.000	0.000	0.000
	14	27.174	-395.688	66.003	0.000	0.000	0.000
11	14	27.174	395.688	-66.003	0.000	0.000	0.000
	15	27.174	-395.688	66.003	0.000	0.000	0.000
12	15	0.000	158.275	-26.401	-0.000	52.802	-316.551
	16	0.000	-0.000	0.000	-0.000	-0.000	-0.000
13	17	0.000	-0.000	0.000	-0.000	0.000	-0.000
	13	0.000	-158.275	26.401	-0.000	52.802	-316.551
14	22	185.141	672.661	-112.203	0.000	0.000	0.000
	18	185.141	-672.661	112.203	0.000	0.000	0.000
15	18	185.141	672.661	-112.203	0.000	0.000	0.000
	19	185.141	-672.661	112.203	0.000	0.000	-0.000
16	19	-0.000	269.065	-44.881	0.000	89.762	-538.129
	20	-0.000	0.000	-0.000	0.000	-0.000	0.000
17	21	0.000	-0.000	-0.000	0.000	0.000	0.000
	22	0.000	-269.065	44.881	0.000	89.762	-538.129
18	27	-12.672	672.661	-112.203	0.000	0.000	0.000
	23	-12.672	-672.661	112.203	0.000	0.000	0.000
19	23	-12.672	672.661	-112.203	0.000	0.000	0.000
	24	-12.672	-672.661	112.203	0.000	0.000	0.000
20	24	-0.000	269.065	-44.881	-0.000	89.762	-538.129
	25	-0.000	0.000	0.000	-0.000	0.000	0.000
21	26	0.000	0.000	-0.000	0.000	0.000	-0.000
	27	0.000	-269.065	44.881	0.000	89.762	-538.129
22	32	-0.354	672.661	-112.203	0.000	0.000	0.000
	28	-0.354	-672.661	112.203	0.000	0.000	0.000
23	28	-0.354	672.661	-112.203	0.000	0.000	0.000
	29	-0.354	-672.661	112.203	0.000	0.000	0.000
24	29	-0.000	269.065	-44.881	0.000	89.762	-538.129
	30	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
25	31	0.000	-0.000	0.000	0.000	-0.000	-0.000
	32	0.000	-269.065	44.881	0.000	89.762	-538.129
26	37	-7.520	672.661	-112.203	0.000	0.000	0.000
	33	-7.520	-672.661	112.203	0.000	0.000	-0.000
27	33	-7.520	672.661	-112.203	0.000	0.000	0.000
	34	-7.520	-672.661	112.203	0.000	0.000	0.000
28	34	-0.000	269.065	-44.881	0.000	89.762	-538.129
	35	-0.000	0.000	-0.000	0.000	-0.000	0.000
29	36	0.000	0.000	0.000	0.000	-0.000	-0.000
	37	0.000	-269.065	44.881	0.000	89.762	-538.129

30	38	25.855	672.661	-112.203	0.000	0.000	0.000	
	39	25.855	-672.661	112.203	0.000	0.000	0.000	
31	39	25.855	672.661	-112.203	0.000	0.000	0.000	
	40	25.855	-672.661	112.203	0.000	-0.000	-0.000	
32	40	-0.000	269.065	-44.881	-0.000	89.762	-538.129	
	41	-0.000	0.000	0.000	-0.000	-0.000	0.000	
33	42	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	
	38	0.000	-269.065	44.881	-0.000	89.762	-538.129	
34	47	144.135	672.661	-112.203	0.000	-0.000	0.000	
	43	144.135	-672.661	112.203	0.000	-0.000	0.000	
35	43	144.135	672.661	-112.203	0.000	0.000	0.000	
	44	144.135	-672.661	112.203	0.000	0.000	0.000	
36	44	0.000	269.065	-44.881	0.000	89.762	-538.129	
	45	0.000	0.000	0.000	0.000	0.000	0.000	
37	46	0.000	-0.000	-0.000	0.000	0.000	-0.000	
	47	0.000	-269.065	44.881	0.000	89.762	-538.129	
38	52	5.624	395.688	-66.003	0.000	0.000	0.000	
	48	5.624	-395.688	66.003	0.000	0.000	0.000	
39	48	5.624	395.688	-66.003	0.000	0.000	0.000	
	49	5.624	-395.688	66.003	0.000	0.000	0.000	
40	49	-0.000	158.275	-26.401	-0.000	52.802	-316.551	
	50	-0.000	0.000	0.000	-0.000	-0.000	-0.000	
41	51	0.000	-0.000	-0.000	0.000	0.000	0.000	
	52	0.000	-158.275	26.401	0.000	52.802	-316.551	
42	2	-1033.862	3018.895	184.967	1618.036	34.411	-6563.599	
	19	-1031.793	3005.396	184.967	1618.036	127.642	-5045.353	
43	19	-898.119	2056.614	-0.187	1078.517	50.714	-4940.417	
	24	-871.620	1889.683	-0.187	1078.517	49.545	7368.241	
44	24	-721.562	945.794	12.479	539.685	-36.200	7469.385	
	29	-695.134	778.881	12.479	539.685	41.634	12847.816	
45	29	-545.877	-165.314	12.834	0.820	-43.683	12880.458	
	34	-519.497	-332.235	12.834	0.820	36.365	11328.839	
46	34	-369.733	-1276.042	20.353	-538.028	-49.105	11278.054	
	40	-343.254	-1442.976	20.353	-538.028	77.862	2797.325	
47	40	-194.366	-2385.579	-5.502	-1076.858	-7.302	2696.978	
	44	-167.939	-2552.492	-5.502	-1076.858	-41.616	-12702.487	
48	44	-18.674	-3495.105	-149.636	-1615.709	-126.932	-12767.635	
	4	-15.663	-3514.120	-149.636	-1615.709	-233.249	-15257.659	
49	4	-111.259	702.588	5.625	316.976	19.080	-3437.267	
	49	-87.826	554.586	5.625	316.976	50.187	39.042	
50	6	-1382.898	4159.854	0.000	0.000	0.000	-8939.023	
	18	-1380.828	4146.355	0.000	0.000	0.000	-6845.685	
51	18	-1188.906	2791.407	-0.000	0.000	0.000	-7055.557	
	23	-1162.407	2624.476	-0.000	0.000	0.000	9836.795	
52	23	-948.080	1275.620	-0.000	0.000	0.000	9634.507	
	28	-921.653	1108.707	-0.000	0.000	0.000	17070.076	
53	28	-708.429	-240.587	-0.000	0.000	0.000	17004.793	
	33	-682.049	-407.508	-0.000	0.000	-0.000	14983.695	
54	33	-468.147	-1755.927	-0.000	0.000	-0.000	15085.264	

39	-441.667	-1922.861	-0.000	0.000	-0.000	3610.974	
55	39	-228.907	-3269.302	-0.000	0.000	-0.000	3811.667
	43	-202.479	-3436.216	-0.000	0.000	-0.000	-17099.617
56	43	10.891	-4782.654	0.000	0.000	-0.000	-16969.321
	8	13.902	-4801.668	0.000	0.000	-0.000	-20374.148
57	8	-148.904	940.227	0.000	-0.000	-0.000	-4868.620
	48	-125.471	792.226	0.000	-0.000	0.000	-78.083
58	10	-1033.862	3018.895	-184.967	-1618.036	-34.411	-6563.599
	22	-1031.793	3005.396	-184.967	-1618.036	-127.642	-5045.353
59	22	-898.119	2056.614	0.187	-1078.517	-50.714	-4940.417
	27	-871.620	1889.683	0.187	-1078.517	-49.545	7368.241
60	27	-721.562	945.794	-12.479	-539.685	36.200	7469.385
	32	-695.134	778.881	-12.479	-539.685	-41.634	12847.816
61	32	-545.877	-165.314	-12.834	-0.820	43.683	12880.458
	37	-519.497	-332.235	-12.834	-0.820	-36.365	11328.839
62	37	-369.733	-1276.042	-20.353	538.028	49.105	11278.054
	38	-343.254	-1442.976	-20.353	538.028	-77.862	2797.325
63	38	-194.366	-2385.579	5.502	1076.858	7.302	2696.978
	47	-167.939	-2552.492	5.502	1076.858	41.616	-12702.487
64	47	-18.674	-3495.105	149.636	1615.709	126.932	-12767.635
	12	-15.663	-3514.120	149.636	1615.709	233.249	-15257.659
65	12	-111.259	702.588	-5.625	-316.976	-19.080	-3437.267
	52	-87.826	554.586	-5.625	-316.976	-50.187	39.042

Load Combination 90: ASCE7-10, 0.9D+1.0E-X							
Member	Node	Px (Axial)	Pz (Major)	Fz (Minor)	Mx (Torsion)	My (Minor)	Mz (Major)
1	1	-4397.889	-377.311	704.557	21.229	-2804.188	7497.315
	2	-4102.501	-377.311	704.557	21.229	6889.065	2306.292
2	3	-4524.398	-447.056	-706.089	28.861	4757.648	10017.150
	4	-3932.359	-447.056	-706.089	28.861	-8534.495	1601.315
3	15	87.826	-554.885	-23.629	-316.976	-50.187	59.440
	2	112.132	-708.398	-23.629	-316.976	-185.729	-3563.842
4	5	-5893.948	-588.810	918.468	-33.350	-3662.371	8456.968
	6	-5598.560	-588.810	918.468	-33.350	8973.848	356.160
5	7	-5964.756	-601.397	-921.093	-26.900	6207.705	10974.984
	8	-5372.717	-601.397	-921.093	-26.900	-1131.892	-346.332
6	14	125.470	-792.766	-6.844	-0.000	-0.000	-118.879
	6	149.776	-946.279	-6.844	-0.000	-39.261	-5106.718
7	9	-4397.888	-801.546	704.551	-93.169	-2804.140	9434.271
	10	-4102.499	-801.546	704.551	-93.169	6889.030	-1593.352
8	11	-4524.401	-757.551	-706.093	-77.159	4757.687	11965.401
	12	-3932.361	-757.551	-706.093	-77.159	-8534.527	-2295.512
9	13	87.826	-554.884	30.718	316.976	50.187	59.439
	10	112.132	-708.397	30.718	316.976	226.394	-3563.837
10	13	30.646	395.688	-66.003	0.000	0.000	0.000
	14	30.646	-395.688	66.003	0.000	-0.000	-0.000
11	14	23.702	395.688	-66.003	0.000	-0.000	0.000
	15	23.702	-395.688	66.003	0.000	0.000	0.000
12	15	0.000	158.275	-26.401	0.000	52.802	-316.551

	16		0.000	0.000	0.000	0.000	0.000	0.000
13	17		-0.000	0.000	-0.000	-0.000	-0.000	0.000
	13		-0.000	-158.275	26.401	-0.000	52.802	-316.551
14	22	242.999	672.661	-112.203	0.000	0.000	0.000	0.000
	18	242.999	-672.661	112.203	0.000	0.000	0.000	0.000
15	18	127.298	672.661	-112.203	0.000	0.000	0.000	0.000
	19	127.298	-672.661	112.203	0.000	0.000	0.000	-0.000
16	19	-0.000	269.065	-44.881	0.000	89.762	-538.129	
	20	-0.000	0.000	-0.000	0.000	-0.000	0.000	
17	21	0.000	0.000	-0.000	0.000	-0.000	0.000	
	22	0.000	-269.065	44.881	0.000	89.762	-538.129	
18	27	-13.645	672.661	-112.203	0.000	0.000	0.000	
	23	-13.645	-672.661	112.203	0.000	0.000	0.000	-0.000
19	23	-11.699	672.661	-112.203	0.000	0.000	0.000	0.000
	24	-11.699	-672.661	112.203	0.000	0.000	0.000	-0.000
20	24	-0.000	269.065	-44.881	0.000	89.762	-538.129	
	25	-0.000	0.000	-0.000	0.000	0.000	0.000	0.000
21	26	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
	27	0.000	-269.065	44.881	0.000	89.762	-538.129	
22	32	-0.533	672.661	-112.203	0.000	0.000	0.000	0.000
	28	-0.533	-672.661	112.203	0.000	-0.000	-0.000	-0.000
23	28	-0.176	672.661	-112.203	0.000	0.000	0.000	0.000
	29	-0.176	-672.661	112.203	0.000	-0.000	-0.000	-0.000
24	29	0.000	269.065	-44.881	0.000	89.762	-538.129	
	30	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
25	31	0.000	-0.000	-0.000	0.000	0.000	0.000	0.000
	32	0.000	-269.065	44.881	0.000	89.762	-538.129	
26	37	-7.391	672.661	-112.203	0.000	0.000	0.000	0.000
	33	-7.391	-672.661	112.203	0.000	0.000	0.000	0.000
27	33	-7.649	672.661	-112.203	0.000	0.000	0.000	0.000
	34	-7.649	-672.661	112.203	0.000	0.000	0.000	-0.000
28	34	0.000	269.065	-44.881	0.000	89.762	-538.129	
	35	0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000
29	36	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
	37	0.000	-269.065	44.881	0.000	89.762	-538.129	
30	38	23.770	672.661	-112.203	0.000	0.000	0.000	0.000
	39	23.770	-672.661	112.203	0.000	0.000	0.000	0.000
31	39	27.940	672.661	-112.203	0.000	0.000	0.000	0.000
	40	27.940	-672.661	112.203	0.000	-0.000	0.000	0.000
32	40	0.000	269.065	-44.881	0.000	89.762	-538.129	
	41	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000
33	42	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000
	38	0.000	-269.065	44.881	0.000	89.762	-538.129	
34	47	199.917	672.661	-112.203	0.000	-0.000	0.000	0.000
	43	199.917	-672.661	112.203	0.000	0.000	0.000	-0.000
35	43	88.341	672.661	-112.203	0.000	0.000	0.000	0.000
	44	88.341	-672.661	112.203	0.000	0.000	0.000	0.000
36	44	0.000	269.065	-44.881	-0.000	89.762	-538.129	
	45	0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000

61	32	-723.278	57.362	-14.767	345.845	107.464	11864.382
	37	-696.898	-109.559	-14.767	345.845	15.362	11701.604
62	37	-547.263	-1053.849	-22.029	884.663	101.028	11660.420
	38	-520.784	-1220.783	-22.029	884.663	-36.392	4565.749
63	38	-371.827	-2163.524	1.878	1423.505	48.674	4468.157
	47	-345.399	-2330.437	1.878	1423.505	60.388	-9546.343
64	47	-196.102	-3272.945	201.926	1962.357	145.705	-9624.618
	12	-193.092	-3291.959	201.926	1962.357	289.173	-11956.797
65	12	-111.260	702.547	-10.233	-316.976	6.404	-3422.267
	52	-87.827	554.546	-10.233	-316.976	-50.187	53.817

Steel Check Report

Project:: ON COVER
Description:
Software: Digital Canal VersaFrame

Company: CEC, INC.
User: BMR

Code Check Results (LRFD15)

CRITICAL STRESS SUMMARY

ID	Section Name	Status	Governing Criteria	Stress Ratio	Load Combination	Distance (ft)
1	HSS8X8X1/4	OK	Axial-Bending	0.7745	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	13.758
2	HSS8X8X3/8	OK	Axial-Bending	0.7693	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	18.825
3	HSS12X8X1/4	OK	Axial-Bending	0.1802	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	5.7363
4	HSS8X8X1/4	OK	Axial-Bending	0.8250	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	13.758
5	HSS8X8X3/8	OK	Axial-Bending	0.9359	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	18.825
6	HSS12X8X1/4	OK	Axial-Bending	0.2421	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	5.7363
7	HSS8X8X1/4	OK	Axial-Bending	0.7745	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	13.758
8	HSS8X8X3/8	OK	Axial-Bending	0.7693	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	18.825
9	HSS12X8X1/4	OK	Axial-Bending	0.1802	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	5.7363
10	HSS7X5X3/16	OK	Total Deflection Y	0.5086	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
11	HSS7X5X3/16	OK	Total Deflection Y	0.5086	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
12	HSS7X5X3/16	OK	Axial-Bending	0.0671	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
13	HSS7X5X3/16	OK	Axial-Bending	0.0671	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	4.0000
14	HSS7X5X3/16	OK	Total Deflection Y	0.9732	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
15	HSS7X5X3/16	OK	Total Deflection Y	0.9732	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
16	HSS7X5X3/16	OK	Axial-Bending	0.1294	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
17	HSS7X5X3/16	OK	Axial-Bending	0.1294	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	4.0000
18	HSS7X5X3/16	OK	Total Deflection Y	0.9732	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
19	HSS7X5X3/16	OK	Total Deflection Y	0.9732	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
20	HSS7X5X3/16	OK	Axial-Bending	0.1294	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
21	HSS7X5X3/16	OK	Axial-Bending	0.1294	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	4.0000
22	HSS7X5X3/16	OK	Total Deflection Y	0.9732	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
23	HSS7X5X3/16	OK	Total Deflection Y	0.9732	ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS	10.000
24	HSS7X5X3/16	OK	Axial-Bending	0.1294	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
25	HSS7X5X3/16	OK	Axial-Bending	0.1294	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	4.0000
26	HSS7X5X3/16	OK	Total Deflection Y	0.9473	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
27	HSS7X5X3/16	OK	Total Deflection Y	0.9473	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
28	HSS7X5X3/16	OK	Axial-Bending	0.1273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
29	HSS7X5X3/16	OK	Axial-Bending	0.1273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	4.0000
30	HSS7X5X3/16	OK	Total Deflection Y	0.9473	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
31	HSS7X5X3/16	OK	Total Deflection Y	0.9473	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
32	HSS7X5X3/16	OK	Axial-Bending	0.1273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
33	HSS7X5X3/16	OK	Axial-Bending	0.1273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	4.0000
34	HSS7X5X3/16	OK	Total Deflection Y	0.9473	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
35	HSS7X5X3/16	OK	Total Deflection Y	0.9473	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
36	HSS7X5X3/16	OK	Axial-Bending	0.1273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
37	HSS7X5X3/16	OK	Axial-Bending	0.1273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	4.0000
38	HSS7X5X3/16	OK	Total Deflection Y	0.4956	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
39	HSS7X5X3/16	OK	Total Deflection Y	0.4956	ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS	10.000
40	HSS7X5X3/16	OK	Axial-Bending	0.0661	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
41	HSS7X5X3/16	OK	Axial-Bending	0.0661	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	4.0000
42	HSS12X8X1/4	OK	Axial-Bending	0.4537	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
43	HSS12X8X1/4	OK	Axial-Bending	0.3715	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
44	HSS12X8X1/4	OK	Axial-Bending	0.5904	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	6.2370
45	HSS12X8X1/4	OK	Axial-Bending	0.5913	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
46	HSS12X8X1/4	OK	Axial-Bending	0.5754	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
47	HSS12X8X1/4	OK	Axial-Bending	0.4986	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	6.2370
48	HSS12X8X1/4	OK	Axial-Bending	0.6342	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.7105
49	HSS12X8X1/4	OK	Axial-Bending	0.1557	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
50	HSS12X8X1/4	OK	Axial-Bending	0.6282	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
51	HSS12X8X1/4	OK	Axial-Bending	0.5243	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
52	HSS12X8X1/4	OK	Axial-Bending	0.8105	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	6.2370
53	HSS12X8X1/4	OK	Axial-Bending	0.8049	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
54	HSS12X8X1/4	OK	Axial-Bending	0.7901	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000

55	HSS12X8X1/4	OK	Axial-Bending	0.6961	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	6.2370
56	HSS12X8X1/4	OK	Axial-Bending	0.8520	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.7105
57	HSS12X8X1/4	OK	Axial-Bending	0.2273	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
58	HSS12X8X1/4	OK	Axial-Bending	0.4537	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
59	HSS12X8X1/4	OK	Axial-Bending	0.3715	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
60	HSS12X8X1/4	OK	Axial-Bending	0.5904	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	6.2370
61	HSS12X8X1/4	OK	Axial-Bending	0.5913	ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	0.0000
62	HSS12X8X1/4	OK	Axial-Bending	0.5754	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000
63	HSS12X8X1/4	OK	Axial-Bending	0.4986	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	6.2370
64	HSS12X8X1/4	OK	Axial-Bending	0.6342	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.7105
65	HSS12X8X1/4	OK	Axial-Bending	0.1557	ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	0.0000

SELECTED LOAD COMBINATIONS

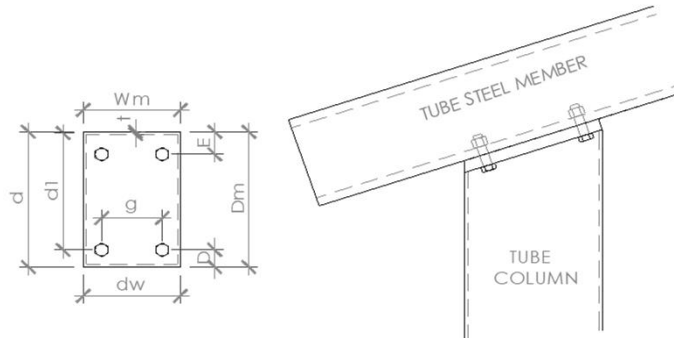
Load Combination	Code Check	Total	Live	Dependent	Conditional
ASCE7-10 1.4D	x			-	-
ASCE7-10 1.2D+1.6LrorS+0.5WA-Z	x			-	-
ASCE7-10 1.2D+1.6LrorS+0.5WB-Z	x			-	-
ASCE7-10 1.2D+1.6LrorS+0.5WA+Z	x			-	-
ASCE7-10 1.2D+1.6LrorS+0.5WB+Z	x			-	-
ASCE7-10 1.2D+1.6LrorS+0.5WA-X	x			-	-
ASCE7-10 1.2D+1.6LrorS+0.5WB-X	x			-	-
ASCE7-10 1.2D+1.0WA-Z+0.5LrorS	x			-	-
ASCE7-10 1.2D+1.0WB-Z+0.5LrorS	x			-	-
ASCE7-10 1.2D+1.0WA+Z+0.5LrorS	x			-	-
ASCE7-10 1.2D+1.0WB+Z+0.5LrorS	x			-	-
ASCE7-10 1.2D+1.0WA-X+0.5LrorS	x			-	-
ASCE7-10 1.2D+1.0WB-X+0.5LrorS	x			-	-
ASCE7-10 1.2D+1.0E-Z+0.2LrorS	x			-	-
ASCE7-10 1.2D+1.0E+Z+0.2LrorS	x			-	-
ASCE7-10 1.2D+1.0E-X+0.2LrorS	x			-	-
ASCE7-10 0.9D+1.0WA-Z	x			-	-
ASCE7-10 0.9D+1.0WB-Z	x			-	-
ASCE7-10 0.9D+1.0WA+Z	x			-	-
ASCE7-10 0.9D+1.0WB+Z	x			-	-
ASCE7-10 0.9D+1.0WA-X	x			-	-
ASCE7-10 0.9D+1.0WB-X	x			-	-
ASCE7-10 0.9D+1.0E-Z	x			-	-
ASCE7-10 0.9D+1.0E+Z	x			-	-
ASCE7-10 0.9D+1.0E-X	x			-	-
ASD ASCE7-10 1.0D		x		-	-
ASD ASCE7-10 1.0D+1.0LrorS		x		-	-
ASD ASCE7-10 1.0D+0.6WA-Z		x		-	-
ASD ASCE7-10 1.0D+0.6WB-Z		x		-	-
ASD ASCE7-10 1.0D+0.6WA+Z		x		-	-
ASD ASCE7-10 1.0D+0.6WB+Z		x		-	-
ASD ASCE7-10 1.0D+0.6WA-X		x		-	-
ASD ASCE7-10 1.0D+0.6WB-X		x		-	-
ASD ASCE7-10 1.0D+0.7E-Z		x		-	-
ASD ASCE7-10 1.0D+0.7E+Z		x		-	-
ASD ASCE7-10 1.0D+0.7E-X		x		-	-
ASD ASCE7-10 1.0D+0.45WA-Z+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.45WB-Z+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.45WA+Z+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.45WB+Z+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.45WA-X+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.45WB-X+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.525E-Z+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.525E+Z+0.75LrorS		x		-	-
ASD ASCE7-10 1.0D+0.525E-X+0.75LrorS		x		-	-
ASD ASCE7-10 0.6D+0.6WA-Z		x		-	-
ASD ASCE7-10 0.6D+0.6WB-Z		x		-	-
ASD ASCE7-10 0.6D+0.6WA+Z		x		-	-
ASD ASCE7-10 0.6D+0.6WB+Z		x		-	-
ASD ASCE7-10 0.6D+0.6WA-X		x		-	-
ASD ASCE7-10 0.6D+0.6WB-X		x		-	-
ASD ASCE7-10 0.6D+0.7E-Z		x		-	-
ASD ASCE7-10 0.6D+0.7E+Z		x		-	-
ASD ASCE7-10 0.6D+0.7E-X		x		-	-

CONNECTION DESIGN

CONNECTION S1 - RA1/RA2 TO C1/C2

Member End Results:

	Fx (Axial)	Fy (Major Shear)	Fz (Minor Shear)	Mx (Torsion)	My (Minor Moment)	Mz (Major Moment)
Combination 1:	-31527 lbs.	0 lbs.	6244 lbs.	0 lb-ft	72794 lb-ft	0 lb-ft
Combination 2:	-27267 lbs.	0 lbs.	5846 lbs.	0 lb-ft	68399 lb-ft	0 lb-ft



of Bottom Bolts: 2 Bolts

of Top Bolts: 2 Bolts

Bolt Diameter: 1.14 in

$F_y = 46000$ psi

$F_y = 36000$ psi

Member Pitch = 9.47 degrees

Use: 1.25 in

beam

plate

$d_w = 8.000$ in.

plate width

$d = 8.111$ in.

plate depth

$t_p = 1.000$ in.

plate thickness

$W_{eld} = 0.563$ in.

$E = 2.5$ in.

$D = 2.5$ in.

$g = 3.0$ in.

$d_1 = 5.5$ in.

Backer Plate = 0.750 in.

plate thickness

Member Size:

$D_m = 8.000$ in.

$W_m = 8.000$ in.

$t = 0.250$ in.

Bolt Size: 1.14 in.

$P_{uf} = 91940$ lbs

$P_{uf} = 87567$ lbs

combination 1:

combination 2:

$\phi_{rn} = 68844$ lbs/Bolt (tension)

$\phi_{rn} = 24679$ lbs/Bolt (shear)

$T_b = 67990$ lbs/Bolt (actual bolt tension)

$T_b = 64755$ lbs/Bolt (actual bolt tension)

Bolt Design:

combination 1:	$d_{b,reqd} = \sqrt{\frac{2M_u}{\pi\phi F_t d_1}}$				
	$d_{b,reqd} = 1.13$	<	1.140 dia	OK	
	$n_{min} = R_u/\phi r_n$				
	$= 0.25$ Bolts	<	2 Bolts	OK	
combination 2:	$d_{b,reqd} = \sqrt{\frac{2M_u}{\pi\phi F_t d_1}}$				
	$d_{b,reqd} = 1.11$	<	1.140 dia	OK	
	$n_{min} = R_u/\phi r_n$				
	$= 0.24$ Bolts	<	2 Bolts	OK	

End Plate Design:

Check End Plate Thickness

$$\begin{aligned}s &= 2.45 \text{ in.} \\ pf &= 2.25 \text{ in.} \\ Y &= 35.89 \text{ in.}\end{aligned}$$

$$\begin{aligned}P_t &= \pi d_b^2 F_t / 4 \\ &= 91792 \text{ lbs}\end{aligned}$$

$$\begin{aligned}\phi M_{np} &= \phi [2P_t(\sum d_n)] \\ &= 755053 \text{ in-lb}\end{aligned}$$

$$\begin{aligned}t_{p, reqd} &= \sqrt{\frac{1.11 \gamma_f (\phi M_{np})}{\phi_b F_{py} Y}} \\ &= 0.94 \text{ in} < 1.000 \text{ in} \quad \text{OK}\end{aligned}$$

Check Shear yielding:

$$\begin{aligned}\text{combination 1:} \quad \phi_{Rn} &= 2 \times \phi (0.6 F_y A_g) \\ &= 311040 \text{ lbs} > 6244 \text{ lbs} \quad \text{OK}\end{aligned}$$

$$\begin{aligned}\text{combination 2:} \quad \phi_{Rn} &= 2 \times \phi (0.6 F_y A_g) \\ &= 311040 \text{ lbs} > 5846 \text{ lbs} \quad \text{OK}\end{aligned}$$

Check Fillet Welds:

(sidewall to end plate)

$$\begin{aligned}D_{min} &= 0.9 F_y t / (2 \times 1.392 L) \\ &= 0.50 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

$$\begin{aligned}\text{combination 1:} \quad D_{min} &= R_u / (2 \times 1.392 L) \\ &= 0.29 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

(top and bottom wall to end plate)

$$\begin{aligned}D_{min} &= P_{uf} / (1.392 L) \\ &= 8.26 \text{ sixteenths} \rightarrow 9/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

$$\begin{aligned}\text{combination 2:} \quad D_{min} &= R_u / (2 \times 1.392 L) \\ &= 0.28 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

(top and bottom wall to end plate)

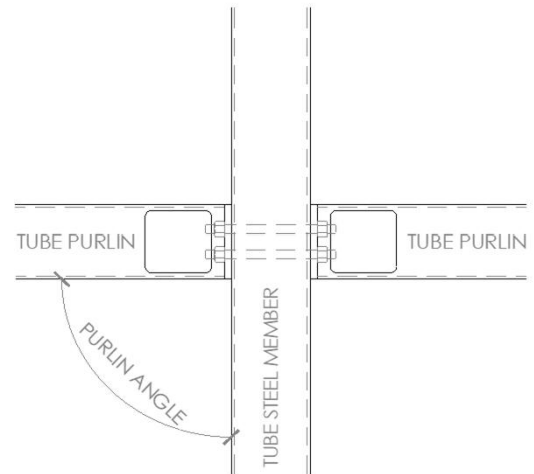
$$\begin{aligned}D_{min} &= P_{uf} / (1.392 L) \\ &= 7.86 \text{ sixteenths} \rightarrow 8/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

CONNECTION S2 - P1 TO RA1/RA2

Member End Results:

	Fx (Axial)	Fy (Major Shear)	Fz (Minor Shear)	Mx (Torsion)	My (Minor Moment)	Mz (Major Moment)
Combination 1:	1153 lbs.	4490 lbs.	560 lbs.	0 lb-ft	0 lb-ft	0 lb-ft
Combination 2:	-78 lbs.	4490 lbs.	560 lbs.	0 lb-ft	0 lb-ft	0 lb-ft

Plate Thickness = 0.25 in.
 Member Width = 5.00 in.
 Member Depth = 7.00 in.
 Bolt Diameter = 0.75 in.
 # of Bolts = 2
 Weld Size = 0.19 in.
 Purlin Angle = 0.00 degrees



Check Bolt:

combination 1: Total Shear = 4524.7 lbs.

Try: (2) 0.75 in. diameter bolts

Allowable V =	31792.5 lbs.	>	4524.7 lbs.
f_v =	5123 psi		OK
f_t =	1305 psi		
Limiting Tension Stress	ϕf_t = 81986 psi		
Combined Shear & Tension	81986 psi	>	1305 psi
			OK

combination 2: Total Shear = 4524.7 lbs.

Try: (2) 0.75 in. diameter bolts

Allowable V =	31792.5 lbs.	>	4524.7 lbs.
f_v =	5123 psi		OK
f_t =	0 psi		
Limiting Tension Stress	ϕf_t = 81986 psi		
Combined Shear & Tension	81986 psi	>	0 psi
			OK

Check Weld:

0.188 in. Fillet Weld

combination 1:

Effective throat thickness =	0.13 in		
Capacity of Weld =	4.18 k/in		
Total Capacity =	100.22 kips		
	100217 lbs.	>	5677 lbs.
			OK

combination 2:

Effective throat thickness =	0.13 in		
Capacity of Weld =	4.18 k/in		
Total Capacity =	100.22 kips		
	100217 lbs.	>	4525 lbs.
			OK

Check Plate:

$$A_g = 1.75$$

$$A_{e1} = 1.31$$

$$A_{e2} = 1.08$$

combination 1:

$$P_u = \phi_t F_y A_g$$

$$= 56700.0 \text{ lbs.}$$

>

$$4524.7 \text{ lbs. OK}$$

$$P_u = \phi_t F_u A_e$$

$$= 49066.4 \text{ lbs.}$$

>

$$4524.7 \text{ lbs. OK}$$

$$40579.0 \text{ lbs.}$$

>

$$4524.7 \text{ lbs. OK}$$

combination 2:

$$P_u = \phi_t F_y A_g$$

$$= 56700.0 \text{ lbs.}$$

>

$$4524.7 \text{ lbs. OK}$$

$$P_u = \phi_t F_u A_e$$

$$= 49066.4 \text{ lbs.}$$

>

$$4524.7 \text{ lbs. OK}$$

$$40579.0 \text{ lbs.}$$

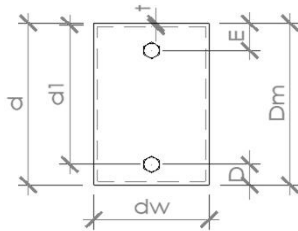
>

$$4524.7 \text{ lbs. OK}$$

CONNECTION S3 - P2 TO RA2

Member End Results:

	Fx (Axial)	Fy (Major Shear)	Fz (Minor Shear)	Mx (Torsion)	My (Minor Moment)	Mz (Major Moment)
Combination 1:	0 lbs.	1796 lbs.	224 lbs.	0 lb-ft	448 lb-ft	3592 lb-ft
Combination 2:	0 lbs.	1761 lbs.	224 lbs.	0 lb-ft	448 lb-ft	3523 lb-ft



of Bottom Bolts: 1 Bolt

of Top Bolts: 1 Bolt

Min. Bolt Diameter: 0.40 in

$F_y = 46000$ psi

$F_y = 36000$ psi

Member Pitch = 0.00 degrees

Use: 0.75 in.

beam

plate

$d_w = 5.000$ in.

$d = 7.000$ in.

$t_p = 0.500$ in.

$W_{eld} = 0.188$ in.

$E = 1.5$ in.

$D = 1.5$ in.

$d_1 = 5.4$ in.

Backer Plate = 0.250 in.

plate width

plate depth

plate thickness

plate thickness

Member Size:

$D_m = 7.000$ in.

$W_m = 5.000$ in.

$t = 0.188$ in.

Bolt Size: 0.40 in.

$P_{uf} = 6158$ lbs

$P_{uf} = 6039$ lbs

combination 1:

combination 2:

$\phi_m = 8476$ lbs/Bolt (tension)

$\phi_m = 3038$ lbs/Bolt (shear)

$T_b = 7973$ lbs/Bolt (actual bolt tension)

$T_b = 7819$ lbs/Bolt (actual bolt tension)

Bolt Design:

combination 1:

$$d_{b,reqd} = \sqrt{\frac{4M_u}{\pi\phi F_t d_1}}$$

$$d_{b,reqd} = 0.39 < 0.400 \text{ dia} \quad \text{OK}$$

$$n_{min} = R_u / \phi r_n$$

$$= 0.60 \text{ Bolts} < 1 \text{ Bolts} \quad \text{OK}$$

combination 2:

$$d_{b,reqd} = \sqrt{\frac{4M_u}{\pi\phi F_t d_1}}$$

$$d_{b,reqd} = 0.38 < 0.400 \text{ dia} \quad \text{OK}$$

$$n_{min} = R_u / \phi r_n$$

$$= 0.58 \text{ Bolts} < 1 \text{ Bolts} \quad \text{OK}$$

End Plate Design:

Check End Plate Thickness

$$\begin{aligned}s &= 2.50 \text{ in.} \\ pf &= 1.31 \text{ in.} \\ Y &= 23.95 \text{ in.}\end{aligned}$$

$$\begin{aligned}P_t &= \pi d_b^2 F_t / 4 \\ &= 11301 \text{ lbs}\end{aligned}$$

$$\begin{aligned}\phi M_{np} &= \phi [2P_t(\sum d_n)] \\ &= 91644 \text{ in-lb}\end{aligned}$$

$$\begin{aligned}t_{p, reqd} &= \sqrt{\frac{1.11 \gamma_r (\phi M_{np})}{\phi_b F_{py} Y}} \\ &= 0.40 \text{ in} < 0.500 \text{ in} \quad \text{OK}\end{aligned}$$

Check Shear yielding:

$$\begin{aligned}\text{combination 1:} \quad \phi_{Rn} &= 2 \times \phi (0.6 F_y A_g) \\ &= 97200 \text{ lbs} > 1810 \text{ lbs} \quad \text{OK}\end{aligned}$$

$$\begin{aligned}\text{combination 2:} \quad \phi_{Rn} &= 2 \times \phi (0.6 F_y A_g) \\ &= 97200 \text{ lbs} > 1776 \text{ lbs} \quad \text{OK}\end{aligned}$$

Check Fillet Welds:

(sidewall to end plate)

$$\begin{aligned}D_{min} &= 0.9 F_y t / (2 \times 1.392 L) \\ &= 0.42 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

$$\begin{aligned}\text{combination 1:} \quad D_{min} &= R_u / (2 \times 1.392 L) \\ &= 0.10 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

(top and bottom wall to end plate)

$$\begin{aligned}D_{min} &= P_{uf} / (1.392 L) \\ &= 0.88 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

$$\begin{aligned}\text{combination 2:} \quad D_{min} &= R_u / (2 \times 1.392 L) \\ &= 0.10 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

(top and bottom wall to end plate)

$$\begin{aligned}D_{min} &= P_{uf} / (1.392 L) \\ &= 0.87 \text{ sixteenths} \rightarrow 1/16 \text{ inch weld} \quad \text{OK}\end{aligned}$$

FOOTING DESIGN

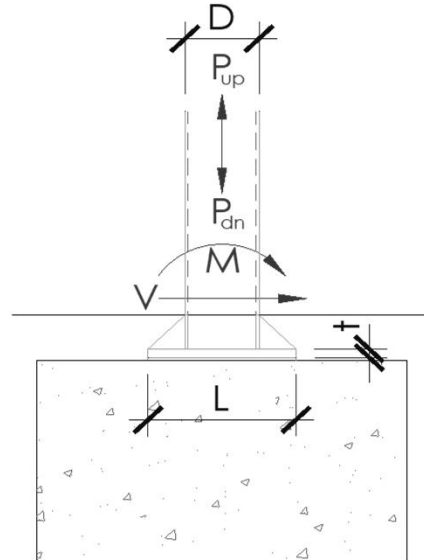
BASE PLATE DESIGN:

Column and Base Plate Parameters:

Column Depth, $D = 8.00$ in.
Column Width, $W = 8.00$ in.
Col. Thickness, $t_c = 0.2500$ in.
Plate Length, $L = 16.00$ in.
Plate Thickness, $t_p = 1.00$ in.

Applied Forces:

Max Axial, $P_{dn} = 21.16$ kips
Max Shear, $V = 4.29$ kips
Moment, $M = 31.80$ kip-ft
Uplift, $P_{up} = 3.73$ kips



Check Plate:

critical section = 4.20 in.

combination 1: $M_{pl} = 5.28$ in.-kips/in
 $t_p = 1.08$ in.

USE GUSSETS

combination 2: $M_{pl} = 1.86$ in.-kips/in
 $t_p = 0.64$ in.

OK

combination 3: $M_p = 5.28$ in.-kips/in
 $t_p = 1.08$ in.

USE GUSSETS

Check Weld:

Weld Thickness, $t_w = 0.1875$ in
 $t_e = 0.133$ in
 $A = 4.17$ in²
 $I = 43.05$ in⁴
 $S = 10.76$ in³

Weld Analysis:

Weld Type: Fillet
Weld Thickness, $t_w = 0.1875$ in.
**E70 Electrodes

$$f_v = P/A$$
$$6.10 \text{ ksi}$$

$$f_b = Mc/I$$
$$2.96 \text{ ksi}$$

$$f_r = \sqrt{f_v^2 + f_b^2}$$
$$6.78 \text{ ksi} < 31.50 \text{ ksi} \quad \text{OK}$$

Use: 16 in. x 16 in. x 1 in. thick baseplate with (8) 3/8 in. gussets

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Specifier's comments:

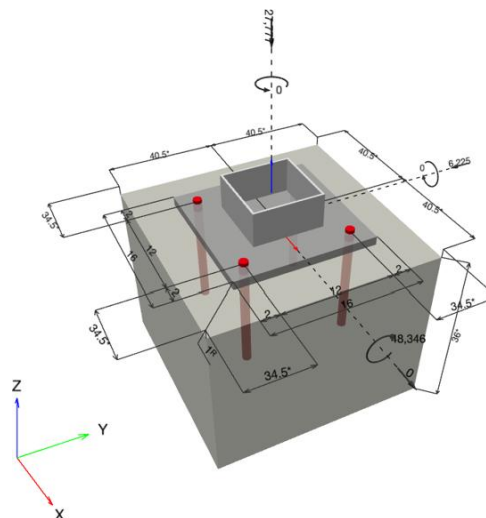
1 Input data

Anchor type and diameter:	Hex Head ASTM F 1554 GR. 36 1
Item number:	not available
Specification text:	Ø 1 in Hex Head ASTM F 1554 GR. 36 with 12 in nominal embedment depth per Technical data , cast in place installation per MPII,
Effective embedment depth:	$h_{ef} = 12.000$ in.
Material:	ASTM F 1554
Evaluation Service Report:	Hilti Technical Data
Issued Valid:	- -
Proof:	Design Method ACI 318-19 / CIP
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 1.000$ in.
Anchor plate ^R :	$l_x \times l_y \times t = 16.000$ in. x 16.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS8X8X.250; (L x W x T) = 8.000 in. x 8.000 in. x 0.250 in.
Base material:	cracked concrete, Custom, $f'_c = 3,000$ psi; $h = 36.000$ in.
Reinforcement:	tension: not present, shear: not present; edge reinforcement: none or < No. 4 bar



^R - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, ft.lb]



Input data and results must be checked for conformity with the existing conditions and for plausibility!
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1.1 Design results

Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -27,777; V _x = 0; V _y = -6,225; M _x = -48,346.000; M _y = 0.000; M _z = 0.000;	no	81

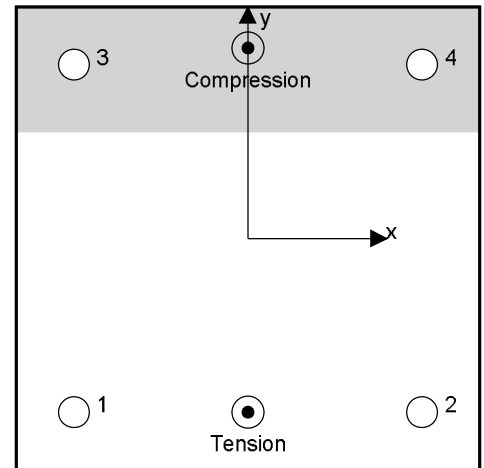
2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	15,819	1,556	0	-1,556
2	15,819	1,556	0	-1,556
3	0	1,556	0	-1,556
4	0	1,556	0	-1,556

Max. concrete compressive strain: 0.40 [‰]
Max. concrete compressive stress: 1,731 [psi]
Resulting tension force in (x/y)=(0.000/-6.000): 31,637 [lb]
Resulting compression force in (x/y)=(0.000/6.570): 59,414 [lb]



Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N _{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	15,819	26,361	61	OK
Pullout Strength*	15,819	19,538	81	OK
Concrete Breakout Failure**	31,637	51,446	62	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)



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3.1 Steel Strength

$$N_{sa} = A_{se,N} f_{uta} \quad \text{ACI 318-19 Eq. (17.6.1.2)}$$

$$\phi N_{sa} \geq N_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

Variables

$A_{se,N} [\text{in.}^2]$	$f_{uta} [\text{psi}]$
0.61	58,000

Calculations

$N_{sa} [\text{lb}]$
35,148

Results

$N_{sa} [\text{lb}]$	ϕ_{steel}	$\phi N_{sa} [\text{lb}]$	$N_{ua} [\text{lb}]$
35,148	0.750	26,361	15,819

3.2 Pullout Strength

$$N_{pN} = \psi_{c,p} N_p \quad \text{ACI 318-19 Eq. (17.6.3.1)}$$

$$N_p = 8 A_{brg} f'_c \quad \text{ACI 318-19 Eq. (17.6.3.2.2a)}$$

$$\phi N_{pN} \geq N_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

Variables

$\psi_{c,p}$	$A_{brg} [\text{in.}^2]$	λ_a	$f'_c [\text{psi}]$
1.000	1.16	1.000	3,000

Calculations

$N_p [\text{lb}]$
27,912

Results

$N_{pn} [\text{lb}]$	ϕ_{concrete}	$\phi N_{pn} [\text{lb}]$	$N_{ua} [\text{lb}]$
27,912	0.700	19,538	15,819

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3.3 Concrete Breakout Failure

$$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \quad \text{ACI 318-19 Eq. (17.6.2.1b)}$$

$$\phi N_{cbg} \geq N_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.3.1)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = 16 \lambda_a \sqrt{f'_c} h_{ef}^{5/3} \quad \text{ACI 318-19 Eq. (17.6.2.2.3)}$$

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
12.000	0.000	0.000	34.500	1.000
c_{ac} [in.]	k_c	λ_a	f'_c [psi]	
-	16	1.000	3,000	

Calculations

A_{Nc} [in. ²]	A_{Nc0} [in. ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
1,728.00	1,296.00	1.000	1.000	1.000	1.000	55,121

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
73,494	0.700	51,446	31,637



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4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1,556	13,708	12	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	6,225	137,190	5	OK
Concrete edge failure in direction y-**	6,225	45,072	14	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

$$V_{sa} = 0.6 A_{se,V} f_{uta} \quad \text{ACI 318-19 Eq. (17.7.1.2b)}$$

$$\phi V_{steel} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

Variables

$A_{se,V}$ [in. ²]	f_{uta} [psi]
0.61	58,000

Calculations

V_{sa} [lb]
21,089

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
21,089	0.650	13,708	1,556

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4.2 Pryout Strength

$$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-19 Eq. (17.7.3.1b)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Nc} \text{ see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-19 Eq. (17.6.2.1.4)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.3.1)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.4.1b)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.6.2.6.1b)}$$

$$N_b = 16 \lambda_a \sqrt{f'_c} h_{ef}^{5/3} \quad \text{ACI 318-19 Eq. (17.6.2.2.3)}$$

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	12.000	0.000	0.000	34.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	-	16	1.000	3,000

Calculations

A_{Nc} [in. ²]	A_{Nc0} [in. ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
2,304.00	1,296.00	1.000	1.000	1.000	1.000	55,121

Results

V_{cp} [lb]	$\phi_{concrete}$	ϕV_{cp} [lb]	V_{ua} [lb]
195,985	0.700	137,190	6,225

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4.3 Concrete edge failure in direction y-

$$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-19 Eq. (17.7.2.1b)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-19 Table 17.5.2}$$

$$A_{Vc} \text{ see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)*}$$

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-19 Eq. (17.7.2.1.3)}$$

$$\Psi_{ec,V} = \left(\frac{1}{1 + \frac{e_v}{1.5c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.3.1)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.4.1b)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-19 Eq. (17.7.2.6.1)}$$

$$V_b = 9 \lambda_a \sqrt{f_c} c_{a1}^{1.5} \quad \text{ACI 318-19 Eq. (17.7.2.2.1b)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\Psi_{c,V}$	h_a [in.]
24.000	34.500	0.000	1.000	36.000
l_e [in.]	λ_a	d_a [in.]	f_c [psi]	$\Psi_{parallel,V}$
8.000	1.000	1.000	3,000	1.000

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
2,916.00	2,592.00	1.000	0.987	1.000	57,959

Results

V_{cbg} [lb]	$\phi_{concrete}$	ϕV_{cbg} [lb]	V_{ua} [lb]
64,389	0.700	45,072	6,225

*Anchor row defined by: Anchor 1, 2; Case 3 controls

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization β_{NV} [%]	Status
0.810	0.138	5/3	75	OK

$$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} \leq 1$$



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- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- For additional information about ACI 318 strength design provisions, please go to <https://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/>

Fastening meets the design criteria!

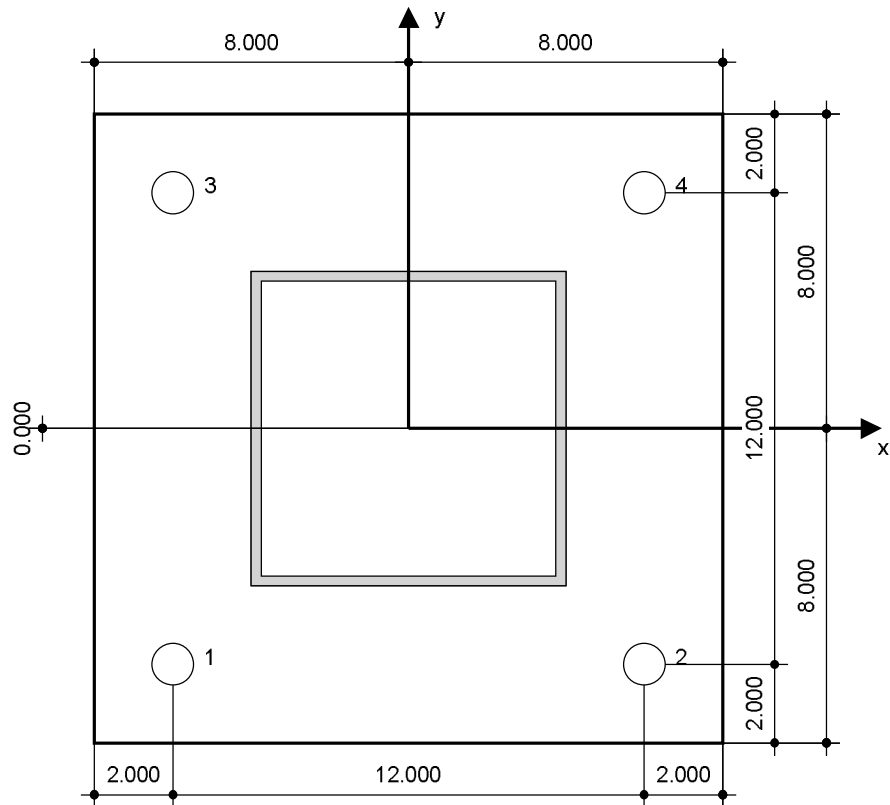
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7 Installation data

Profile: Square HSS (AISC), HSS8X8X.250; (L x W x T) = 8.000 in. x 8.000 in. x 0.250 in.
 Hole diameter in the fixture: $d_f = 1.062$ in.
 Plate thickness (input): 1.000 in.
 Recommended plate thickness: not calculated

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
 Item number: not available
 Maximum installation torque: -
 Hole diameter in the base material: - in.
 Hole depth in the base material: 12.000 in.
 Minimum thickness of the base material: 13.172 in.

Ø 1 in Hex Head ASTM F 1554 GR. 36 with 12 in nominal embedment depth per Technical data , cast in place installation per MPII



Coordinates Anchor [in.]

Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	-6.000	-6.000	34.500	46.500	34.500	46.500
2	6.000	-6.000	46.500	34.500	34.500	46.500
3	-6.000	6.000	34.500	46.500	46.500	34.500
4	6.000	6.000	46.500	34.500	46.500	34.500

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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Spread Footing - 92999

Footing Dimensions:

W = 6.75 ft
 Thickness = 3.00 ft
 $P_{ftg} = 19819.6875$ lbs
 Total No. of Hor. Bars Each Way Top & Bottom: (9)
 Bar size (#): #6
 $f'_c = 3000$ psi
 $f_y = 60000$ psi

Applied Loads:

P = 21157 lbs
 $P_u = -3726$ lbs
 $M_o = 44380$ lb-ft
 (9)
 #6

Soil Conditions:

Soil Bearing Pressure, q = 1500.00 psf
 Maximum Passive = 1500.00 psf
 Allowable Passive = 100.00 pcf

Pressure @ Base:

$Q_{lat} = 300.00$ psf

Overturning Stability:

$M_o = 44380.11$ lb-ft

$M_s = 73037.85$ lb-ft

73037.85 > 44380.11
 F.S. = 1.65

OK

Bearing Pressure Analysis:

q = 899.36 psf < 1500.00

OK

Uplift Analysis:

Wind Uplift Load = 3726.14 lbs.

Weight of Footing, $W_f = 19819.69$ lbs.

OK

Steel Reinforcement Analysis:

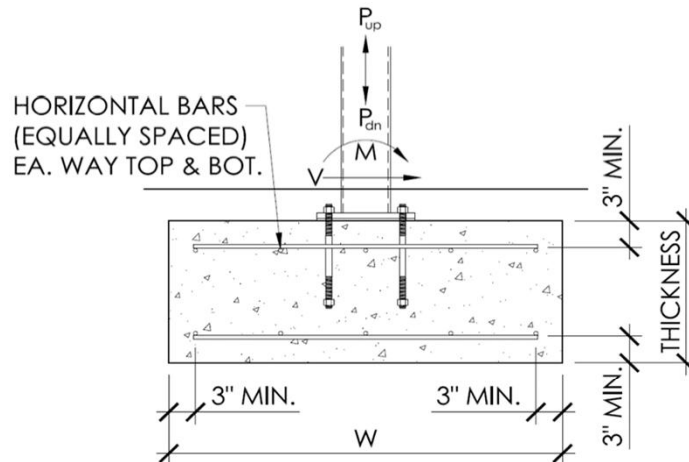
$A_s \text{ Min} = 7.29$ in²

$A_s \text{ actual} = 7.95$ in²

OK

$P_{all} = 320770.33$ lb > 40977 lb

OK



Use: 6.75 ft. x 6.75 ft. x 3 ft. deep concrete footing with (9) #6 bars each way top & bottom

Notes:

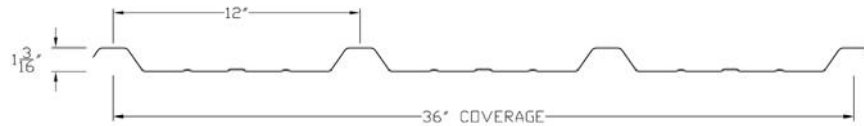
1. The foundation design is based on Table 1806.2 of the building code, Class 5 soil material. If different soil conditions are encountered, it is recommended that a site specific geotechnical report is conducted to determine the load bearing values of the soil.
2. If the footing depth does not meet local frost requirements, footings shall be re-designed under the direction of an engineer. It is the contractor's responsibility to verify the local frost depth.

ROOF PANEL DATA



Multi-Rib

Bare Galvalume & Painted Galvalume



SECTION PROPERTIES						TOP IN COMPRESSION			BOTTOM IN COMPRESSION		
GAUGE	FY (ksi)	WEIGHT (psf)	V _a (kip/ft.)	P _{a_end} (lbs/ft.)	P _{a_int} (lbs/ft.)	I _x (in. ⁴ /ft.)	S _e (in. ³ /ft.)	M _a (kip-in./ft.)	I _x (in. ⁴ /ft.)	S _e (in. ³ /ft.)	M _a (kip-in./ft.)
24	50.0	1.10	0.7727	235.0	320.8	0.050	0.055	1.375	0.029	0.046	1.148

1. Section properties are calculated in accordance with the 2016 AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
2. V_a is the allowable shear.
3. P_a is the allowable load for web crippling on end & interior supports.
4. I_x is for deflection determination.
5. S_e is for bending.
6. M_a is the allowable bending moment.
7. All values are for one foot of panel width.

Allowable Uniform Loads (PSF)

		Span in Feet															
Span Type	Load Type	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00
Single	Positive Wind	407	229	146	101	74	57	45	36	30	25	21	18	16	14	12	11
	Negative Wind	340	191	122	85	62	47	37	30	25	21	18	15	13	11	10	9
	Live	407	229	146	101	74	57	45	36	30	25	21	18	16	14	12	11
	Deflection (L/180)	500	500	279	161	101	68	47	34	26	20	15	12	10	8	7	5
	Deflection (L/240)	500	409	209	121	76	51	35	26	19	15	11	9	7	6	5	4
2 Span	Positive Wind	314	182	118	83	61	47	37	30	25	21	18	15	13	11	10	9
	Negative Wind	365	214	140	98	73	56	44	36	30	25	21	18	16	14	12	11
	Live	314	182	118	83	61	47	37	30	25	21	18	15	13	11	10	9
	Deflection (L/180)	500	500	500	309	194	130	91	66	50	38	30	24	19	16	13	11
	Deflection (L/240)	500	500	400	231	146	97	68	50	37	28	22	18	14	12	10	8
3 Span	Positive Wind	380	224	146	103	76	58	46	37	31	26	22	19	16	14	13	11
	Negative Wind	438	261	172	122	90	69	55	45	37	31	26	23	20	17	15	14
	Live	380	224	146	103	76	58	46	37	31	26	22	19	16	14	13	11
	Deflection (L/180)	500	500	418	242	152	102	71	52	39	30	23	19	15	12	10	8
	Deflection (L/240)	500	500	314	181	114	76	53	39	29	22	17	14	11	9	7	6
4 Span	Positive Wind	359	210	137	96	71	54	43	35	29	24	21	18	15	13	12	10
	Negative Wind	414	246	162	114	84	65	51	42	34	29	25	21	18	16	14	13
	Live	359	210	137	96	71	54	43	35	29	24	21	18	15	13	12	10
	Deflection (L/180)	500	500	444	257	161	108	76	55	41	32	25	20	16	13	11	9
	Deflection (L/240)	500	500	333	192	121	81	57	41	31	24	18	15	12	10	8	7

Notes:

1. Allowable uniform loads are based upon equal span lengths.
2. Live is the allowable live or snow load.
3. Deflection (L/180) is the allowable load that limits the panel's deflection to L/180 while under positive or live load.
4. Deflection (L/240) is the allowable load that limits the panel's deflection to L/240 while under positive or live load.
5. The weight of the panel has **NOT** been deducted from the allowable loads.
6. Positive Wind, Negative Wind, and Live Load values are limited to combined shear & bending using Eq. H2-1 of the AISI Specification.
7. Positive Wind and Live Load values are limited by web crippling using a bearing length of 2".
8. Web crippling values are determined using a ratio of the uniform load **actually** supported by the top flanges of the section.
9. Load Tables are limited to a maximum allowable load of 500 psf.



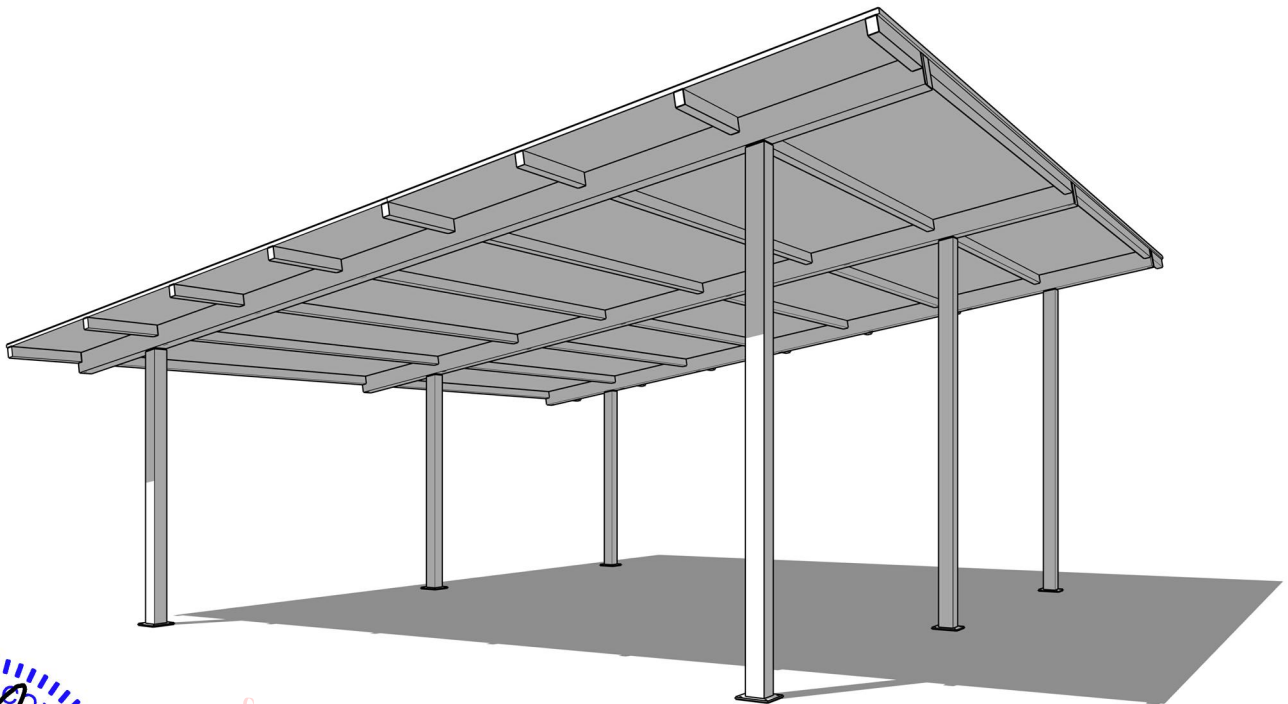
Installation Guide for:

Steelworx Monoslope Shelter - 40' x 48'

Model # MO-4048-SW-212-10E

First Covenant Church
2625 East Magnolia Road
Salina, KS

Job # 92999-25



Digitally signed
by Jason M.
Conn, P.E.
Date: 2025.10.10
11:39:35 -0400

800 East 9 Mile Road, Warren, MI 48089
(586) 486-1088 Office (586) 754-9130 Fax (800) 657-6118 Toll Free
www.Coverworx.com info@coverworx.com

GENERAL:

1. PROPER BRACING OF MEMBERS DURING INSTALLATION MUST BE PERFORMED UNTIL COMPLETE.
2. ANY MODIFICATIONS TO THE PROPOSED SHELTER NEED TO HAVE PRIOR CONSENT FROM A LICENSED ENGINEER.
3. THE INSTALLATION OF THE SHELTER SHALL BE PERFORMED BY SOMEONE OF EXPERIENCE AND COMPETENCE. IT SHALL BE THE RESPONSIBILITY OF THE INSTALLER TO PROPERLY ASSEMBLE THE SHELTER AS SHOWN IN THIS DOCUMENT AND TO CONSTRUCT SHELTER FOUNDATIONS AS SPECIFIED IN SUPPLEMENTAL ENGINEERING DOCUMENTS.
4. READ AND UNDERSTAND INSTALLATION INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING WITH THE INSTALLATION PROCESS.
5. ALWAYS USE THE INSTALLATION INSTRUCTIONS THAT HAVE SHIPPED WITH THE SHELTER AS THESE ARE THE MOST CURRENT. POSSIBLE CHANGES IN MATERIAL QUANTITIES, LENGTHS, PART LABELS, ETC. MAY HAVE BEEN NECESSARY DURING FINAL SHOP DRAWINGS, EVEN AFTER SEALED ENGINEERING.
6. SHOULD THERE BE ANY ERROR IN MANUFACTURING OR INSTALLATION, COVERWORX SHOULD BE NOTIFIED AS SOON AS POSSIBLE. ABSOLUTELY NO FIELD REPAIRS WILL BE HONORED WITHOUT PRIOR AUTHORIZATION OF PROCESS AND COST BY COVERWORX MANAGEMENT.

STRUCTURAL STEEL & HARDWARE SPECIFICATIONS:

1. STEEL PLATES SHALL BE ASTM A36 (36 KSI).
2. STEEL TUBES (RECTANGULAR & SQUARE HSS) SHALL BE MINIMUM ASTM A500 GRADE B (46 KSI).
3. ALL FRAME CONNECTION BOLTS TO BE ASTM A325 (92 KSI).
4. ANCHOR RODS SHALL BE F1554 GRADE 36 (36 KSI) THREADED WITH HEAVY HEX NUT.
5. ALL WELDING IS DONE IN A AWS CERTIFIED FACTORY AND CONFORMS TO AWS D1.1 OR D1.3 AS REQUIRED.
6. ALL BOLTED CONNECTIONS SHOULD FOLLOW THE "TURN-OF-NUT PRETENSIONING" METHOD AS OUTLINED IN THE AISC SPECIFICATIONS.
7. ALL STEEL FRAMEWORK WILL RECEIVE A CORROSION PROTECTIVE ZINC-RICH EPOXY PRIMER FOLLOWED BY A TGIC POLYESTER POWDER COAT, ELECTRO-STATICALLY APPLIED AND CURED.



FOUNDATION		
Item	Size	Quantity
ANCHOR BOLT BRACING TEMPLATE	16" x 16"	6
F1554 GRADE 36 ANCHOR BOLT	1"-8 x 16"	24
F436 FLAT WASHER	1"	48
A563 HEX NUT	1"-8	48

FRAMING		
Item	Size	Quantity
COLUMN (C1)	8" x 8" x 1/4" x 13'-3 3/8"	3
COLUMN (C2)	8" x 8" x 3/8" x 18'-4 1/4"	3
RAFTER BEAM (RA1)	12" x 8" x 1/4" x 44'-0"	1
RAFTER BEAM (RA2)	12" x 8" x 1/4" x 44'-0"	2
PURLIN (P1)	7" x 5" x 3/16" x 19'-4"	16
PURLIN (P2)	7" x 5" x 3/16" x 3'-8"	16
A325 HEX HEAD BOLT	3/4"-10 x 1 1/2"	64
A325 HEX HEAD BOLT	3/4"-10 x 2"	32
A325 HEX HEAD BOLT	1 1/4"-7 x 3 3/4"	24
FLAT WASHER	3/4"	96
FLAT WASHER	1 1/4"	24

ROOFING		
Item	Size	Quantity
ROOF PANEL - LOWER PANELS	24 Ga. MULTI-RIB x 25'-4"	16
ROOF PANEL - UPPER PANELS	24 Ga. MULTI-RIB x 19'-4"	16
COVER TRIM	2" x 2" x 10'-6"	10
RAKE TRIM	2 1/2" x 2" x 10'-6"	10
1 1/4" TEK SCREW	12-24 x 1 1/4" TEK 5	440
7/8" TEK SCREW	1/4-14 x 7/8" TEK 1	750

FINISHING		
Item	Size	Quantity
TOUCH-UP PAINT	-	1

COLORS:

FRAME:

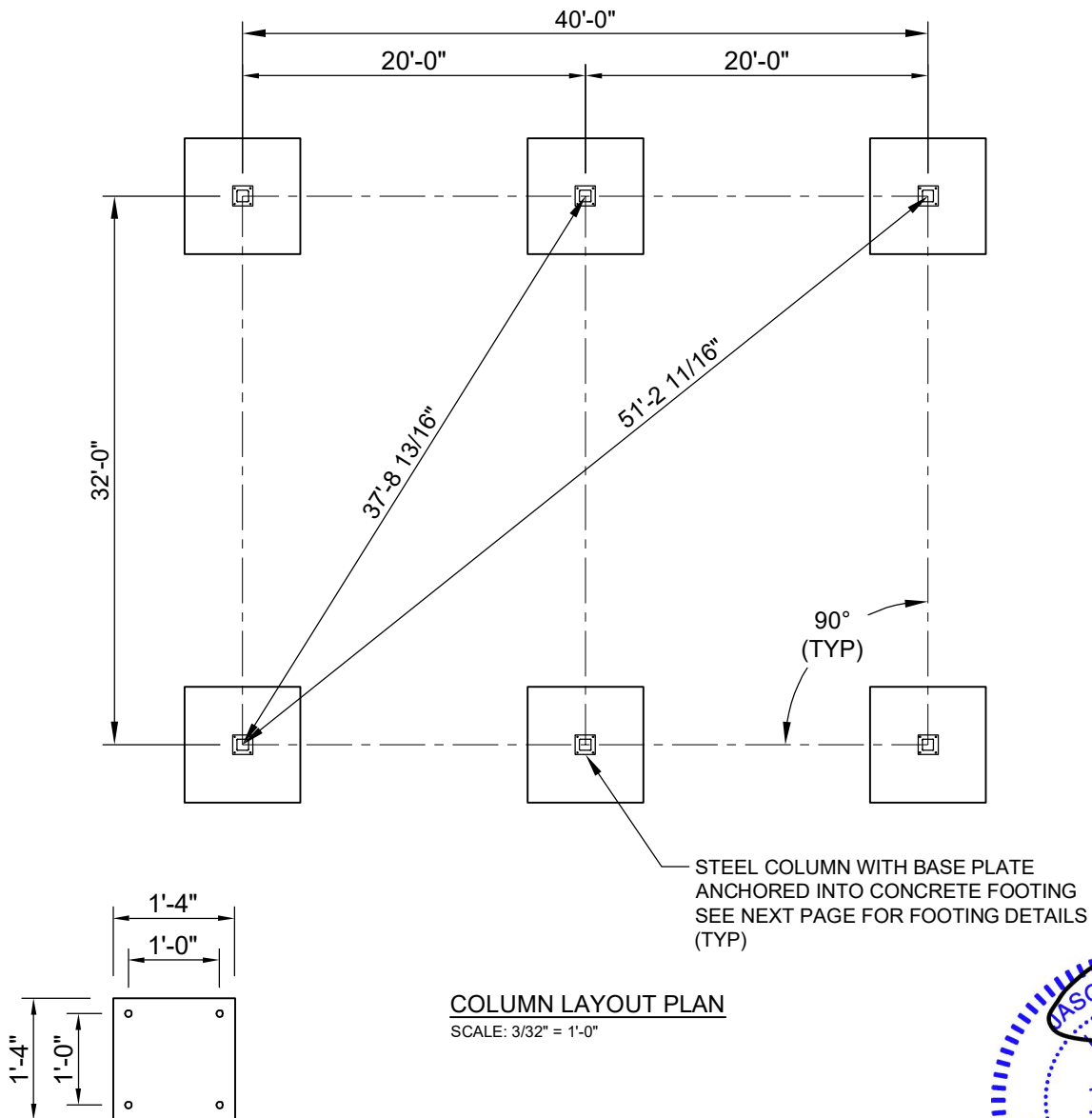
ROOF:



LAYOUT:

1. DETERMINE LOCATION OF SHELTER. VERIFY THAT SHELTER WILL NOT INFRINGE ON BUILDING SETBACKS, EASEMENTS OR HEIGHT RESTRICTIONS.
2. USING STRING LOCATE COLUMN / FOOTING CENTERLINES. MEASURE CENTERLINES AS SHOWN ON THE "COLUMN LAYOUT PLAN". BE SURE TO EXTEND STRING STAKES BEYOND THE AREA OF EXCAVATION.
3. COMPARING DIAGONAL DIMENSIONS IN OPPOSITE DIRECTIONS WILL DETERMINE IF THE LAYOUT IS SQUARE. VERIFY MEASUREMENTS WITH THOSE SHOWN IN THE "COLUMN LAYOUT PLAN". IF DIMENSIONS VARY ADJUST AS NECESSARY BEFORE PROCEEDING.

NOTE: COLUMN BASE PLATES MUST BE CENTERED ON FOOTINGS



COLUMN LAYOUT PLAN

SCALE: 3/32" = 1'-0"

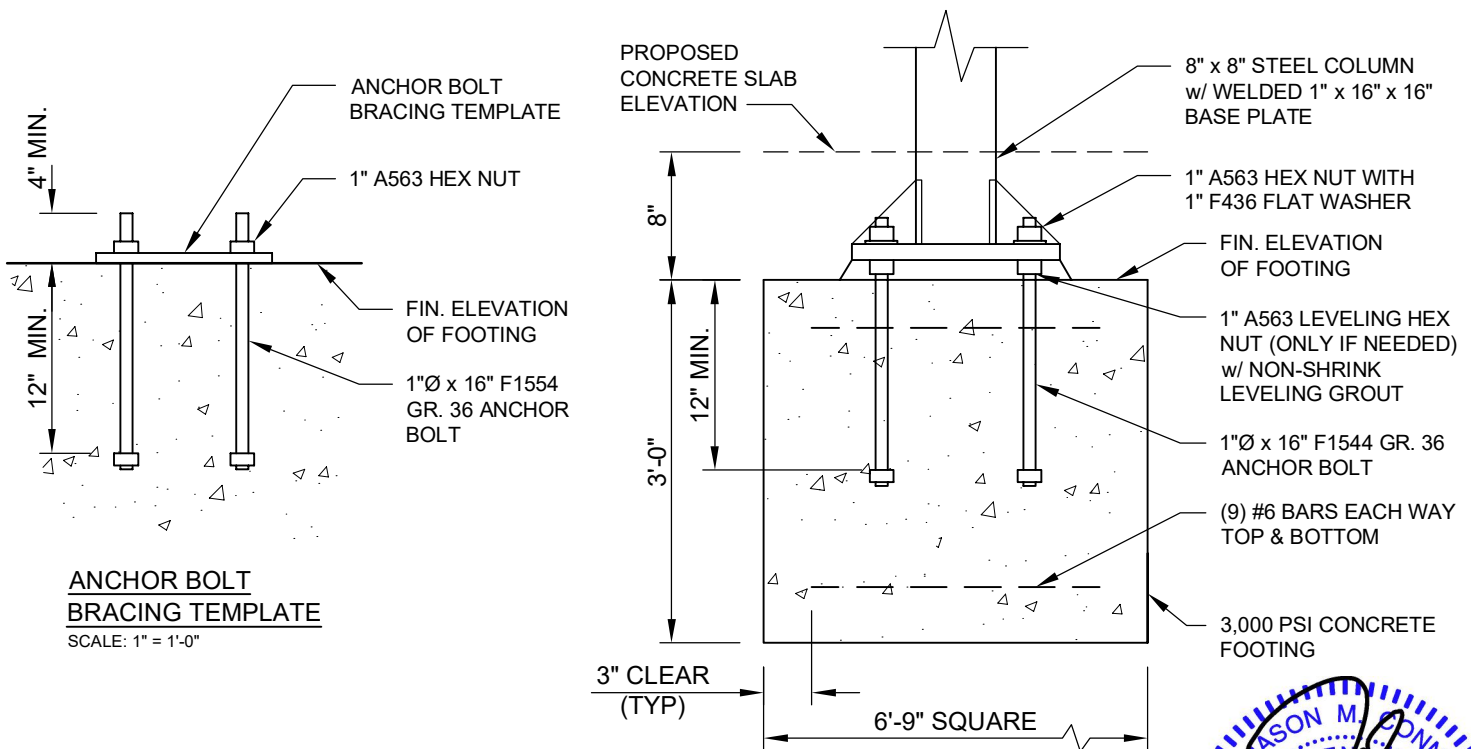
BASE PLATE ANCHOR LAYOUT

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



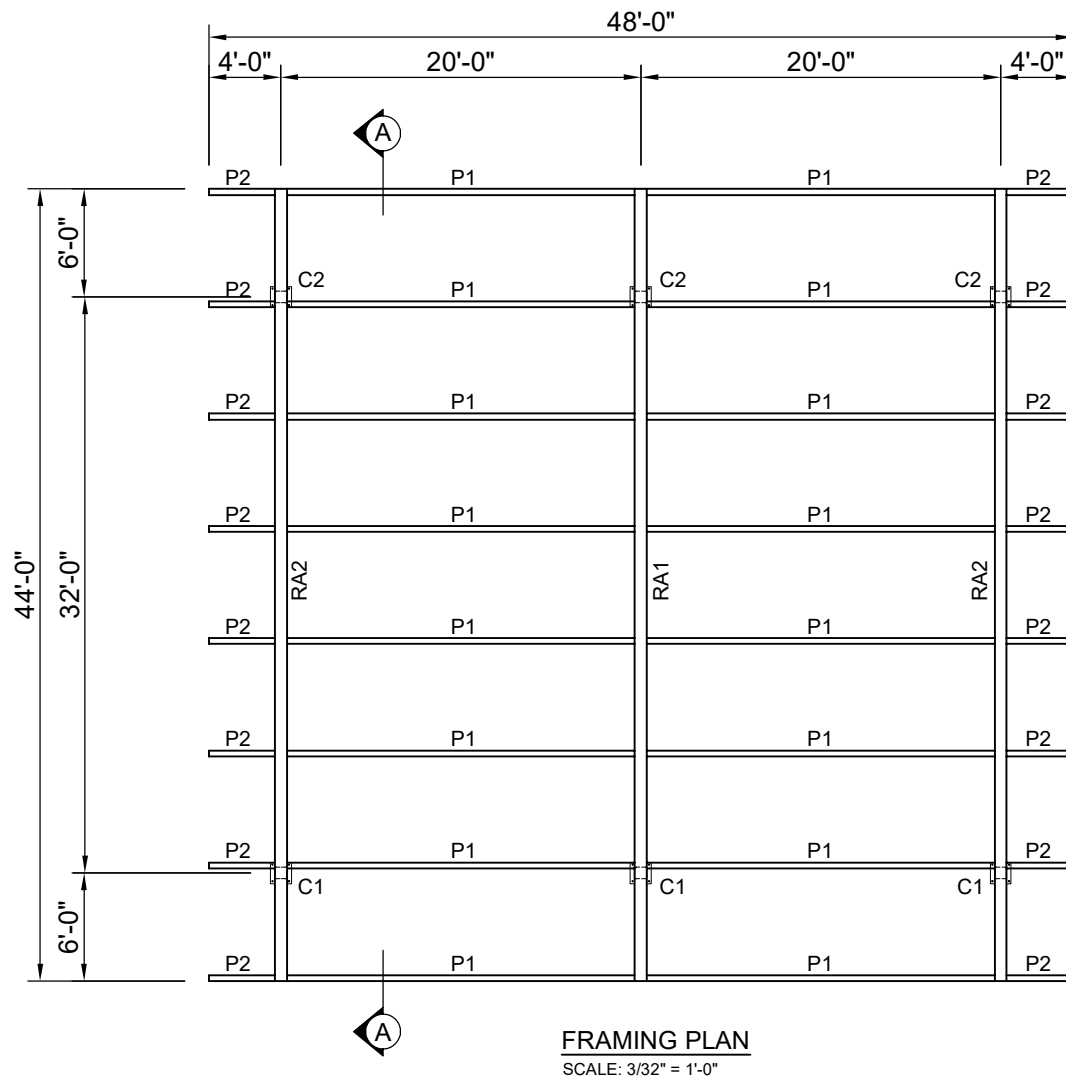
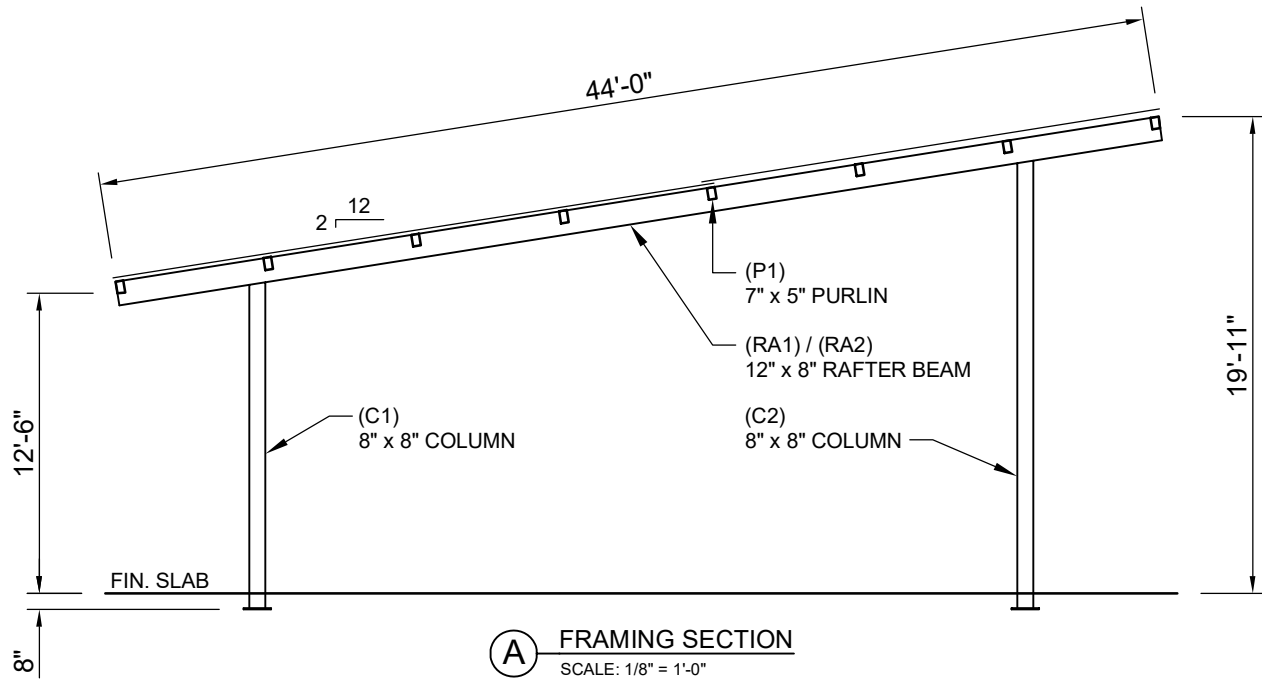
FOOTINGS:

1. BEFORE STARTING EXCAVATION UNDERGROUND UTILITIES SHOULD BE LOCATED SO THAT FOOTINGS ARE NOT PLACED DIRECTLY OVER EXISTING UTILITIES.
2. PRE-ASSEMBLE THE ANCHOR BOLT BRACING TEMPLATES AS PER DETAIL BELOW AND ALIGN ANCHORS AS SHOWN IN THE "FOOTING LAYOUT PLAN" FROM PREVIOUS PAGE. POSITION CENTER OF BRACING TEMPLATES WITH STRING CENTERLINES USED DURING LAYOUT. CHECK FOR LEVEL SURFACE AND ADJUST AS NECESSARY. IT IS VERY IMPORTANT THAT ANCHOR ALIGNMENT FOR EACH FOOTING IS PRECISELY ORIENTATED AS SHOWN IN THE "FOOTING LAYOUT PLAN" AND ANCHORS ARE AT EXACT CENTER OF FOOTING.
3. POUR CONCRETE FOOTINGS AS SPECIFIED IN THE ENGINEERING DETAILS. TOP ELEVATION OF FOOTINGS TO BE 8" BELOW PROPOSED FINISHED SLAB ELEVATION TO MAINTAIN THE PROPOSED CLEAR EAVE HEIGHT OF 12'-6". MAKE SURE THAT ALL FOOTING TOP LEVELS ARE LEVEL AND AT THE SAME ELEVATION.
4. REMOVE AND DISCARD ANCHOR BOLT BRACING TEMPLATES FROM ANCHOR BOLTS ONCE THE CONCRETE HAS HARDENED AND REACHED FULL STRENGTH (48 HOURS MINIMUM). SAVE HEX NUTS TO USE FOR COLUMN ASSEMBLY LATER.
5. VERIFY THAT FOOTINGS ARE LEVEL AND UNIFORM ONCE THE CONCRETE HAS SET AND HARDENED. IF FOOTINGS ARE NOT LEVEL WITH EACH OTHER LEVELING NUTS CAN BE USED BELOW THE COLUMN BASE PLATES AND ADJUSTED AS NEEDED TO BRING THE BASE PLATES TO A UNIFORM LEVEL. ALWAYS USE NON-SHRINK GROUT BELOW THE BASE PLATE WHEN USING LEVELING NUTS.



FOOTING DETAIL
SCALE: 1" = 1'-0"





NOTE:
(RA2) RAFTER BEAMS
NEED TO HAVE INTERNAL
PURLIN BACKER PLATES
FACING OUTWARD WHICH
ARE REQ'D FOR THE (P2)
PURLIN CONNECTIONS.



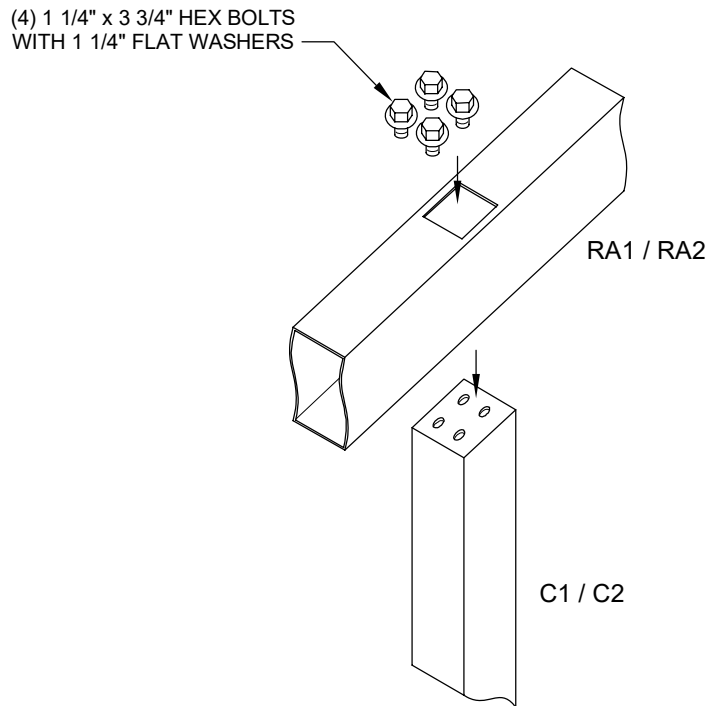
COLUMNS:

1. LOWER EACH COLUMN ONTO THE ANCHOR BOLTS WITH THE HIGH POINT ORIENTATED CORRECTLY (REFER TO FRAMING PLAN & SECTION FOR LOCATIONS OF COLUMN). PLUMB COLUMNS AND SECURE TO ANCHOR BOLTS WITH 1" A563 HEX NUTS AND 1" F436 FLAT WASHERS.

RAFTER BEAMS:

1. RAISE AND BRACE THE RAFTER BEAMS ONTO THE COLUMNS. ATTACH RAFTER BEAMS TO COLUMNS USING (4) 1 1/4" x 3 3/4" HEX BOLTS WITH FLAT WASHERS. LEVEL AND BRACE.

NOTE: KEEP ALL CONNECTIONS LOOSELY ATTACHED UNTIL AFTER ALL FRAMING MEMBERS ARE IN PLACE SO ADJUSTMENTS MAY BE POSSIBLE.



COLUMN & RAFTER BEAM INSTALLATION

SCALE: 3/4" = 1'-0"

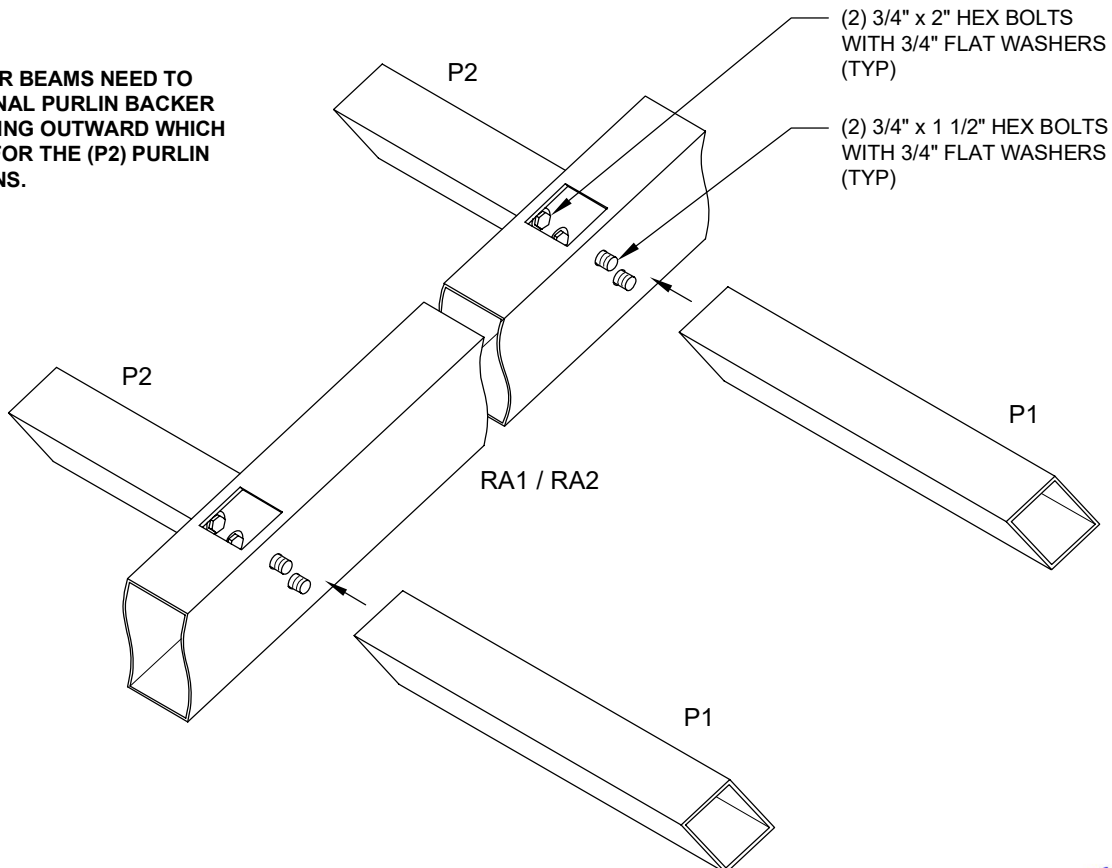


PURLINS:

1. RAISE PURLINS INTO PLACE BY ALIGNING THE HOLES IN THE ENDS OF THE PURLINS WITH THE HOLES IN THE SIDES OF THE RAFTER BEAMS.
2. ATTACH (P1) PURLINS USING (2) 3/4" x 1 1/2" HEX BOLTS WITH FLAT WASHERS.
3. ATTACH (P2) PURLINS USING (2) 3/4" x 2" HEX BOLTS WITH FLAT WASHERS.
4. BEFORE TIGHTENING ALL CONNECTIONS VERIFY THE SHELTER IS PROPERLY ALIGNED, LEVEL AND PLUMB.
5. TIGHTEN ALL BOLTED CONNECTIONS THROUGHOUT THE ENTIRE STRUCTURE AND DOUBLE CHECK EACH CONNECTION AGAIN AFTER ALL OTHER CONNECTIONS HAVE BEEN TIGHTENED.
6. SUPPORTS AND BRACING MAY NOW BE REMOVED.

NOTE:

(RA2) RAFTER BEAMS NEED TO HAVE INTERNAL PURLIN BACKER PLATES FACING OUTWARD WHICH ARE REQ'D FOR THE (P2) PURLIN CONNECTIONS.



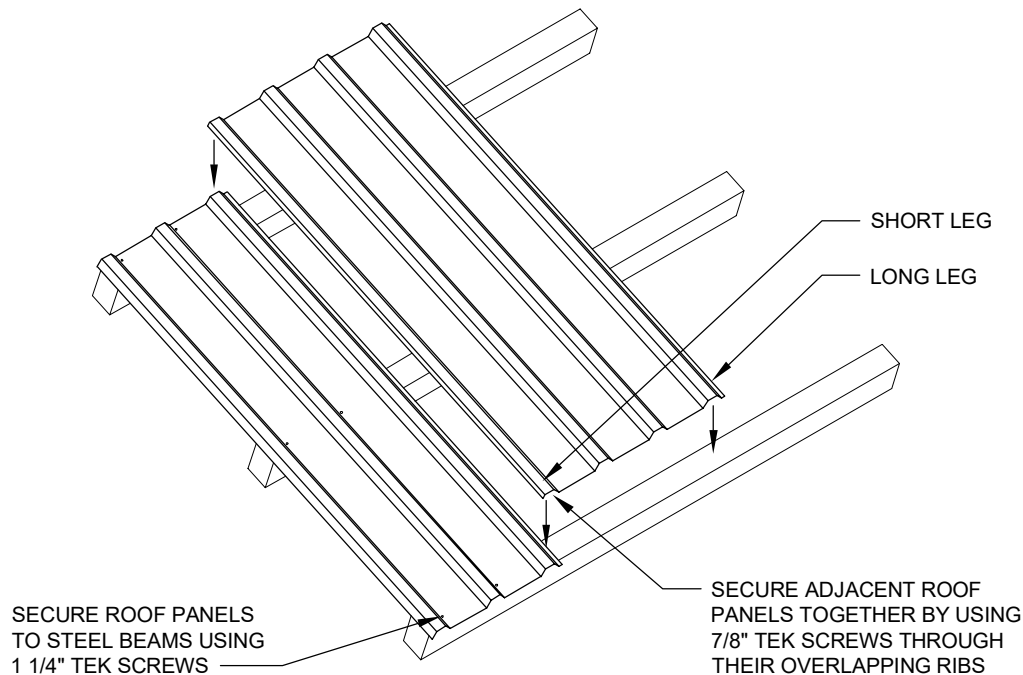
PURLIN INSTALLATION

SCALE: 3/4" = 1'-0"



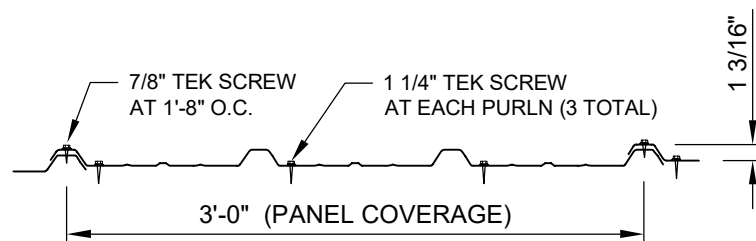
ROOF PANELS:

1. PANELS WILL BE IN TWO DIFFERENT LENGTHS. START WITH THE LONGER PANELS AT THE LOWER EAVE FIRST SO THAT SHORTER PANELS WILL LAY ON TOP AND OVERLAP THE LONGER PANELS BELOW. LAYOUT PANELS FROM LEFT TO RIGHT TO ENSURE THAT EACH PANEL'S SHORT LEG SIDE WILL OVERLAP ON TOP OF THE PREVIOUS PANEL'S LONG LEG SIDE.
2. POSITION PANELS AT THE SIDES SO THAT THE **CENTER** OF THE PANEL'S LAST / FIRST HIGH RIB IS EVEN WITH THE END OF THE P2 PURLINS AND ALIGN THE EAVE ENDS TO EXTEND ABOUT 1" BEYOND THE EAVE PURLINS (LOWER AND UPPER EAVE). THE UPPER ROOF PANELS SHOULD OVERLAP THE LOWER PANELS BY ABOUT 6". USE SEALANT TAPE OR CAULK BETWEEN PANELS AT THE OVERLAP (INSTALLER PROVIDED).
3. ATTACH THE PANELS TO ALL STEEL FRAMING MEMBERS USING 1 1/4" TEK SCREWS, PLACING A SCREW AT ONE SIDE OF EACH RIB (SEE FASTENING PATTERN DETAIL BELOW).
4. ADJACENT PANELS WILL OVERLAP AT ONE RIB. USE THE 7/8" TEK SCREWS TO ATTACH THE OVERLAPPING RIBS, PLACING A SCREW AT EVERY 1'-8" (SEE FASTENING PATTERN BELOW).
5. CHECK EVERY OTHER PANEL TO MAINTAIN SQUARENESS WITH RESPECT TO THE STRUCTURE.



ROOF PANEL INSTALLATION

SCALE: 3/8" = 1'-0"



FASTENING PATTERN



PANEL COVER TRIM:

1. POSITION THE COVER TRIM AGAINST THE EAVE EDGE OF THE ROOF PANELS, LEAVING AN APPROXIMATE 1/4" GAP AT THE LOWER END FOR DRAINAGE. TRIM EXCESS LENGTH AS NEEDED. OVERLAP ENDS BY 4" TO 6".
2. SECURE TRIM BY USING 7/8" TEK SCREWS THROUGH EVERY ROOF PANEL RIB.
3. IF LEAVES & OTHER DEBRIS ARE A CONCERN OF GETTING CAUGHT THIS TRIM CAN BE OMITTED AT OWNER'S DISCRETION.

RAKE TRIM:

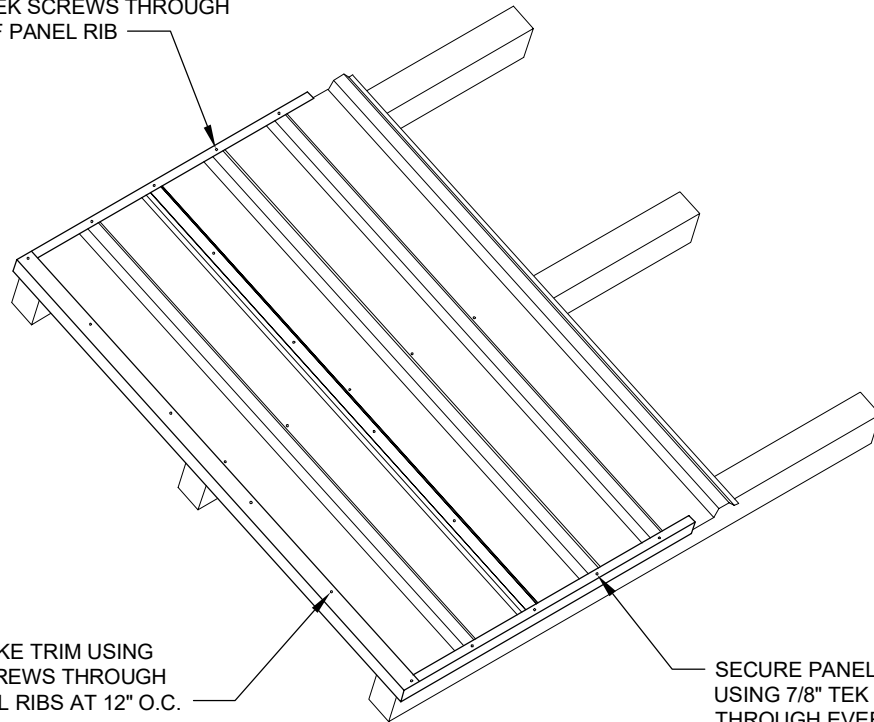
1. POSITION THE RAKE TRIM AGAINST THE SIDES OF THE END PANELS. TRIM EXCESS LENGTH AS NEEDED. OVERLAP ENDS BY 4" TO 6".
2. SECURE TRIM BY USING 7/8" TEK SCREWS THROUGH THE PANEL RIBS AT EVERY 12".

NOTE: TRIM MATERIAL WILL BE SHIPPED WITH A PROTECTIVE PLASTIC FILM THAT WILL NEED TO BE REMOVED PRIOR TO INSTALLATION.

SECURE PANEL COVER TRIM
USING 7/8" TEK SCREWS THROUGH
EVERY ROOF PANEL RIB

SECURE RAKE TRIM USING
7/8" TEK SCREWS THROUGH
ROOF PANEL RIBS AT 12" O.C.

SECURE PANEL COVER TRIM
USING 7/8" TEK SCREWS
THROUGH EVERY ROOF
PANEL RIB



TRIM INSTALLATION

SCALE: 3/8" = 1'-0"



MAINTENANCE:

1. DURING THE ASSEMBLY PROCESS SOME SCRAPES AND SCRATCHES MAY HAVE OCCURRED. THESE WILL REQUIRE TOUCHING UP. ALSO, OVER TIME, NORMAL USE MAY CREATE MORE SCRATCHES. FOLLOW THE STANDARD PAINT PROCEDURES LISTED ON ANY SPRAY PAINT CAN. HOWEVER, IT IS IMPORTANT TO REMOVE ALL LOOSE PAINT, GREASE, OIL AND/OR RUST BEFORE LIGHTLY SANDING SURROUNDING PAINT FOR GOOD ADHESION. ADDITIONAL MATCHING TOUCH-UP PAINT IS AVAILABLE UPON REQUEST AT AN ADDITIONAL COST.
2. CLEAN THE STEEL SURFACES PERIODICALLY USING A MILD CLEANING SOLUTION, AND HAND-WIPE TO MAINTAIN "LIKE NEW" APPEARANCE.
3. PERIODICALLY CHECK FOR DEBRIS THAT MAY HAVE GOTTEN STUCK WITHIN THE ROOF TRIM AND REMOVE.



SECTION 10850

BUILDING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building specialties shall be furnished and installed as shown and herein specified. Installation shall be in accordance with the respective manufacturer's instructions. Certain manufacturer's products have been selected as a basic standard, and reference to these products has been made. Other manufacturers' products of equal capacities and design characteristics may be used, if approved by the Architect prior to the Bidding. The Contractor shall submit for approval shop drawings or standard cuts and illustrations or a combination thereof showing all items he proposes to use.

1.02 PENETRATION FIRESTOPPING DEVICES

- A. Install U.L. listed firestopping systems at pipe penetrations through rated wall and floor assemblies.
- B. Firestopping devices shall be appropriate for the condition being firestopped. Systems shall include but are not limited to firecaulk, pipe collars, pillows, wrap strips, etc.
- C. Contractor shall submit proposed system for approval to Authority Having Jurisdiction.
- D. Manufacturers: 3M fire Protection Products; Hilti; of equivalent systems as approved by AHJ.

1.03 WALL AND CEILING ACCESS PANELS

- A. Flush Mounted, Non-Rated Wall Access Panels. For installation in a drywall and metal stud assembly. No exposed fasteners. Provide wallboard bead for flush to ceiling installation
- B. Product: JL Industries Model AT Gasketed Access Panel or equal. Size 16"x16".
- C. Specification Requirements.
 - Frame - 16 ga. steel
 - Door - 16 ga. steel
 - Finish - Galvanized. Product shall be field painted at exposed areas.
 - Hinge - Continuous type.
 - Latch - Flush Compression Latch; Screwdriver operated cam lock.
- D. Locate as identified in field. For bidding purposes, **provide 6 access panels.**

END OF SECTION 10850

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section includes:
 - 1. Sleeves without waterstop.
 - 2. Grout.
 - 3. Silicone sealants.
 - 4. Escutcheons.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of components.
 - b. Include operating characteristics and furnished accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
 - 1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
 - 2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
 - 3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
 - 4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
 - 5. Molded-PVC Sleeves: With nailing flange.
 - 6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Grout:
 - 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 3. Design Mix: 5000 psi, 28-day compressive strength.
 - 4. Packaging: Premixed and factory packaged.

2.2 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company
 - 2. Dearborn Brass
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The)
 - 5. Mid-America Fittings, LLC; A Midland Industries Company
 - 6. ProFlo; a Ferguson Enterprises, Inc. brand
- B. Escutcheon Types:
 - 1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
 3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
 4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
 5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
 6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.
- C. Floor Plates:
1. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

3.2 INSTALLATION OF SLEEVES, GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.
- C. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Division 7.

3.3 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.4 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 2. Prepare test and inspection reports.

- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.5 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops.
 - 4. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

3.6 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Chrome-Plated Piping: One piece, steel or split plate steel with polished, chrome-plated finish.
 - 3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
 - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 7. Bare Piping in Equipment Rooms:
 - a. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.

END OF SECTION 210500

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SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Trim and drain valves.

1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Fire Main Equipment: HAMV - Main Level.
 - a. Indicator Posts, Gate Valve: HCBZ - Level 1.
 - b. Ball Valves, System Control: HLUG - Level 3.
 - c. Butterfly Valves: HLXS - Level 3.
 - d. Check Valves: HMER - Level 3.
 - e. Gate Valves: HMRZ - Level 3.
 - 2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.
 - a. Valves, Trim and Drain: VQGU - Level 1.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B31.9 for building services piping valves.

- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NFPA Compliance for Valves:
 - 1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
- E. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Croker; a Division of Morris Group International
 - c. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
 - d. Flowserve Corporation
 - e. Jomar Valve
 - f. KITZ Corporation
 - g. Metso Automation USA Inc.
 - h. Milwaukee Valve Company
 - i. NIBCO INC.
 - j. Potter Roemer LLC; a Division of Morris Group International
 - k. Red-White Valve Corp.
 - l. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - m. Victaulic Company
 - n. WATTS; A Watts Water Technologies Company
 - o. Zurn Industries, LLC
 - 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port size: Full or standard.
 - e. Seats: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Handlever.
 - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
 - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.
- B. Angle Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
 - b. NIBCO INC.
 - c. United Brass Works, Inc
 - 2. Description:
 - a. Pressure Rating: 175 psig.

- b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. NIBCO INC.
 - b. United Brass Works, Inc
 - 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
 - 1. Section 211000 "Water-Based Fire-Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
- B. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above the pipe center.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

- c. FNW; Ferguson Enterprises, Inc.
 - 2. Description: Factory-fabricated components, NFPA approved, UL listed, or FM Global approved for fire-suppression piping support.
 - 3. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Pipe/Tube Hangers and Supports for Fire-Suppression Piping - Copper:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Cooper B-line; brand of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
 - 2. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM Global approved for fire-suppression piping support.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 PIPE HANGERS FOR FIRE-SUPPRESSION PIPING - METAL, TRAPEZE TYPE

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM Global-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FASTENER SYSTEMS

- A. Fastener System - NFPA/UL/FM Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM Global-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC
 - 2. Indoor Applications: Zinc coated or Stainless.
 - 3. Outdoor Applications: Stainless steel.

2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Division 07 Firestopping section for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to comply with NFPA 13 requirements, minimum 5 times the water-filled weight of piping and supported components plus 250 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Pipe Slopes: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- F. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- G. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- H. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- I. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions. Install in accordance with approvals and listings.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Comply with NFPA requirements.
- K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. C-Clamps (MSS Type 23): For structural shapes.
 - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

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SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe labels.
 - 2. Stencils.
 - 3. Valve tags.
 - 4. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve-numbering scheme.
- D. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 - 2. Brady Corporation
 - 3. Carlton Industries, LP
 - 4. Champion America
 - 5. Craftmark Pipe Markers
 - 6. emedco
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Services Inc.
 - 10. Pipemarket.com; Brimar Industries, Inc.
 - 11. Seton Identification Products; a Brady Corporation company
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.2 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 - 2. Brady Corporation
 - 3. Carlton Industries, LP
 - 4. Champion America
 - 5. Craftmark Pipe Markers
 - 6. emedco
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Services Inc.
 - 10. Pipemarker.com; Brimar Industries, Inc.
 - 11. Seton Identification Products; a Brady Corporation company
- B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04 inch stainless steel, 0.024 inch aluminum, 0.031 inch or anodized aluminum, 0.031 inch thick, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire, link chain, beaded chain, or S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.3 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Brady Corporation
 - 2. Champion America
 - 3. Craftmark Pipe Markers
 - 4. emedco
 - 5. Kolbi Pipe Marker Co.
 - 6. LEM Products Inc.
 - 7. Marking Services Inc.
 - 8. Pipemarker.com; Brimar Industries, Inc.
 - 9. Seton Identification Products; a Brady Corporation company
- B. Description: Preprinted accident-prevention tags, of plasticized card stock.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Fire-Suppression Pipe Label Color Schedule:
 - 1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.4 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
 - 1. Valve-Tag Size and Shape:
 - a. Fire-Suppression Standpipe: 1-1/2 inches, round.
 - b. Wet-Pipe Sprinkler System: 1-1/2 inches, round.
 - c. Dry-Pipe Sprinkler System: 1-1/2 inches, round.
 - d. Preaction System: 1-1/2 inches, round.
 - 2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.5 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings.

END OF SECTION 210553

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SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-suppression piping, fittings, and appurtenances.
 - 2. Fire-suppression piping specialties.
 - 3. Sprinklers.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles.
 - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Prior to preparation of shop drawings, convene a meeting including General Contractor and all subcontractors potentially impacted by installation of fire protection piping systems, to facilitate coordination of installation of all impacted systems. Submittal of plans and calculations is acknowledgement that coordination has been performed. Rework in the field due to conflicts between fire protection systems and other systems will be performed at no cost to the Owner, Architect, or Engineer.
 - 2. Prepare in accordance with NFPA 13 section "Working Plans."
 - a. Include plans, elevations, and sections of the system piping and details.
 - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
 - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Prepare computer-generated hydraulic calculations in accordance with the following:
 - a. Name of hydraulic program used.
 - b. Water supply information, including fire hydrant flow test data report.
 - 4. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation
 - 5. Include diagrams for power, signal, and control wiring as applicable.
- C. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
 - 1. Prior to full submittal, provide a coordination submittal indicating locations and types of all sprinkler heads coordinated with the Architects reflected ceiling plan. Additionally, indicate proposed locations of all exposed piping for review.
 - 2. Following approval of the initial coordination submittal described above, submit complete layout and calculations.
- B. Qualification Data: For qualified Installer and professional engineer.

- C. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Field Test Reports:
 - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - 2. Fire-hydrant flow test report.
- F. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression service in accordance with requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-suppression service.
 - 2. Do not proceed with interruption of fire-suppression service without Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe sprinkler system.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression System Components, Devices, and Accessories: Listed in ULSE's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13, and ASME A17.1.
- D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.
- E. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.
 - 1. Fire-Hydrant Flow Test:
 - a. Perform fire-hydrant flow test and record the following conditions:
 - 1) Date:.
 - 2) Time:
 - 3) Performed by: .
 - 4) Location of Residual Fire Hydrant R: Insert location.
 - 5) Location of Flow Fire Hydrant F: Insert location.
 - 6) Static Pressure at Residual Fire Hydrant R:.
 - 7) Measured Flow at Flow Fire Hydrant F:.
 - 8) Residual Pressure at Residual Fire Hydrant R:.
 - b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations.
 - 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 3. Sprinkler Occupancy Hazard Classifications: per NFPA 13.
 - 4. Minimum Density for Automatic-Sprinkler Piping Design: Per NFPA 13.
 - 5. Maximum protection area per sprinkler in accordance with ULSE listing.
 - 6. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated or required by Authority Having Jurisdiction.
 - 7. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig.
 - b. NPS 2-1/2 (DN 65) Hose Connections: 100 psig.
- F. Obtain documented approval of fire-suppression system design from AHJs.

2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

- A. Steel Pipe, Fittings, and Appurtenances:
 - 1. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
 - a. Standards:
 - 1) UL 852.
 - 2) FM 1630.
 - b. Factory-applied exterior coating.
 - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
 - d. Pipe ends may be factory or field formed to match joining method.
 - 2. Steel Pipe Nipples: Galvanized and black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
 - 3. Steel Couplings: Galvanized steel, ASTM A865/A865M, threaded.
 - 4. Gray-Iron Threaded Fittings: Galvanized gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
 - 5. Malleable- or Ductile-Iron Unions: ASME B16.3.
 - 6. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 7. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
 - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
 - 8. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

- a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- 9. Plain-End-Pipe Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Gruvlok; an ASC Engineered Solution
 - 2) Shurjoint; a part of Aalberts Integrated Piping Systems
 - 3) Victaulic Company
 - b. Pressure Rating: 175 psig minimum.
 - c. Plain-End Fittings for Steel Piping: Painted plain-end fittings, ASTM A53/A53M, carbon steel or ASTM A106/A106M, forged steel with dimensions matching steel pipe.
 - d. Plain-End-Pipe Couplings for Steel Piping: Rigid pattern for steel-pipe dimensions, ductile-iron or malleable-iron housing. Include EPDM-rubber gasket, and bolts and nuts.
- 10. Grooved-Joint, Steel-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) CPS Products, Inc.
 - 2) Gruvlok; an ASC Engineered Solution
 - 3) Shurjoint; a part of Aalberts Integrated Piping Systems
 - 4) Smith-Cooper International
 - 5) SPF/Anvil; an ASC Engineered Solution
 - 6) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - 7) Victaulic Company
 - b. Pressure Rating: 175 psig minimum.
 - c. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 - d. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 FIRE-SUPPRESSION PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Shurjoint; a part of Aalberts Integrated Piping Systems
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - c. Victaulic Company
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 5. Type: Mechanical-tee and -cross fittings.
 - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The)

- c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - d. Victaulic Company
 - 2. Standard: ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Croker; a Division of Morris Group International
 - c. Potter Roemer LLC; a Division of Morris Group International
 - 2. Standard: UL 199.
 - 3. Pressure Rating: 175 psig.
 - 4. Body Material: Brass.
 - 5. Size: Same as connected piping.
 - 6. Inlet: Threaded.
 - 7. Drain Outlet: Threaded and capped.
 - 8. Branch Outlet: Threaded, for sprinkler.
- D. Adjustable Drop Nipples:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aegis Technologies, Inc.
 - 2. Standard: UL 1474.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 - 5. Size: Same as connected piping.
 - 6. Length: Adjustable.
 - 7. Inlet and Outlet: Threaded.
- E. Flexible Sprinkler Hose Fittings:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ALEUM USA
 - b. Easyflex, Inc.
 - c. Flexhead; an ASC Engineered Solution
 - d. Gateway Tubing, Inc.
 - e. Reliable Automatic Sprinkler Co., Inc. (The)
 - f. Victaulic Company
 - 2. Standards:
 - a. UL 2443.
 - b. FM 1637.
 - 3. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - 4. Pressure Rating: 175 psig minimum.
 - 5. Size: Same as connected piping, for sprinkler.
- F. Manual Air Vent/Valve:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - 2. Description: Ball valve that requires human intervention to vent air.
 - 3. Body: Forged brass.

4. Ends: Threaded.
5. Minimize Size: 1/2 inch.
6. Minimum Water Working Pressure Rating: 300 psig.

G. Automatic Air Vent:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. CLA-VAL
 - c. Engineered Corrosion Solutions
 - d. Metraflex Company (The)
 - e. Reliable Automatic Sprinkler Co., Inc. (The)
2. Description: Automatic air vent that automatically vents trapped air without human intervention. Approved for use in wet-pipe fire-suppression system.
3. Vents oxygen continuously from system.
4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: 175 psig.

H. Automatic Air Vent Assembly:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Engineered Corrosion Solutions
 - c. South-Tek Systems, LLC
2. Description: Automatic air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly. Approved for use in wet-pipe fire-suppression system.
3. Vents oxygen continuously from system.
4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: 175 psig.

2.5 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Reliable Automatic Sprinkler Co., Inc. (The)
 2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 3. Victaulic Company
 4. Viking Group Inc.
- B. Standards:
 1. UL 199.
 2. UL 1626.
 3. UL 1767.
 4. FM 2000.
 5. FM 2008.
 6. FM 2030.
- C. Listed in ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- D. Pressure Rating for Sprinklers:
 1. Standard Automatic Sprinklers: 175 psig minimum.
 2. Residential Sprinklers: 175 psig maximum.
- E. Sprinklers, Automatic Wet with Heat-Responsive Element:
 1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

2. Standard Spray, Standard Response:
 - a. Upright.
 - b. Pendent.
 - c. Flat, concealed pendent.
 - d. Horizontal sidewall.
 3. Standard Spray, Quick Response:
 - a. Upright.
 - b. Pendent.
 - c. Flat, concealed pendent.
 - d. Horizontal sidewall.
 - e. Flat, concealed horizontal sidewall.
- F. Sprinkler Finishes: painted.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
- H. Sprinkler Guards and Water Shields:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The)
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
 - c. Victaulic Company
 - d. Viking Group Inc.
 2. Standard: UL 199.
 3. Description: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
1. Flow test is to be performed to meet the criteria established by NFPA 13.
 2. Flow test is to be conducted in accordance with NFPA 291.
 3. Test is to be performed during a period of ordinary demand for the water system.
 - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
 4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
 5. The pitot reading is to range from 10 to 35 psig.
 6. Open additional hydrant outlets as needed to control pitot readings.
 7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
1. Flow data report is to be written in accordance with NFPA 291.
 2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.

- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.
- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 and NFPA 14 requirements for installation of fire-suppression piping.
- C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- G. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards.
- H. Fill wet-type fire-suppression system piping with water.
- I. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

3.3 INSTALLATION OF PIPING JOINTS

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
- M. Brazed Joints: Join copper tube and fittings in accordance with Copper Development Association's "Copper Tube Handbook," "Brazed Joints" chapter.
- N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
- O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- P. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Air Vent:
 - 1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
 - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
 - 3. Pipe from outlet of air vent to drain.

3.5 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."

- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform the following tests and inspections :
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
 - 4. Verify that sprinklers' original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
- D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- E. Prepare test and inspection reports.

3.8 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE

- A. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:
 - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 6. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 7. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
- B. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:
 - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:
 - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.10 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Flat concealed sprinklers.
 - 3. Wall Mounting: Flat concealed sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Upright, Pendent, and Sidewall Sprinklers: White enamel in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view.
 - 2. Recessed Sprinklers: White enamel, with factory-painted white escutcheon.
 - 3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

END OF SECTION 211000

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SECTION 220010 - PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section Includes:
 - 1. Demolition and removal of selected portions of plumbing systems.
 - 2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; clean, repair and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
 - 1. It is not expected that hazardous materials will be encountered in the Work.
 - a. Hazardous materials will be removed by Owner before start of the Work.
 - b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

- B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video, measured drawings.
 - 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
 - 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

- A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
 - 3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.
 - 4. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.
 - a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - 5. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:
 - a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
 - b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

- A. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- B. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Remove piping systems throughout project area as required for new work.
 - 1. Restore complete operation to items not being removed as part of the Work.
 - 2. Remove all abandoned piping and associated installation.
- B. Clean and repair items that are to remain to “like-new” condition.

END OF SECTION 220010

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves without waterstop.
 - 2. Sleeve-seal systems.
 - 3. Grout.
 - 4. Silicone sealants.
 - 5. Escutcheons.

1.2 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
 - 1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
 - 2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, LLC
 - b. American Polywater Corporation
 - c. GPT; a division of EnPRO Industries
 - d. Metraflex Company (The)
 - e. Proco Products, Inc
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - a. Hydrostatic Seal: 20 psig minimum.
 - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - c. Pressure Plates: Carbon steel.
 - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.

C. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

D. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) ITW Polymers Sealants North America
 - 3) Polymeric Systems, Inc.; PPG Industries, Inc.
 - 4) Sherwin-Williams Company (The)
 - 5) Sika Corporation
 - 6) The Dow Chemical Company
 - 7) Tremco Incorporated
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
2. Silicone Sealant, S, P, T, NT: Single-component, 100/50, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Pecora Corporation
 - 2) Sika Corporation
 - 3) The Dow Chemical Company
 - 4) Tremco Incorporated
 - b. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.
3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Smooth-On

2.3 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company
 - 2. Dearborn Brass
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The)
 - 5. Mid-America Fittings, LLC; A Midland Industries Company
 - 6. ProFlo; a Ferguson Enterprises, Inc. brand
- B. Escutcheon Types:
 - 1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
 - 2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
 - 3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
 - 4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
 - 5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
 - 6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.
- C. Floor Plates:
 - 1. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Division 7.

3.2 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.4 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
 - 1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
 - 2. Prepare test and inspection reports.
- B. Escutcheons:
 - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.5 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs above Grade:
 - a. Sleeves with waterstops or stack-sleeve fittings.
 - 3. Interior Wall and Partitions:
 - a. Sleeves without waterstops.

3.6 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
 - 3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated finish.
 - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
 - 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
- B. Install floor plates for piping penetrations of equipment-room floors.
- C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
 - 2. Existing Piping: Split floor plate.

END OF SECTION 220500

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports - metal.
 - 2. Pipe hangers - metal, trapeze type.
 - 3. Strut support system - metal, rod type.
 - 4. Strut support system - metal, cable type.
 - 5. Thermal hanger shield inserts.
 - 6. Fastener systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers.
 - 2. Metal strut support systems.
 - 3. Rooftop-mounted strut support systems.
 - 4. Pipe stands.
 - 5. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 PIPE HANGERS AND SUPPORTS - METAL

- A. Pipe Hangers and Supports - Carbon Steel:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Cooper B-line; brand of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
 - 2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 3. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 - 4. Nonmetallic Coatings: Plastic coated or epoxy powder coated.

5. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Pipe Hangers and Supports - Stainless Steel:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Cooper B-line; brand of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
 - d. Rocket Rack; Robroy Industries
 2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Pipe/Tube Hangers and Supports - Copper:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Cooper B-line; brand of Eaton, Electrical Sector
 - c. FNW; Ferguson Enterprises, Inc.
 2. Description: MSS SP-58, Types 1 through 58, copper-plated-steel, factory-fabricated components.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 STRUT SUPPORT SYSTEMS - METAL

- A. Strut Support System - Metal, Rod Type:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Anvil; an ASC Engineered Solution
 - c. Atkore Unistrut
 - d. CADDY; brand of nVent Electrical plc
 - e. Carpenter & Paterson, Inc
 - f. Cooper B-line; brand of Eaton, Electrical Sector
 - g. Empire Industries, Inc.
 - h. Flex-Strut Inc.
 - i. G-Strut
 - j. Haydon Corporation
 - k. PHD Manufacturing, Inc
 - l. Rocket Rack; Robroy Industries
 - m. Wesanco/ZSi-Foster; an Ideal Tridon Group Company
 2. Description: Factory-fabricated pipe-support assembly, made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 4. Struts: Continuous slotted carbon-steel channel with inturned lips.
 5. Strut Width: Selected for applicable load criteria.
 6. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
 8. Metallic Coating: Gold (yellow zinc dichromate) galvanized.
 9. Paint Coating: Green epoxy, acrylic, or urethane.

- B. Strut Support System - Metal, Cable Type:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Gripple Inc.
 2. Description: Factory-fabricated pipe-support system, consisting of cable pipe clamps and associated vibration isolation rubber pads, slotted channel brackets, wire rope suspension components, and associated accessories for a complete piping suspension system; no tools required for manual assembly in the field to support multiple parallel pipe routing.
 3. Standards:
 - a. ICC-ES PMG Product Certificate.
 - b. Brackets: Fire-rated, tested to F120 in accordance with BS EN 1363-1:2020.
 4. Components:
 - a. Pipe Clamps: Size-adjustable standard clamps with rubber pad, 14 dBA noise reduction; with sleeve to prevent galvanic corrosion.
 - b. Brackets: Slotted channels furnished in pre-cut lengths to suit specific system application for Project.
 - c. Suspension Components: Hanging cables with adjustable fastener; can be pre-installed on the brackets using pre-fitted washer/nuts or retention clips.
 - 1) Wire Rope: High tensile steel wire rope, complying with ASTM A1023/A1023M, ASTM A641/A641M Class A zinc coating; 7 by 7 and 7 by 19 cross-sectional construction; having a tensile strength of 256,000 psi; lengths, diameters, and wire construction to accommodate design loads.
 - a) Locking screw/release button.
 - b) Foot attachment type to suit application.
 - c) End Fix Type: Loop , strap hook , eyelet or as required to suit application.
 - d. Adjustable Fastener: Mild steel (type EN1A), bright zinc plated, one-channel body; encasing a series of Type 302 stainless steel springs with serrated self-locking Grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load as required.

2.5 THERMAL HANGER SHIELD INSERTS

- A. Thermal Hanger Shield Inserts:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA
 - b. Buckaroos, Inc.
 - c. Carpenter & Paterson, Inc
 - d. KB Enterprise
 - e. National Pipe Hanger Corporation
 - f. Pipe Shields Inc.
 - g. Piping Technology & Products, Inc
 - h. Rilco Manufacturing Co., Inc
 - i. Value Engineered Products, Inc
 2. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psig minimum compressive strength and vapor barrier.
 3. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psig minimum compressive strength.
 4. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
 5. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
 6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC
 - 2. Indoor Applications: Zinc-plated or stainless steel.
 - 3. Outdoor Applications: Stainless steel.

2.7 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- F. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal hanger shield insert with clamp sized to match OD of insert.

- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
 - a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include calcium-silicate-insulation inserts of length at least as long as protective shield.
- G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate in accordance with ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- I. Strut System Installation: Metal, rod type; arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems. Install in accordance with manufacturer's written installation instructions.
- J. Thermal Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- K. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
 - 2. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
 - 3. Install fasteners in accordance with manufacturer's written instructions.
- L. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 - 2. Comply with requirements in Painting Section(s) for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
 - 3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Stencils.
 - 4. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America
 - d. Craftmark Pipe Markers
 - e. emedco
 - f. Kolbi Pipe Marker Co.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Pipemarket.com; Brimar Industries, Inc.
 - j. Seton Identification Products; a Brady Corporation company
 - 2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 6. Fasteners: Stainless steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation

- b. Carlton Industries, LP
 - c. Champion America
 - d. Craftmark Pipe Markers
 - e. emedco
 - f. Kolbi Pipe Marker Co.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Pipemarket.com; Brimar Industries, Inc.
 - j. Seton Identification Products; a Brady Corporation company
 - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number. Coordinate with Owner prior to ordering.

2.2 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 - 2. Brady Corporation
 - 3. Carlton Industries, LP
 - 4. Champion America
 - 5. Craftmark Pipe Markers
 - 6. emedco
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Services Inc.
 - 10. Pipemarket.com; Brimar Industries, Inc.
 - 11. Seton Identification Products; a Brady Corporation company
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.3 STENCILS

- A. Stencils for Piping:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Craftmark Pipe Markers
 - b. Kolbi Pipe Marker Co.
 - c. Marking Services Inc.
 - d. Pipemarket.com; Brimar Industries, Inc.
 - 2. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
 - 3. Stencil Material: Aluminum, brass, or fiberboard.
 - 4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 5. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 6. Letter and Background Color: As indicated for specific application under Part 3.

2.4 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 - 2. Brady Corporation
 - 3. Carlton Industries, LP
 - 4. Champion America
 - 5. Craftmark Pipe Markers
 - 6. emedco
 - 7. Kolbi Pipe Marker Co.
 - 8. LEM Products Inc.
 - 9. Marking Services Inc.
 - 10. Pipemarket.com; Brimar Industries, Inc.
 - 11. Seton Identification Products; a Brady Corporation company
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04-inch stainless steel, 0.024-inch aluminum, 0.031-inch or anodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain or S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
 - 1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
 - 2. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 - 3. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 4. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
 - 5. Sanitary Waste and Storm Drainage Piping: White letters on a black background.

3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1-1/2 inches, round.
 - b. Domestic Hot Water: 1-1/2 inches, round.
 - c. Domestic Hot-Water Return: 1-1/2 inches, round.
 - d. Low-Pressure Compressed Air: 1-1/2 inches, round.
2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION 220553

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. Knauf Insulation
 - c. Manson Insulation Inc.
 - d. Owens Corning
 - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
- B. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

- C. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 - 1. Permanently flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 58 to plus 176 deg F.
 - 3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
 - 1. Fire- and water-resistant, flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 3. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - 1. Fire- and water-resistant, flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 3. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 - 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
 - 5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Airex Manufacturing Inc.
 - b. Johns Manville; a Berkshire Hathaway company
 - c. P.I.C. Plastics, Inc.
 - d. Proto Corporation
 - e. Speedline Corporation
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
 - 1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - 2. Stainless Steel Jacket: ASTM A240/A240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M
 - b. Foster Brand; H. B. Fuller
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - 2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 - 3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
 - 4. Aluminum Finish: Embossed.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Aeroflex USA
 - c. Avery Dennison Corporation, Specialty Tapes Division
 - d. Ideal Tape Co., Inc., an American Biltrite Company
 - e. Knauf Insulation
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Ideal Tape Co., Inc., an American Biltrite Company
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Plumberex Specialty Products, Inc.
 - b. ProFlo; a Ferguson Enterprises, Inc. brand
 - c. Truebro; IPS Corporation
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 7 for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations where access is required. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
 4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install prefabricated pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
 2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09900 "Painting".
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 1. NPS 1-1/4 and Smaller: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 2. NPS 1-1/2 and Larger: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
- D. Piping, Exposed:
 1. PVC: 20 mils thick.
 2. Aluminum, Smooth: 0.016 inch thick.
 3. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

END OF SECTION 220719

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings - domestic water.
 - 2. Piping joining materials - domestic water.
 - 3. Transition fittings - domestic water.
 - 4. Dielectric fittings - domestic water.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Copper tube and fittings - domestic water.
 - 2. Ductile-iron pipe and fittings - domestic water.
 - 3. PEX tube and fittings - domestic water.
 - 4. Polypropylene (PP-R and PP-RCT) pipe and fittings - domestic water.
 - 5. Piping joining materials - domestic water.
 - 6. Transition fittings - domestic water.
 - 7. Dielectric fittings - domestic water.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, showing the items described in this Section, and coordinated with all building trades.
 - 1. Drawings shall clearly indicate piping material proposed for use at each location. Basis of design is copper unless noted otherwise in the Drawings. Where alternate materials are proposed, increase sizes as necessary to provide equivalent hydraulic diameter, and clearly indicate on Coordination Drawings.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Architect's written permission.

1.6 WARRANTY

- A. Polypropylene (PP-R and PP-RCT) Pipe and Fittings Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R and PP-RCT pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
 - 1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of piping system due to defects in materials or manufacturing.

2. Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type K ASTM B88, Type L.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cambridge-Lee Industries, LLC
 - b. Cerro Flow Products, LLC
 - c. Mueller Streamline Co.; a company of Mueller Industries
- B. Annealed-Temper Copper Tube: ASTM B88, Type K ASTM B88, Type L.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cambridge-Lee Industries, LLC
 - b. Cerro Flow Products, LLC
 - c. Mueller Streamline Co.; a company of Mueller Industries
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems
 - b. Mueller Streamline Co.; a company of Mueller Industries
 - c. NIBCO INC.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- H. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - b. Conex Banninger - USA
 - c. Copper Press Brand; Merit Brass Company
 - d. Elkhart Brass Mfg. Co., Inc
 - e. FNW; Ferguson Enterprises, Inc.
 - f. Mueller Streamline Co.; a company of Mueller Industries

- g. NIBCO INC.
- h. Viega LLC
- 2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
- 3. Housing: Copper.
- 4. O-Rings and Pipe Stops: EPDM.
- 5. Tools: Manufacturer's special tools.
- 6. Minimum 200 psig working-pressure rating at 250 deg F.

2.3 PIPING JOINING MATERIALS - DOMESTIC WATER

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS - DOMESTIC WATER

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Pipeline Solutions
 - c. Ford Meter Box Company, Inc. (The)
 - d. Jay R. Smith Mfg Co; a division of Morris Group International
 - e. JCM Industries, Inc
 - f. Romac Industries, Inc.
 - g. Smith-Blair, a Xylem brand.
 - h. Viking Johnson
 - 2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.
- D. Plastic-to-Metal Transition Unions - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. aquatherm
 - b. Colonial Engineering, Inc.
 - c. NIBCO INC.
 - d. Spears Manufacturing Company
 - 2. Source Limitations: Obtain plastic-to-metal transition unions from single manufacturer.
 - 3. Description:
 - a. Brass threaded end.
 - b. Solvent-cement-joint or threaded plastic end.
 - c. Rubber O-ring.

- d. Union nut.

2.5 DIELECTRIC FITTINGS - DOMESTIC WATER

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. HART Industrial Unions, LLC
 - d. Jomar Valve
 - e. Matco-Norca
 - f. WATTS; A Watts Water Technologies Company
 - g. Zurn Industries, LLC
 - 2. Source Limitations: Obtain dielectric unions from single manufacturer.
 - 3. Standard: ASSE 1079.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company
 - b. GF Piping Systems: Georg Fischer LLC
 - c. Matco-Norca
 - d. WATTS; A Watts Water Technologies Company
 - e. Zurn Industries, LLC
 - 2. Source Limitations: Obtain dielectric flanges from single manufacturer.
 - 3. Standard: ASSE 1079.
 - 4. Factory-fabricated, bolted, companion-flange assembly.
 - 5. Pressure Rating: 125 psig minimum at 180 deg F.
 - 6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Nipples - Domestic Water:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil; an ASC Engineered Solution
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - c. Matco-Norca
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Victaulic Company
 - 2. Source Limitations: Obtain dielectric nipples from single manufacturer.
 - 3. Standard: IAPMO PS 66.
 - 4. Electroplated steel nipple complying with ASTM F1545.
 - 5. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 6. End Connections: Male threaded or grooved.
 - 7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Drawn-temper copper tube, ASTM B88, Type L; copper push-on joint fittings; and push-on joints.
 - 4. Polypropylene (PP-R and PP-RCT), SDR 7.4 SDR 11 pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install domestic water piping level without pitch and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping to permit valve servicing.
- H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- L. All stubouts to fixtures are to be copper.
- M. Do not route piping above or below any electrical equipment (panelboards, transformers, disconnect switches, etc.)
- N. Unless noted otherwise, pipe sizes indicated on drawings are based on copper. Where alternate materials are used, sizes shall be increased to provide equivalent hydraulic diameter.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.5 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper ductile iron tube and pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install vinyl-coated hangers for PP-R/PP-RCT pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.

- F. Support vertical runs of copper tube and pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PP-R/PP-RCT pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system in accordance with either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
 - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - g. Prepare reports for tests and for corrective action required.

- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221116

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hubless, cast-iron soil pipe and fittings.
 - 2. PVC pipe and fittings.
 - 3. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Installation photographs.
 - 1. After installation of underground piping and support, but prior to backfilling, submit photographs showing entirety of underground piping system.
- C. Field quality-control reports.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AB & I Foundry; a part of the McWane family of companies
 - 2. Charlotte Pipe and Foundry Company
 - 3. Tyler Pipe; a part of the McWane family of companies
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky; a part of the McWane family of companies
 - b. Charlotte Pipe and Foundry Company

- c. Dallas Specialty & Mfg. Co.
 - d. Fernco Inc
 - e. Ideal Tridon Group
 - f. Matco-Norca
 - g. MIFAB, Inc
 - h. Mission Rubber Company, LLC
 - i. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Standards: ASTM C1277 and CISPI 310.
 - 3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AB & I Foundry; a part of the McWane family of companies
 - b. ANACO-Husky; a part of the McWane family of companies
 - c. Charlotte Pipe and Foundry Company
 - d. Clamp-All Corp
 - e. Dallas Specialty & Mfg. Co.
 - f. Ideal Tridon Group
 - g. MIFAB, Inc
 - h. Mission Rubber Company, LLC
 - i. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Standards: ASTM C1277 and ASTM C1540..
 - 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Apollo Valves; a part of Aalberts Integrated Piping Systems
 - 2. Charlotte Pipe and Foundry Company
 - 3. GF Piping Systems
 - 4. JM Eagle
 - 5. National Pipe and Plastic, Inc. (Oldcastle)
 - 6. North America Pipe Corporation
 - 7. Rocky Mountain Colby Pipe Company
 - 8. Silver-line Plastics
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- E. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F656.
- G. Solvent Cement: ASTM D2564.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc
 - 3) Mission Rubber Company, LLC
 - 4) Plastic Oddities
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems
 - 2) Cascade Waterworks Mfg. Co.
 - 3) EBAA Iron Sales, Inc.
 - 4) Ford Meter Box Company, Inc. (The)
 - 5) JCM Industries, Inc
 - 6) Romac Industries, Inc.
 - b. Standard: AWWA C219.
 - c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation where applicable.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Sanitary Drain: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install aboveground PVC piping in accordance with ASTM D2665.
- O. Install underground PVC piping in accordance with ASTM D2321.
- P. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."
- V. Trenching:
 - 1. Notify Architect of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
 - 2. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
 - 3. Do not interfere with 45 degree bearing splay of foundations.
 - 4. Cut trenches wide enough to allow inspection of installed utilities.
 - 5. Hand trim excavations and remove loose material.
 - 6. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
 - 7. Remove excavated material that is unsuitable for re-use from site.
 - 8. Remove excess excavated material from site.
- W. Backfilling:
 - 1. Utilize sand for bedding of pipe, and for backfill to a minimum of 6" over the top of pipes.
 - 2. Hand tamp sand below all piping to ensure continuous support of entire piping system prior to backfilling.
 - 3. Fill to subgrade elevations unless otherwise indicated.
 - 4. Employ placement method that does not disturb or damage other work.
 - 5. Systematically fill to allow maximum time for natural settlement.
 - a. Do not fill over porous, wet, frozen or spongy subgrade;
 - b. Maintain optimum moisture content of fill materials to attain required compaction density.
 - c. Place materials in equal continuous layers not exceeding 6" compacted depth for each layer.

3.2 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.3 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.

3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 INSTALLATION OF VALVES

- A. Shutoff Valves:
 1. Install shutoff valve on each sewage pump discharge.
 2. Install full-port ball valve for piping NPS 2 and smaller.
 3. Install gate valve for piping NPS 2-1/2 and larger.
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- C. Backwater Valves: Install backwater valves in piping subject to backflow.
 1. Horizontal Piping: Horizontal backwater valves. [**Use normally closed type unless otherwise indicated.**]
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- E. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

- a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. The use of PVC, where allowed in paragraphs below, shall be limited to spaces not utilized as return air plenums.
- C. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Aboveground, vent piping NPS 5 (DN 125) and larger is to be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- H. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; coupled joints.
 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Domestic-water heater, electric - thermostat-control, tankless type.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of electric domestic-water heater.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality control reports.
- D. Field quality control reports.
- E. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electric domestic water heater equipment intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

- A. Domestic-Water Heater, Electric - Thermostat-Control, Tankless Type:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bosch Thermotechnology Corp.
 - b. Bradley Corporation
 - c. Chronomite Laboratories, Inc; a division of Morris Group International
 - d. Eemax, Inc.; a Rheem brand
 - e. Stiebel Eltron, Inc
2. Source Limitations: Obtain domestic-water heaters, electric - thermostat-control, tankless type from single source from single manufacturer.
3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Thermostat.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
5. Support: Bracket for wall mounting.
6. Capacity and Characteristics: On Drawings

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRIC, DOMESTIC-WATER HEATERS

- A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
 1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Anchor domestic-water heaters to substrate.
- B. Fill electric, domestic-water heaters with water.
- C. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 223300

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SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commercial sinks.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions and thicknesses, dimensions of individual components and profiles, and finishes for plumbing fixtures.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Plans, elevations, sections, and mounting details.
 - 2. Details of equipment assemblies, including accessories. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, location and size of each field connection, location and size of each cutout, and anchorage provisions and attachment methods. Indicate coordination requirements for adjacent and interfacing Work.
 - 3. Diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. For lavatories and faucets.
 - 2. For shower valves to include in maintenance manuals.
 - 3. For sinks and faucets to include in operation and maintenance manuals.
 - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Servicing and adjustments of automatic faucets.
 - 4. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
 - 5. For wash fountains and components to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 COMMERCIAL SINKS

A. Kitchen/Utility Sinks:

- 1. Kitchen/Utility Sinks, Counter Mounted - Stainless Steel:
 - a. Source Limitations: Obtain sinks from single source from single manufacturer.
 - b. Fixture:
 - 1) Standard: ASME A112.19.3/CSA B45.4.
 - 2) Type: Stainless steel, self-rimming, sound-deadened unit less ledge back.
 - 3) Number of Compartments: As indicated on drawings.
 - 4) Overall Dimensions: As indicated on drawings.
 - 5) Material: 18 gauge, Type 304 stainless steel.
 - c. Faucet(s): Provide faucet as scheduled..
 - d. Supply Fittings:
 - 1) Standard: ASME A112.18.1/CSA B125.1.
 - 2) Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
 - a) Operation: Loose key or lever handle.
 - b) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
 - e. Waste Fittings:
 - 1) Standard: ASME A112.18.2/CSA B125.2.
 - 2) Trap(s) Size: NPS 1-1/2.
 - 3) Trap(s) Material:
 - a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
 - f. Mounting: On counter with sealant or undermount with manufacturer's recommended hardware and sealant.

B. Sink Faucets, Manually Operated:

- a. Manufacturers: Subject to compliance with requirements, :
 - 1) American Standard
 - 2) Chicago Faucets; Geberit Group
 - 3) T&S Brass and Bronze Works, Inc.
 - 4) Delta
- 2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
- 3. Standards:
 - 1) ASME A112.18.1/CSA B125.1.
 - 2) NSF 61.
 - 3) NSF 372.
- 4. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor. Refer to fixture schedule on drawings for additional requirements.
 - a. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
 - b. Finish: Chrome plated .
- 5. Sink Faucets, Manually Operated - Service Sink:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Chicago Faucets; Geberit Group
 - 2) T&S Brass and Bronze Works, Inc.
 - b. Source Limitations: Obtain sink faucets from single source from single manufacturer.

- c. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
 - d. Faucet:
 - 1) Standards:
 - a) ASME A112.18.1/CSA B125.1.
 - b) NSF 61 and NSF 372.
 - c) ICC A117.1.
 - d) ASSE 1001 (VB).
 - 2) Finish: Rough chrome plated.
 - 3) Handles: Lever.
 - 4) Cartridges: One-fourth turn compression.
 - 5) Brace: Adjustable top brace.
 - e. Vacuum Breaker: Required for hose outlet.
 - f. Spout Outlet: Hose thread in accordance with ASME B1.20.7.
- C. Sink Supply Fittings:
- 1. NSF Standards: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
 - 2. Standard: ASME A112.18.1/CSA B125.1.
 - 3. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
 - 4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
 - 5. Operation: Loose key or metal lever.
 - a. Risers Sizes: NPS 3/8.
 - b. Risers Material: ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
- D. Sink Waste Fittings:
- 1. Standard: ASME A112.18.2/CSA B125.2.
 - 2. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
 - 3. Trap:
 - a. Size: NPS 1-1/2.
 - b. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.
- C. Examine counters for suitable conditions where lavatories and sinks will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

- A. Sink Installation:
 - 1. Install sinks level and plumb in accordance with roughing-in drawings.
 - 2. Install supports, affixed to building substrate, for wall-mounted sinks.
 - 3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
 - 4. Set floor-mounted sinks in leveling bed of cement grout.
 - 5. Install water-supply piping with stop on each supply to each sink faucet.

- a. Install stops/valves in locations that are accessible for ease of operation.
6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 INSTALLATION OF PIPING CONNECTIONS

- A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damage to finishes. Replace any fixtures unable to be repaired to the satisfaction of the Architect.
- B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section Includes:
 - 1. TAB of Air Systems:
 - a. Constant-volume air systems.
 - 2. TAB of equipment.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NC: Noise criteria.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, provide a summary report of the examination review required in "Examination" Article, if issues are discovered that may preclude the proper testing and balancing of the systems. Submit a summary report of the examination review required in "Examination" Article.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article, to be used and filled out by systems installers verifying that systems are ready for TAB.
- E. Certified TAB Reports: Within 14 days of completion of testing and balancing work.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration and calibration interval.

1.4 QUALITY ASSURANCE

- A. TAB Specialist Firm's Qualifications: Certified by NEBB or TABB.
 - 1. TAB Certified Professional: Employee of the TAB specialist firm and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist firm and certified by NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in system designs that may preclude proper TAB of systems and equipment. Submit Contract Documents Examination Report summary of findings.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for TAB.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean and permanent filters are installed, and equipment with functioning controls is ready for operation.
- F. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning as indicated on Drawings or in the Specifications.
- G. Observe demonstration of operating safety interlocks and controls on HVAC equipment.
- H. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Prepare system-readiness checklists of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed and are in normal operating positions.
 - j. Note location of balancing devices that are inaccessible.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Installing Contractor to Perform the Following:
 - a. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

- b. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - c. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
- B. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.
- D. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Fans and ventilators.
 - 3. Unit heaters.
 - 4. Energy-recovery units.
 - 5. Dedicated outdoor-air units.
 - 6. Split-system air conditioners.
 - 7. Variable-refrigerant-flow systems.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare single-line schematic diagram of systems or color-coded HVAC drawings for the purpose of identifying HVAC components, including each air terminal unit and each air diffuser, register, and grille.
- C. For variable-air-volume systems, develop a plan to simulate diversity and include in TAB plan.
- D. Determine suitable locations in main and branch ducts for accurate duct-airflow measurements.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
- F. Verify that motor controllers are equipped with properly sized thermal protection.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet.
 - b. Measure static pressure directly at the fan inlet.
 - c. Measure static pressure differential across each component that makes up the air-handling system.
 - d. Apply artificial loading of filters to simulate a dirty filter pressure drop condition at the time static pressures are measured.

3. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all volume dampers have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets' and outlets' airflow. Apply correction factors as applicable for each size and style of air device.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design range. Readjust to within design tolerance if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
 4. Traverse the supply airflow in full airside economizer mode. Observe the mixed air plenum pressure as compared to normal operation: return air dampers open and minimum outside air varying to 100 percent outside air dampers fully open and return air dampers fully closed. Mixed air pressure is to remain constant plus/minus 20 percent or, otherwise, damper/fan adjustments will be required.
 5. Mark all final settings.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

- A. Motors: 1/2 hp and larger; test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation. Verify and report Hz at maximum and minimum flows.

3.8 TOLERANCES

- A. Set HVAC system's airflow rates and water-flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, flow rate is within 10 cfm.
 2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, flow rate is within 10 cfm.
- B. Maintaining pressure relationships as designed is to have priority over the tolerances specified above. If the above tolerances change the relative positive or negative airflow from/into the space, tolerances are to

be adjusted so as to keep the relative positive cfm or negative cfm from/into the space a constant cfm differential.

3.9 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

3.10 FINAL TESTING AND BALANCING REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist firm and technician.
 - 3. Project name.
 - 4. Project location.
 - 5. Project Architect's name, firm, and address.
 - 6. Project engineer's name, firm, and address.
 - 7. Project Contractor's name, firm, and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fan performance forms, including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Heating coil, dry-bulb conditions.
 - e. Face and bypass damper settings at coils.
 - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Duct, outlet, and inlet sizes.
- E. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
- B. Related Requirements:
 - 1. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.4 COORDINATION

- A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- B. Coordinate installation and testing of heat tracing.

1.5 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule" article for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.

- C. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Johns Manville; a Berkshire Hathaway company
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.

2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA
 - b. Childers Brand; H. B. Fuller Construction Products
 - c. Foster Brand; H. B. Fuller
 - d. Knauf Insulation
 - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA
 - b. Childers Brand; H. B. Fuller Construction Products
 - c. Eagle Bridges - Marathon Industries
 - d. Foster Brand; H. B. Fuller

2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Knauf Insulation
 - e. Mon-Eco Industries, Inc.
 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges - Marathon Industries
 - c. Foster Brand; H. B. Fuller
 - d. Mon-Eco Industries, Inc.
 2. Materials are compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
- B. ASJ Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller
 2. Materials are compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Aeroflex USA
 - c. Avery Dennison Corporation, Specialty Tapes Division
 - d. Ideal Tape Co., Inc., an American Biltrite Company
 - e. Knauf Insulation
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division
 - b. Avery Dennison Corporation, Specialty Tapes Division
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.8 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company
 - b. RPR Products, Inc.
 2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 7
- D. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Comply with manufacturer's written installation instructions and ASTM C1710.
- B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Square and Rectangular Ducts and Plenums:
 - 1. Provide 1/4 inch more per side for a tight, compression fit.
 - 2. Cut sheet insulation with the following dimensions:
 - a. Width of duct plus 1/4 inch, one piece.
 - b. Height of duct plus 1/4 inch, plus thickness of insulation, two pieces.
 - c. Width of duct plus 1/4 inch, plus two times the thickness of insulation, one piece.
 - 3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
 - 4. Insulation without self-adhering backing:
 - a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch where sheets will butt together.
 - b. Roll sheet down into position.
 - c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.
 - 5. Insulation with self-adhering backing:
 - a. Peel back release paper in 6- to 8-inch increments and line up sheet.
 - b. Press firmly to activate adhesive.
 - c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
 - d. Allow 1/4-inch overlap for compression at butt joints.
 - e. Apply adhesive at the butt joint to seal the two sheets together.
 - 6. Insulate duct brackets following manufacturer's written installation instructions.
- D. Circular Ducts:
 - 1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
 - 2. Cut the sheet to the required size.

3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER INSULATION

- A. Comply with manufacturer's written installation instructions.
 1. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 2. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 3. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 4. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Definitions:
 1. Supply air ducts shall be ducts conveying air that has been heated or cooled for space conditioning purposes. Discharge ducts from dedicated outside air units shall be considered supply air ducts.
 2. Outdoor air ducts shall be ducts conveying untreated outside air.
 3. Return air ducts shall be ducts conveying room temperature air from conditioned spaces to the return side of air handling equipment, to be recirculated.
 4. Exhaust ducts shall be ducts conveying room temperature air from conditioned spaces to be discharged to the exterior.
- B. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.
 3. Indoor, concealed return located in unconditioned space.

4. Indoor, exposed return located in unconditioned space.
- C. Items Not Insulated:
1. Phenolic ducts.
 2. Double wall spiral formed duct with internal insulation
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums and casings.
 5. Flexible connectors.
 6. Vibration-control devices.
 7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation is the following:
1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. 1.5 lb/cu. ft. nominal density.
- B. Concealed, rectangular, supply-air duct insulation is the following:
1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
- C. Concealed, rectangular, return-air duct insulation in unconditioned space is the following:
1. Glass-Fiber Blanket: 3 inches thick and 0.75 lb/cu. ft. nominal density.
- D. Exposed, single wall round and flat-oval, supply-air duct insulation is the following:
1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
- E. Exposed, rectangular, supply-air duct insulation is the following:
1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
- F. Supply and return air duct within ten feet of air moving equipment shall be insulated with the following:
1. Flexible Elastomeric liner, 1/2" thick.

END OF SECTION 230713

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Manual gas shutoff valves.
 - 3. Pressure regulators.
 - 4. Dielectric fittings.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 3. Pressure regulators. Indicate pressure ratings and capacities.
 - 4. Dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 54 and the International Fuel Gas Code.
- B. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.

2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. PE Pipe: ASTM D2513, SDR 11.
 - 1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
 - 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
 - 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet is threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. UV shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 - 4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet is threaded or flanged or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. UV shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 - 5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Suitable for joining PE pipe to PE pipe.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Mueller Co. LLC; Mueller Water Products, Inc.
 - 2) Perfection Corporation
 - 3) R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated
 - b. PE body with molded-in, stainless steel support ring.
 - c. Seals: NBR.
 - d. Acetal collets.
 - e. Electro-zinc-plated steel stiffener.
- 6. Plastic Mechanical Couplings, NPS 2 (DN 50) and Larger: Suitable for joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Mueller Co. LLC; Mueller Water Products, Inc.
 - 2) Perfection Corporation
 - 3) R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated
 - b. Fiber-reinforced plastic body.
 - c. PE body tube.
 - d. Seals: NBR.
 - e. Acetal collets.
 - f. Stainless steel bolts, nuts, and washers.
- 7. Steel Mechanical Couplings: Suitable for joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Baker Hughes Company
 - 2) Smith-Blair, a Xylem brand.
 - b. Steel flanges and tube with epoxy finish.
 - c. Seals: NBR.
 - d. Steel bolts, washers, and nuts.
 - e. Factory-installed anode for steel-body couplings installed underground.

2.4 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated, stainless steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig.
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 24 inches.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.
- B. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Lee Brass Company
 2. Body: Bronze, complying with ASTM B584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged as indicated in "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Capitol Manufacturing Company
 - c. GF Piping Systems: Georg Fischer LLC
 - d. HART Industrial Unions, LLC
 - e. Jomar Valve
 - f. Matco-Norca
 - g. WATTS; A Watts Water Technologies Company
 - h. Wilkins
 - i. Zurn Industries, LLC
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping in accordance with the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

- C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

3.3 INSTALLATION OF OUTDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install fittings for changes in direction and branch connections.

3.4 INSTALLATION OF INDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- L. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- M. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

- O. Connect branch piping from top or side of horizontal piping.
- P. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- Q. Do not use natural-gas piping as grounding electrode.
- R. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.5 INSTALLATION OF VALVES

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.
- B. Do not install valves in return-air plenums.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 2. Cut threads full and clean using sharp dies.
 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- B. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

- A. Connect to utility's gas meter and pressure regulator according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.

- C. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas in accordance with the International Fuel Gas Code and authorities having jurisdiction.
 - 2. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.10 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping is to be one of the following:
 - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping is to be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

- A. Aboveground, branch piping NPS 1 and smaller is to be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping NPS 1 ¼ and larger is to be the following:
 - 1. Steel pipe with wrought-steel fittings and welded joints.

3.12 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Distribution piping valves for pipe sizes NPS 2 and smaller are to be the following:
 - 1. Bronze plug valve.
- B. Valves in branch piping for single appliance are to be the following:
 - 1. Bronze plug valve.

END OF SECTION 231123

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings - single wall.
 - 2. Round ducts and fittings - single wall.
 - 3. Round ducts and fittings - double wall.
 - 4. Sheet metal materials.
 - 5. Duct liner.
 - 6. Hangers and supports.
 - 7. Strut support system for ductwork - metal, cable type.
- B. Related Requirements:
 - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 DEFINITIONS

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top and bottom of ducts.
 - 5. Dimensions of all duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

- C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts and Fittings - Single Wall:
 - 1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on static-pressure class indicated on the Drawings.
 - a. Construct ducts of galvanized sheet steel.
 - 2. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - b. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
 - 3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 4. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 ROUND DUCTS AND FITTINGS

- A. Round Ducts and Fittings - Single Wall:
 - 1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class indicated on the Drawings.
 - a. Construct ducts of galvanized sheet steel.
 - 2. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 4. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Round Ducts and Fittings - Double Wall:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wesco
 - b. Wichita Sheet Metal
 2. Source Limitations: Obtain double-wall, round ducts and fittings from single manufacturer.
 3. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class indicated on the Drawings.
 - a. Construct ducts of galvanized sheet steel.
 - b. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 4. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
 5. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - a. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - c. Coat insulation with antimicrobial coating.
 - d. Cover insulation with polyester film complying with UL 181, Class 1.

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
1. Galvanized Coating Designation: G60.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
 3. Lockforming Quality: Sheet steel and galvanized coating is to be able to be formed with back-to-back bends in seams such as the Pittsburgh lock at high speed without cracking or flaking of the coating on the outside of the bend.
- C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
- D. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA
 - b. Armacell LLC
 - c. K-Flex USA
 2. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: **3/32-inch** diameter, with an overall open area of 23 percent.
 9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANTS AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single component, acid curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- D. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- G. Strut Support System for Ductwork - Metal, Cable Type:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. CADDY; brand of nVent Electrical plc
 - b. Gripple Inc.
 2. Source Limitations: Obtain metal cable type strut support system for ductwork from single manufacturer.
 3. Description: Factory-fabricated ductwork support system consisting of cable clamps, slotted channel brackets, wire-rope suspension components, and associated accessories for a complete ductwork suspension system. No tools required for manual assembly in the field to support ductwork routing.
 4. Components:
 - a. Brackets: Slotted steel channels furnished in pre-cut lengths to suit specific system application for Project.
 - b. Suspension Components: Hanging cables with adjustable fasteners.
 - 1) Wire Rope: High-tensile-steel wire rope, complying with ASTM A1023; lengths, diameters, and wire construction to accommodate design loads.
 - a) Foot attachment type to suit application.
 - b) End Fix Type: as required to suit application.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through computer server rooms, electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.
- O. Installation of Metal, Cable-Type Strut Support System for Ductwork: Install in accordance with manufacturer's written installation instructions.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete expansion anchors, fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Do not use powder-actuated concrete fasteners.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 ft..
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09900 "Painting".

3.7 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 5. Provide drainage and cleanup for wash-down procedures.

3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:.
 - a. Pressure Class: Positive 1-inch wg.
- C. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:.
 - a. Pressure Class: Positive or negative 1-inch wg.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
 - 1. ½" thick elastomeric duct liner shall be applied to all supply and return ducts within 10' of fan coil units. Where equipment uses supply and return plenums, plenums shall be lined and round branch runouts shall be unlined.

2. ½" thick elastomeric duct liner shall be applied to all supply and exhaust (intake) ducts within 10' of dedicated outside air units. Where equipment uses supply and return plenums, plenums shall be lined and round branch runouts shall be unlined.
3. ½" thick elastomeric duct liner shall be applied to all transfer ducts.

H. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to-Diameter Ratio: 1.5.
 - b. Round Elbows:
 - 1) Stamped or pleated for 12 inches and smaller diameters.
 - 2) Standing seam for 14 inches and larger diameter.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Phenolic-foam ducts and fittings.
- B. Related Requirements:
 - 1. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Phenolic-foam duct materials.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Duct layout indicating sizes and pressure classes.
 - 3. Elevation of top of ducts.
 - 4. Fittings.
 - 5. Reinforcement and spacing.
 - 6. Seam and joint construction.
 - 7. Equipment installation based on equipment being used on Project.
 - 8. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.3 QUALITY ASSURANCE

- A. Hanger and Support Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for steel hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum hangers and supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

2.2 PHENOLIC-FOAM DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kingspan Insulation LLC
 - 2. Therma duct
- B. Duct Panel: CFC-free phenolic-foam bonded on both sides with factory-applied, 0.001-inch- thick, aluminum foil reinforced with fiberglass scrim. For exterior applications, an added UV stable, IR reflective 1000-micron high impact resistant titanium infused vinyl is factory bonded using a full

lamination process. The lamination process shall permanently bond the vinyl clad to the outer surfaces of the phenolic foam panel to provide a zero-permeability water tight barrier and to form a structurally insulated panel (SIP) in which to form duct segments. Processes that do not employ a full lamination process are not acceptable. Self-applied adhesives such as tapes, caulks or cladding that incorporate pressure sensitive or spray adhesives are not acceptable.

1. Temperature Limits:
 - a. Maximum 185 deg F.
 - b. Minimum: Minus 4 deg F.
2. Maximum Thermal Conductivity: 0.146 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Permeability: 0.00 perm maximum when tested according to ASTM E96/E96M, Procedure A.
4. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
5. Fire/Smoke Resistance: Duct material shall comply with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL according to ASTM E84.
6. Required Markings: UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for closure materials.

C. Closure Materials:

1. V-Groove Adhesive: Silicone.
2. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by manufacturer with coding "181A-P," manufacturer's name, and a date code. Tape shall be used for indoor applications only.
 - a. Tape: Aluminum foil tape imprinted with listing information.
 - b. Minimum Tape Width: **3 inches**.
 - c. Water resistant.
 - d. Mold and mildew resistant.
3. Polymeric Sealing System:
 - a. Structural Membrane: Woven glass fiber.
 - b. Minimum Tape Width: 3 inches.
 - c. Sealant: Water based.
 - d. Color: White.
 - e. Water resistant.
 - f. Mold and mildew resistant.

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according manufacturer's written instructions.
2. Fabricate 90-degree mitered elbows to include turning vanes.

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Zinc-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables: ASTM A492, stainless-steel cables with end connections made of stainless-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install duct sections in maximum practical lengths with fewest possible joints.
- C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- F. Install ducts with a minimum clearance of 1 inch, plus allowance for insulation thickness.
- G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- I. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- J. Branch Connections: Use lateral or conical branch connections.
- K. Install phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards."

3.2 HANGER AND SUPPORT INSTALLATION

- A. Install hangers and supports for phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards" Ch. 6, "Hangers and Supports" and with manufacturer's written instructions.
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Install concrete inserts before placing concrete.
 - 2. Do not use powder-actuated concrete.
- C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 DUCT SCHEDULE

- A. Indoor Ducts and Fittings:
 - 1. Phenolic-Foam Rectangular Ducts and Fittings:
 - a. Minimum Panel Thickness: 7/8 inch.
 - b. Joints: Secure joints with adhesive or clips according to duct manufacturer's written instructions, then tape joints with aluminum vapor tape.
 - c. Sealing: All joints shall be sealed with a generous and continuous bead of silicone sealant and pressed into corners using a smooth radius tool.
- B. Outdoor Ducts and Fittings:
 - 1. Phenolic-Foam Rectangular Ducts and Fittings:

- a. Minimum Panel Thickness: 1-3/32 inches.

END OF SECTION 233116

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Remote damper operators.
 - 5. Flexible connectors.
 - 6. Duct accessory hardware.
 - 7. Flexible ducts, insulated.
 - 8. Flexible duct connectors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Construction details, material descriptions, and dimensions of individual components.
 - 2. For dampers, include housings, linkages, and operators.
 - 3. For damper operators, include electrical or pneumatic pressure rating and damper size rating.
- B. Shop Drawings: For air duct accessories.
 - 1. Plans showing locations, elevations, sections, and attachment details.
 - 2. Duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ruskin; Air Distribution Technologies, Inc.
 - b. Air Balance; MESTEK, Inc.
 - c. Aire Technologies, Inc.; DMI Companies
 - d. American Warming and Ventilating (AWV); Mestek, Inc.
 - e. Arrow United Industries; Mestek, Inc.
 - f. Cesco Products; MESTEK, Inc.
 - g. Greenheck Fan Corporation
 - h. Lloyd Industries, Inc.
 - i. McGill AirFlow LLC
 - j. Nailor Industries Inc
 - k. NCA Manufacturing, Inc.; Metal Industries, Inc.

- l. Pottorff
 - m. Safe Air - Dowco
 - n. United Enertech Corp.
 - o. Vent Products Co., Inc
 2. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1 inch wg differential static pressure.
 3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 4. Frames:
 - a. Hat-shaped, 16-gauge- thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; 16 gauge thick.
 6. Blade Axles: Nonferrous metal.
 7. Bearings: Oil-impregnated bronze.
 - a. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 8. Tie Bars and Brackets: Galvanized steel.
 9. Locking device to hold damper blades in a fixed position without vibration.
- B. Jackshaft:
1. Size: diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.2 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company
 3. DynAir; a Carlisle Company
 4. Elgen Manufacturing
 5. Ward Industries; a brand of Hart & Cooley, LLC
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

2.3 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aero-Dyne Sound Control Co.
 2. CL WARD & Family Inc.

3. Ductmate Industries, Inc; a DMI company
 4. Duro Dyne Inc.
 5. DynAir; a Carlisle Company
 6. Elgen Manufacturing
 7. Ward Industries; a brand of Hart & Cooley, LLC
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Turning Vanes: Fabricate single -wall curved blades of galvanized steel.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- D. Vane Construction:
1. Wall: Single.

2.4 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. DynAir; a Carlisle Company
 2. METALAIRE, Inc
 3. United Enertech Corp.
 4. Young Regulator Company
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.5 DUCT FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company
 3. Duro Dyne Inc.
 4. DynAir; a Carlisle Company
 5. Elgen Manufacturing
 6. Ventfabrics, Inc
 7. Ward Industries; a brand of Hart & Cooley, LLC
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials are to have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream are to comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- G. Indoor System, Duct Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.

2.6 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company
 3. Duro Dyne Inc.
 4. DynAir; a Carlisle Company
 5. Elgen Manufacturing
 6. Hardcast; Carlisle Construction Materials
 7. United Enertech Corp.
 8. Ventfabrics, Inc
 9. Ward Industries; a brand of Hart & Cooley, LLC
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.7 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 1. Galvanized Coating Designation: G60.
 2. Exposed-Surface Finish: Mill phosphatized.
- B. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.8 FLEXIBLE DUCTS, INSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ATCO Rubber Products, Inc.
 - b. Flexmaster U.S.A., Inc
 - c. JP Lamborn Co.
 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 3. Maximum Air Velocity: 4000 fpm.
 4. Temperature Range: Minus 10 to plus 160 deg F.
 5. Insulation R-Value: R4.2.
 6. Vapor-Barrier Film: Polyethylene, ASTM E96/E96M.
- C. Flexible Ducts, Insulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CASCO C.A. Schroeder, Inc.
 - b. Flexmaster U.S.A., Inc
 - c. JP Lamborn Co.
 - d. Thermaflex; a Flex-Tek Group company

2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
3. Maximum Air Velocity: 4000 fpm.
4. Temperature Range: Minus 20 to plus 175 deg F.
5. Insulation R-Value: R4.2.
6. Vapor-Barrier Film: Polyethylene, ASTM E96/E96M.

2.9 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR DUCT ACCESSORIES

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having a duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. Dampers may not be indicated on drawings but shall be provided regardless, unless specifically noted to be omitted.
 1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- F. Install flexible connectors to connect ducts to equipment.
- G. Install duct test holes where required for testing and balancing purposes.
- H. Install flexible ducts in accordance with applicable details in the following publications:
 1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
 2. NAIMA AH116.
 3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
 4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- I. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- J. Connect flexible ducts to metal ducts with draw bands, adhesive plus sheet metal screws.
- K. Installation of Flexible Ducts:
 1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
 6. Install in accordance with ADC instructions.
 7. Do not install above inaccessible ceilings.
 8. Do not install where exposed.
- L. Supporting Flexible Ducts:

1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft.. Provide sufficient support so that maximum centerline sag is 1/2 inch per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.
2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
3. Ducts may not rest on ceilings.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Operate dampers to verify full range of movement.
 2. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
 3. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diffusers - louver face.
 - 2. Diffusers - ceiling-integral plenum slot.
- B. Related Requirements:
 - 1. Section 233300 "Air Duct Accessories" for volume-control dampers not integral to diffusers.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - b. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carnes Company
 - 2. Krueger-HVAC
 - 3. Nailor Industries
 - 4. Price Industries
 - 5. Titus
- B. Source Limitations: Obtain from single source from single manufacturer.
- C. Finish: Baked enamel, white unless indicated otherwise.
- D. Mounting: Ceiling, surface, or direct. Provide accessories and frame styles required for installation at each location.
- E. See schedule on drawings.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers in accordance with ASHRAE 70.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR DIFFUSERS

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 237416.11 - PACKAGED ROOFTOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Packaged rooftop air-conditioning units.

1.2 DEFINITIONS

- A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.3 ACTION SUBMITTALS

- A. Product Data: For each RTU.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
 - 3. Include unit dimensions and weight.
 - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 - 5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include motor ratings, electrical characteristics, and motor accessories.
 - 6. Include certified coil-performance ratings with system operating conditions indicated.
 - 7. Include filters with performance characteristics.
 - 8. Include gas furnaces with performance characteristics.
 - 9. Include dampers, including housings, linkages, and operators.
- B. Shop Drawings: For each packaged rooftop air-conditioning unit.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Source quality control reports.
- C. System startup reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) of filters for each unit.
 - 2. Gaskets: One set(s) for each access door.

1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of packaged rooftop air-conditioning unit that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three year(s) from date of Substantial Completion.
 - 2. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.
- C. ASHRAE 15 Compliance: For refrigeration system safety.

2.2 CAPACITIES AND CHARACTERISTICS

- A. See schedule on drawings.

2.3 PACKAGED ROOFTOP AIR-CONDITIONING UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Daikin Applied
 - 2. Carrier Global Corporation
 - 3. Lennox
 - 4. Trane
- B. Source Limitations: Obtain packaged rooftop air-conditioning units from single manufacturer.
- C. Unit Casings:
 - 1. Unit casing shall be zinc coated, heavy gauge, galvanized steel.
 - a. Weather resistant painted metal with galvanized substrate.
 - b. Meets ASTM B117 672 hour salt spray test.
 - 2. Airstream Surfaces: Exposed vertical panels and top covers in the indoor air section insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material.
 - 3. Panels and Doors:
 - a. Doors:
 - 1) Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinges and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - 2) Gasket: Neoprene, applied around entire perimeters of panel frames.
 - 3) Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
 - 4) Locate doors to allow access to and maintenance of all components.
 - 4. Condensate Drain Pans:
 - a. Location: Each type of cooling coil.
 - b. Construction:
 - 1) Single-wall, stainless steel sheet.
 - c. Drain Connection:
 - 1) Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 2) Minimum Connection Size: 3/4".

- d. Width: Entire width of water-producing device.
- D. Fans, Drives, and Motors:
 - 1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
 - 2. Supply-Air Fans: Centrifugal, rated in accordance with AMCA 210/ASHRAE 51; galvanized or painted steel; mounted on solid-steel shaft.
 - a. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices.
 - 3. Outdoor-Air-Refrigerant Coil Fan: Propeller fan mounted on shaft of permanently lubricated direct drive motor.
- E. Coils:
 - 1. General Requirements for Coils:
 - a. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 - b. Coils are to not act as structural component of unit.
 - 2. Supply-Air Refrigerant Coil:
 - a. Tubes: Aluminum.
 - b. Fins:
 - 1) Material: Aluminum.
 - 3. Outdoor-Air Refrigerant Coil:
 - a. Tubes: Aluminium.
 - b. Fins:
 - 1) Material: Aluminum.
 - c. Fin and Tube Joints: Mechanical bond.
 - d. Coatings: Corrosion-resistant coating.
 - e. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.
 - 1) Working Pressure: Minimum **300 psig**.
 - 4. Hot-Gas Reheat Refrigerant Coil:
 - a. Tubes: Aluminum.
 - b. Fins:
 - 1) Material: Aluminum.
 - c. Fin and Tube Joints: Mechanical bond.
 - d. Suction-discharge bypass valve.
- F. Refrigerant Circuit Components:
 - 1. Number of Refrigerant Circuits: Two.
 - 2. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
 - 3. Refrigeration Specialties:
 - a. Refrigerant: R-454B.
 - b. Expansion valve with replaceable thermostatic element.
 - c. Refrigerant filter/dryer.
 - d. Manual-reset high-pressure safety switch.
 - e. Automatic-reset low-pressure safety switch.
 - f. Minimum off-time relay.
 - g. Automatic-reset compressor motor thermal overload.
 - h. Brass service valves installed in compressor suction and liquid lines.
 - i. Low-ambient kit high-pressure sensor.
 - j. Hot-gas reheat solenoid valve modulating with a replaceable magnetic coil.
- G. Air Filtration:
 - 1. Panel Filters:
 - a. Description: Pleated, factory-fabricated, self-supported, disposable air filters with holding frames.
 - b. Filter Unit Class: UL 900.

- c. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
 - d. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.
- H. Gas Furnaces:
 - 1. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
 - 2. CSA Approval: Designed and certified by and bearing label of CSA.
 - 3. Burners: Aluminized steel.
 - a. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
 - b. Gas Control Valve: Two stage.
 - c. Gas Train: Single-body, regulated, redundant, 24 V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.
 - 4. Safety Controls:
 - a. Gas Manifold: Safety switches and controls complying with ANSI standards.
- I. Dampers:
 - 1. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed -blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate must not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg rated in accordance with AMCA 500-D.
 - 2. Barometric relief dampers.
 - 3. Electronic Damper Operators:
 - a. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - b. Electronic damper position indicator to have visual scale indicating percent of travel and 2 to 10 V dc, feedback signal.
 - c. Operator Motors:
 - 1) Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 2) Permanent Split-Capacitor or Shaded-Pole Type: Gear trains are completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - d. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
- J. Electrical Power Connections:
 - 1. RTU is to have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
- K. Controls:
 - 1. Unit Controls:
 - a. Control-voltage transformer.
 - b. Wall-mounted thermostat or sensor with the following features:
 - 1) Heat-cool-off switch.
 - 2) Fan on-auto switch.
 - 3) Fan-speed switch.
 - 4) Automatic changeover.
 - 5) Adjustable deadband.
 - 6) Exposed set point.
 - 7) Exposed indication.
 - 8) Degree F indication for the following:
 - a) Space temperature.
 - b) Supply-air temperature.

- c) Outdoor-air temperature.
 - d) Space set point.
 - 9) Unoccupied-period-override push button.
- c. Duct-mounted humidistat or sensor for control of HGRH.
- L. Mounting Curbs:
 - 1. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 - 2. Curb Dimensions: Height of 14 inches.
- M. Accessories:
 - 1. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
 - 2. Remote potentiometer to adjust minimum economizer damper position.
 - 3. Return-air bypass damper.
 - 4. Factory- or field-installed, demand-controlled ventilation.
 - 5. Safeties:
 - a. Smoke detector.
 - b. Condensate overflow switch.
 - c. Phase-loss reversal protection.
 - d. High and low pressure control.
 - e. Gas furnace airflow-proving switch.
 - 6. Hail guards of galvanized steel, painted to match casing.

2.4 SOURCE QUALITY CONTROL

- A. AHRI Compliance:
 - 1. Comply with AHRI 210/240 for testing and rating energy efficiencies for 3-5 ton RTUs.
 - 2. Comply with AHRI 340/360 for testing and rating energy efficiencies for 6-25 ton RTUs.
 - 3. Comply with AHRI 270 for testing and rating sound performance for RTUs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PACKAGED AIR-CONDITIONING UNITS

- A. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to RTU, allow space for service and maintenance.
- C. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

3.4 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at horizontal unit connections.
 - 2. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

3.5 ELECTRICAL CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate is to be laminated acrylic or melamine plastic signs as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Locate nameplate where easily visible.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems, clean RTUs internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Inspect for visible damage to unit casing.
 - 3. Inspect for visible damage to furnace combustion chamber.
 - 4. Inspect for visible damage to compressor, coils, and fans.
 - 5. Inspect internal insulation.
 - 6. Verify that labels are clearly visible.
 - 7. Verify that clearances have been provided for servicing.
 - 8. Verify that controls are connected and operable.
 - 9. Verify that filters are installed.
 - 10. Clean all coils and inspect for construction debris.
 - 11. Clean furnace flue and inspect for construction debris.
 - 12. Connect and purge gas line.
 - 13. Remove packing from vibration isolators.
 - 14. Inspect operation of barometric relief dampers.
 - 15. Verify lubrication on fan and motor bearings.
 - 16. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 17. Adjust fan belts to proper alignment and tension.
 - 18. Start unit in accordance with manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
 - 19. Inspect and record performance of interlocks and protective devices; verify sequences of operation.
 - 20. Operate unit for an initial period as recommended or required by manufacturer.

21. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency:
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
22. Calibrate thermostats.
23. Adjust and inspect high-temperature limits.
24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
25. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
26. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
27. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
28. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
29. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.
30. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.9 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. RTU will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237416.11

SECTION 260001 - ELECTRICAL DEMOLITION**PART 1 - GENERAL****1.1 SUMMARY**

- A. The Work of this Section Includes:
 - 1. Demolition and removal of selected portions of electrical systems.
 - 2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; clean, repair and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 FIELD CONDITIONS

- A. Owner will not occupy portions of building immediately adjacent to selective demolition area. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials:
 - 1. It is not expected that hazardous materials will be encountered in the Work.
 - a. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. On-site sale of removed items or materials is not permitted.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
 - 1. Roof.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS (NOT APPLICABLE)**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video, measured drawings.
 - 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
 - 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

3.4 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION SCHEDULE

- A. Remove electrical systems throughout project area as required for new work.
 - 1. Restore complete operation to items not being removed as part of the Work.
 - 2. Remove all abandoned piping and associated installation.
- B. Clean and repair items that are to remain to "like-new" condition.

END OF SECTION 260001

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements generally applicable to all electrical Work on the Project, including but not limited to Work specified in Divisions 26, 27, and 28.

1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
1. 8P8C: An 8-position 8-contact modular jack.
 2. A: Ampere, unit of electrical current.
 3. AC or ac: Alternating current.
 4. AFCI: Arc-fault circuit interrupter.
 5. AGC: Automatic gain control.
 6. AIC: Ampere interrupting capacity.
 7. AL, Al, or ALUM: Aluminum.
 8. ASD: Adjustable-speed drive.
 9. ATP: Acceptance test procedure.
 10. ATS: Automatic transfer switch.
 11. A/V: Audio/visual.
 12. AWG: American wire gauge; see ASTM B258.
 13. BAS: Building automation system.
 14. BDA: Bi-directional amplifier.
 15. BIL: Basic impulse insulation level.
 16. BIM: Building information modeling.
 17. BMS: Building management system.
 18. BNC: Bayonet Neill-Concelman - type of connector.
 19. B/W: Black and white.
 20. CAD: Computer-aided design or drafting.
 21. CATV: Community antenna television.
 22. CB: Circuit breaker.
 23. CCD: Charge-coupled device.
 24. CCTV: Closed-circuit television.
 25. cd: Candela, the SI fundamental unit of luminous intensity.
 26. CO/ALR: Copper-aluminum, revised.
 27. COPS: Critical operations power system.
 28. CU or Cu: Copper.
 29. CU-AL or AL-CU: Copper-aluminum.
 30. DACR: Digital alarm communicator receiver.
 31. DACT: Digital alarm communicator transmitter.
 32. DAS: Distributed antenna system.
 33. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
 34. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
 35. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
 36. dBm: Decibel absolute power with respect to 1 mW.
 37. dBmV: Decibel absolute voltage with respect to 1 mV across identical impedance.
 38. DC or dc: Direct current.
 39. DCOA: Designated critical operations area.
 40. DDC: Direct digital control (HVAC).
 41. DGP: Data gathering panel.
 42. DHCP: Dynamic host configuration protocol.
 43. EGC: Equipment grounding conductor.

44. ELV: Extra-low voltage.
45. EMF: Electromotive force.
46. EMI: Electromagnetic interference.
47. EMP: Electrical maintenance program (operation and maintenance); electromagnetic pulse (transient analysis).
48. EPS: Emergency power supply.
49. EPSS: Emergency power supply system.
50. ERCES: Emergency responder communications enhancement system.
51. ESS: Energy storage system.
52. EV: Electric vehicle.
53. EVPE: Electric vehicle power export equipment.
54. EVSE: Electric vehicle supply equipment.
55. FACU: Fire-alarm control unit.
56. FAS: Fire-alarm system.
57. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
58. FCC: Federal Communications Commission; fire command center.
59. FLC: Full-load current.
60. ft: Foot.
61. ft-cd: Foot-candle, the antiquated U.S. standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" when the SI unit candela (cd) replaced the international candle; see "fc."
62. FTP: File transfer protocol.
63. FXO: Foreign exchange office.
64. GEC: Grounding electrode conductor.
65. GFCI: Ground-fault circuit interrupter.
66. GFPE: Ground-fault protection of equipment.
67. GND: Ground.
68. GROU: General Radiotelephone Operator License (FCC).
69. H.323: Audio and video protocol.
70. HACR: Heating, air conditioning, and refrigeration.
71. HDPE: High-density polyethylene.
72. HID: High-intensity discharge.
73. HP or hp: Horsepower.
74. HVAC: Heating, ventilating, and air conditioning.
75. Hz: Hertz.
76. I&TFAS: Inspection and testing of fire-alarm system.
77. IB-PSC: In-building public safety communications.
78. IBT: Intersystem bonding termination.
79. ICT: Information and communications technology.
80. IDC: Initiating device circuit.
81. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
82. I/O: Input/output.
83. IP: Ingress protection rating (enclosures); Internet protocol (communications).
84. IR: Infrared.
85. IS: Intrinsically safe.
86. IT&R: Inspecting, testing, and repair.
87. ITE: Information technology equipment.
88. kAIC: Kiloampere interrupting capacity.
89. kcmil or MCM: One thousand circular mils.
90. kV: Kilovolt.
91. kVA: Kilovolt-ampere.
92. kvar: Kilovolt-ampere reactive.
93. kW: Kilowatt.

94. kWh: Kilowatt-hour.
95. LAN: Local area network.
96. lb: Pound (weight).
97. lbf: Pound (force).
98. LCD: Liquid-crystal display.
99. LCDI: Leakage-current detector-interrupter.
100. LED: Light-emitting diode.
101. Li-ion: Lithium-ion.
102. lm: Lumen, the SI-derived unit of luminous flux.
103. LNG: Liquefied natural gas.
104. LP-Gas: Liquefied petroleum gas.
105. LRC: Locked-rotor current.
106. LTE: Long-term evolution (mobile device technology standard).
107. LV: Low voltage.
108. lx: Lux, the SI-derived unit of illuminance equal to one lumen per square meter.
109. m: Meter.
110. MATV: Master antenna television.
111. MCC: Motor-control center.
112. MDC: Modular data center.
113. MG set: Motor-generator set.
114. MIDI: Musical instrument digital interface.
115. MLO: Main lugs only.
116. MPEG: Moving Picture Experts Group.
117. MPEG-2: Abbreviation for the ISO/IEC Moving Picture Experts Group's standard for generic coding of moving pictures and associated audio information (ISO/IEC 13818) released in 1995 and used for most over-the-air and satellite broadcast digital television.
118. MPEG-4: Abbreviation for the ISO/IEC Moving Picture Experts Group's standard framework for coding of audio-visual objects (ISO/IEC 14496) released in 1999, with digital rights management and more advanced compression algorithms than MPEG-2.
119. MOV: Metal-oxide varistor.
120. MV: Medium voltage.
121. MVA: Megavolt-ampere.
122. mW: Milliwatt.
123. MW: Megawatt.
124. MWh: Megawatt-hour.
125. NAC: Notification appliance circuit.
126. N.C.: Normally closed.
127. NFC: Near field communications.
128. Ni-Cd: Nickel-cadmium.
129. NICET: National Institute for Certification in Engineering Technologies, a division of the National Society of Professional Engineers.
130. Ni-MH: Nickel-metal hydride.
131. NIU: Network interface unit.
132. N.O.: Normally open.
133. NPT: National (American) standard pipe taper.
134. NTSC: National Television System Committee.
135. OCPD: Overcurrent protective device.
136. ONT: Optical network terminal.
137. PC: Personal computer.
138. PCS: Power conversion system.
139. PCU: Power-conditioning unit.
140. Percent obs/ft (percent obs/m): Percent obscuration per unit distance; unit of measure for sensitivity of smoke detectors.
141. PF or pf: Power factor.
142. PHEV: Plug-in hybrid electric vehicle.
143. PIR: Passive infrared.

- 144. PLC: Programmable logic controller.
- 145. PLFA: Power-limited fire alarm.
- 146. PoE: Power over Ethernet.
- 147. POTS: Plain old telephone service. See "public switched telephone network" definition.
- 148. PSTN: Public switched telephone network.
- 149. PTZ: Pan-tilt-zoom.
- 150. PV: Photovoltaic.
- 151. PVC: Polyvinyl chloride.
- 152. pW: Picowatt.
- 153. RAID: Redundant array of inexpensive disks; redundant array of independent disks.
- 154. RAM: Random-access memory.
- 155. RAT: Radio alarm transmitter.
- 156. REX: Request-to-exit.
- 157. RF: Radio frequency.
- 158. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
- 159. RMS or rms: Root-mean-square.
- 160. RPM or rpm: Revolutions per minute.
- 161. SCADA: Supervisory control and data acquisition.
- 162. SCCR: Short-circuit current rating.
- 163. SCR: Silicon-controlled rectifier.
- 164. SIP: Session initiation protocol.
- 165. SLC: Signaling-line circuit.
- 166. SPD: Surge protective device.
- 167. SPDT: Single pole, double throw.
- 168. sq.: Square.
- 169. SWD: Switching duty.
- 170. TCP/IP: Transmission Control Protocol/Internet Protocol.
- 171. TEFC: Totally enclosed fan-cooled.
- 172. TR: Tamper resistant.
- 173. TVSS: Transient voltage surge suppressor.
- 174. UHF: Ultra-high frequency.
- 175. UL: (standards) UL Standards & Engagement Inc.; (product categories) UL, LLC.
- 176. UL CCN: UL Category Control Number.
- 177. UPS: Uninterruptible power supply.
- 178. USB: Universal serial bus.
- 179. UTC: Coordinated universal time.
- 180. UV: Ultraviolet.
- 181. V: Volt, unit of electromotive force.
- 182. V(ac): Volt, alternating current.
- 183. V(dc): Volt, direct current.
- 184. VA: Volt-ampere, unit of complex electrical power.
- 185. VAR: Volt-ampere reactive, unit of reactive electrical power.
- 186. VFC: Variable-frequency controller.
- 187. VOM: Volt-ohm-multimeter.
- 188. VoIP: Voice over Internet Protocol.
- 189. VPN: Virtual private network.
- 190. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
- 191. VU: Volume unit.
- 192. W: Watt, unit of real electrical power.
- 193. WAN: Wide area network.
- 194. Wh: Watt-hour, unit of electrical energy usage.
- 195. WPT: Wireless power transfer.
- 196. WPTE: Wireless power transfer equipment.
- 197. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERM C: Electrical rigid metal conduit.
10. ERM C-A: Aluminum electrical rigid metal conduit.
11. ERM C-S: Steel electrical rigid metal conduit.
12. ERM C-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERM C-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERM C-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).
21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERM C-S-G.
38. RMC: See ERM C.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.

9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-FPL/FPLR/FPLP: Metal-clad cable containing FPL, FPLR, or FPLP.
31. MC-HL: Metal-clad cable, hazardous location.
32. MI: Mineral-insulated, metal-sheathed cable.
33. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
34. MV: Medium-voltage cable.
35. NM: Nonmetallic sheathed cable.
36. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
37. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
38. NPLF: Non-power-limited fire-alarm circuit cable.
39. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
40. NPLFR: Non-power-limited fire-alarm circuit riser cable.
41. NUCC: Nonmetallic underground HDPE conduit with conductors.
42. OFC: Conductive optical fiber general-purpose cable.
43. OFCG: Conductive optical fiber general-purpose cable.
44. OFCP: Conductive optical fiber plenum cable.
45. OFCR: Conductive optical fiber riser cable.
46. OFN: Nonconductive optical fiber general-purpose cable.
47. OFNG: Nonconductive optical fiber general-purpose cable.
48. OFNP: Nonconductive optical fiber plenum cable.
49. OFNR: Nonconductive optical fiber riser cable.
50. P: Marine shipboard cable.
51. PLTC: Power-limited tray cable.
52. PLTC-ER: Power-limited tray cable, exposed run.
53. PV: Photovoltaic cable.
54. RHH: (high heat) Thermoset rubber, heat-resistant cable.
55. RHW: Thermoset rubber, moisture-resistant cable.
56. SA: Silicone rubber cable.
57. SE: Service-entrance cable.
58. SER: Service-entrance cable, round.
59. SEU: Service-entrance cable, flat.
60. SIS: Thermoset cable for switchboard and switchgear wiring.
61. TBS: Thermoplastic cable with outer braid.
62. TC: Tray cable.
63. TC-ER: Tray cable, exposed run.

64. TC-ER-HL: Tray cable, exposed run, hazardous location.
65. THW: Thermoplastic, heat- and moisture-resistant cable.
66. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
67. THHW: Thermoplastic, heat- and moisture-resistant cable.
68. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
69. TW: Thermoplastic, moisture-resistant cable.
70. UF: Underground feeder and branch-circuit cable.
71. USE: Underground service-entrance cable.
72. XHH: Cross-linked polyethylene, heat-resistant cable.
73. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Abbreviations for Grounding and Bonding:

1. BBC: Backbone bonding conductor, for connecting multiple TBBs serving the same floor.
2. PBB: Primary bonding busbar; located in main distribution frame room, ideally near electrical service entrance.
3. RBB: Rack bonding busbar; located in equipment cabinets and racks.
4. SBB: Secondary bonding busbar; located in intermediate distribution frame rooms.
5. TBB: Telecommunications bonding backbone, for connecting SBBs to PBB.
6. TBC: Telecommunications bonding conductor, for connecting PBB to intersystem bonding termination device or busbar at electrical service entrance.
7. TEBC: Telecommunications equipment bonding conductor, for connecting RBBs to SBBs or PBB.
8. UBC: Unit bonding conductor, for connecting individual communications equipment to RBBs or SBBs.

F. Definitions:

1. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
2. Conductive Cable: Cable containing non-current-carrying electrically conductive members such as metallic strength members and metallic vapor barriers.
3. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
4. Conduit: A structure containing one or more duct raceways.
5. Direct Buried: Installed underground without encasement in concrete or other protective material.
6. Electrical Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
7. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that is designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety of human life.
8. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cover Plate: A cover designed for protecting wiring devices installed in flush-mounted device boxes while permitting their safe operation; also called a faceplate or wallplate.
 - f. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - g. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - h. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.

- i. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - j. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - n. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - o. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - p. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
9. Jacket: A continuous nonmetallic outer covering for conductors or cables.
 10. Local Operator Console (LOC): Equipment used by authorized personnel and emergency responders to activate and operate a mass notification system (MNS).
 11. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
 12. Monitoring: Acquisition, processing, communication, and display of system and equipment status data and event and alarm signals.
 13. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.
 14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
 15. Nonsecure: Unlocked or open. (For doors and gates.)
 16. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein. Also called "single-line diagram."
 17. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
 18. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
 19. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.
 20. Protective Device: A device that senses when an abnormal current flow, abnormal voltage potential, or other abnormal electrical waveform exists and then disconnects the affected portion of the circuit from the system. Common protective devices include fuses, circuit breakers, relays, ground-fault circuit interrupters, and arc-fault circuit interrupters.
 21. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
 22. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
 23. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
 24. Secure: Closed and locked and with no unlock or open commands pending. (For doors and gates.)
 25. Sheath: A continuous metallic covering for conductors or cables.
 26. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
 27. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
 28. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.

29. Voice over Internet Protocol (VoIP): Digital telephone packet technology that uses the internet for its transmission medium.
30. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
 - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
 - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
31. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 1. Notify Architect no fewer than seven days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Architect's written permission.
 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Emergency lighting.
 - b. Elevators.
 - c. Fire-alarm systems.
- B. Interruption of Existing Fire-Alarm System: Do not interrupt fire-alarm system to facilities occupied by Owner or others unless permitted under the following conditions:
 1. Notify Architect no fewer than seven days in advance of proposed interruption of fire-alarm system.
 2. Do not proceed with interruption of fire-alarm system without Architect's written permission.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of electrical Work on the Project. Consult Architect for resolution of conflicting requirements.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-insulated wire.
 - 2. Metallic sheathed cable.
 - 3. Connectors and splices.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
 - 2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
 - 3. Section 260529 "Hangers and Supports for Electrical Systems" specifies hangers, supports, and concrete bases referenced by this Section.
 - 4. Section 260533.13 "Conduits for Electrical Systems" specifies installation of raceways referenced by this Section.
 - 5. Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling" specifies installation of sleeves and sleeve seals referenced by this Section.
 - 6. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.

1.2 ACTION SUBMITTALS

- A. Product Schedule: Indicate type, use, location, and termination locations.
- B. Product Data: For each type of product.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 THERMOPLASTIC-INSULATED WIRE

- A. Description: Thermoplastic-insulated wire for use in accordance with Article 310 of NFPA 70.
- B. UL ZLGR - Type THHN Insulated Wire:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cerro Wire LLC
 - b. Southwire Company, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Thermoplastic-Insulated Wire: UL CCN ZLGR, including UL 83.
 - 3. Standard Features:
 - a. Referenced Standard: Article 310 of NFPA 70.
 - b. Insulation Voltage Rating: 600 V.
 - c. Insulation Temperature Rating: 90 deg C.
 - d. Conductor Material: Copper.
 - e. Conductor Size: As indicated on the Drawings.

- 1) Minimum Conductor Size: 12 AWG.
- C. UL ZLGR - Type THHW Insulated Wire:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Wire; brand of Belden, Inc.
 - b. Southwire Company, LLC
 - c. Cerro Wire LLC
 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Thermoplastic-Insulated Wire: UL CCN ZLGR, including UL 83.
 3. Standard Features:
 - a. Referenced Standard: Article 310 of NFPA 70.
 - b. Insulation Voltage Rating: 600 V.
 - c. Insulation Temperature Rating: 90 deg C.
 - d. Conductor Material: Copper.
 - e. Conductor Size: As indicated on the Drawings.
 - 1) Minimum Conductor Size: 12 AWG.
- D. UL ZLGR - Type THWN Insulated Wire:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Wire; brand of Belden, Inc.
 - b. Cerro Wire LLC
 - c. Southwire Company, LLC
 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Thermoplastic-Insulated Wire: UL CCN ZLGR, including UL 83.
 3. Standard Features:
 - a. Referenced Standard: Article 310 of NFPA 70.
 - b. Insulation Voltage Rating: 600 V.
 - c. Insulation Temperature Rating: 75 deg C.
 - d. Conductor Material: Copper.
 - e. Conductor Size: As indicated on the Drawings.
 - 1) Minimum Conductor Size: 12 AWG.
- E. UL ZLGR - Type THWN-2 Insulated Wire:
1. Manufacturers: Subject to compliance with requirements, **[provide products by the following]** **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Alpha Wire; brand of Belden, Inc.
 - b. Cerro Wire LLC
 - c. Southwire Company, LLC
 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Thermoplastic-Insulated Wire: UL CCN ZLGR, including UL 83.
 3. Standard Features:
 - a. Referenced Standard: Article 310 of NFPA 70.
 - b. Insulation Voltage Rating: 600 V.
 - c. Insulation Temperature Rating: 90 deg C.
 - d. Conductor Material: Copper.
 - e. Conductor Size: As indicated on the Drawings.
 - 1) Minimum Conductor Size: 12 AWG.

2.3 METALLIC SHEATHED CABLE

- A. UL PJAZ - Metal-Clad Cable, Type MC:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Wire; brand of Belden, Inc.
 - b. Cerro Wire LLC
 - c. Southwire Company, LLC
 2. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Metal-Clad Cable: UL CCN PJAZ, including UL 1569.
 4. Standard Features:
 - a. Referenced Standard: Article 330 of NFPA 70.
 - b. Circuits: Single circuit.
 - c. Conductors: Copper, complying with ASTM B3 for bare annealed copper.
 - d. Ground Conductor: Bare.
 - e. Conductor Insulation:
 - 1) Type TFN/THHN/THWN-2. Comply with UL 83.
 - 2) Type XHHW-2. Comply with UL 44.
 - f. Armor: Steel, interlocked.

2.4 CONNECTORS AND SPLICES

- A. UL PJOX - Armored and Metal-Clad Cable Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB, Installation Products
 - b. Adalet; division of Scott Fetzer Co.
 - c. American Fittings Corp. (AMFICO)
 - d. Arlington Industries, Inc.
 - e. Bridgeport Fittings Inc.
 - f. Crouse-Hinds; brand of Eaton, Electrical Sector
 - g. Halex; division of Scott Fetzer Co.
 - h. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - i. O-Z/Gedney; brand of Appleton Group
 - j. Service Wire Co.
 - k. SIGMA Engineered Solutions
 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Type AC and Type MC Cable Connectors: UL CCN PJOX, including UL 514B.
 3. Standard Features: For steel and aluminum sheathed cables, designed to connect conductors specified in this Section.
- B. UL ZMVV - Wire Connectors and Soldering Lugs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB, Installation Products
 - b. Amphenol TPC Wire & Cable
 - c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - d. Eaton
 - e. Fastenal Co.
 - f. Gardner Bender; brand of ECM Industries LLC; division of nVent Electric plc
 - g. Hillsdale Terminal

- h. Ideal Industries, Inc.
- i. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
- j. Marinco Power Products
- k. Morris Products Inc.
- l. Newark; an Avnet Company
- m. Panduit Corp
- n. Penn-Union Corp.; subsidiary of Nesco, Inc.
- o. TE Connectivity Ltd.
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Wire Connectors and Soldering Lugs: UL CCN ZMVV, including UL 486A-486B or UL 486C.
- 3. Standard Features:
 - a. One piece, seamless, designed to terminate conductors specified in this Section.
 - b. Material: Copper.
 - c. Type: One hole with standard barrels.
 - d. Termination: Crimp.
- 4.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Material: Copper.
 - a. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - b. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Maintenance: NFPA 70B.

3. Electrical Safety: NFPA 70E.
 4. Temporary Electric Power Work: NECA NEIS 200.
 5. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 6. Work in Confined Spaces: NFPA 350.
 7. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 8. Installation of Type AC and Type MC Cables: NECA NEIS 120.
 9. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
 2. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.
 3. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 4. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
 5. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
 6. Provide support for cables.
 7. Connections:
 - a. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
 - b. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1) Utilize twist-on insulated spring connectors for conductor sizes 8 AWG and smaller. Do not use push-in wire connectors.
 - 2) Utilize mechanical connectors or compression connectors for conductor sizes 6 AWG and larger.
 8. Wiring at Outlets: Install conductor at each outlet, with at least of slack.
- D. Interfaces with Other Work:
1. Identification:
 - a. Identify and color-code conductors and cables.
 - b. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.
 2. Sleeves and Sleeve Seals: Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.
 3. Firestopping: Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.4 FIELD QUALITY CONTROL

- A. Adminstrant for Electrical Power Tests and Inspections:
1. Administer and perform tests and inspections.
- B. Tests and Inspections:
1. Perform manufacturer's recommended tests and inspections.
 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection in accordance with the single-line diagram.
 - b. Test bolted connections for high resistance using one or more of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.

- 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- C. Nonconforming Work:
- 1. Wire or cable assembly will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grounding and bonding conductors.
 - 2. Grounding and bonding clamps.
 - 3. Grounding and bonding bushings.
 - 4. Grounding and bonding hubs.
 - 5. Grounding and bonding connectors.
 - 6. Intersystem bonding bridge grounding connectors.
 - 7. Grounding and bonding busbars.
 - 8. Grounding (earthing) electrodes.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
 - 2. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
 - c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are unacceptable for submitted product.
- B. Shop Drawings: Prepare and submit the following:
 - 1. Plans showing dimensioned locations of grounding features described in "Field Quality Control for Grounding and Bonding" Article, including the following:
 - a. Grounding electrodes.
 - b. Grounding arrangements and connections for separately derived systems.
- C. Sustainable Design Submittals:
 - 1. Product data for sustainable design features for each type of product.
- D. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's published instructions.

1.4 SERVICE CONDITIONS FOR ELECTRICAL EQUIPMENT

- A. Electrical and ICT Equipment Grounding (Earthing): Do not exceed 5 Ω resistance to ground (earth).
 - 1. Contact Architect for resolution if 5 Ω specified resistance to ground (earth) is not attained after second attempt to increase effectiveness of grounding (earthing) electrode.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 GROUNDING AND BONDING CONDUCTORS

- A. Equipment Grounding Conductor:
 - 1. Standard Features: 600 V, THHN/THWN-2 or THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. ASTM - Bare Copper Grounding and Bonding Conductor:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ERICO; brand of nVent Electrical plc
 - b. Harger Lightning & Grounding; business of Harger, Inc.
 - 2. Standard Features: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3.
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.3 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.
- B. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. America Fujikura Ltd. (AFL); Fujikura Ltd.
 - c. Arlington Industries, Inc.
 - d. Cooper B-line; brand of Eaton, Electrical Sector
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector
 - f. ERICO; brand of nVent Electrical plc
 - g. Galvan Industries, Inc.; Electrical Products Division, LLC
 - h. Greaves Corp.; Essex Products Group, Inc.
 - i. Harger Lightning & Grounding; business of Harger, Inc.
 - j. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
 - k. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - l. Panduit Corp
 - m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 - 4. Standard Features:
 - a. Two pieces with zinc-plated bolts.
 - b. Clamp Material: Die-cast zinc alloy.
 - c. Listed for outdoor use.

- C. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. America Fujikura Ltd. (AFL); Fujikura Ltd.
 - c. Arlington Industries, Inc.
 - d. Cooper B-line; brand of Eaton, Electrical Sector
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector
 - f. ERICO; brand of nVent Electrical plc
 - g. Galvan Industries, Inc.; Electrical Products Division, LLC
 - h. Greaves Corp.; Essex Products Group, Inc.
 - i. Harger Lightning & Grounding; business of Harger, Inc.
 - j. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
 - k. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - l. Panduit Corp
 - m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 4. Standard Features:
 - a. Clamp Material: Tinned brass.
 - b. Listed for outdoor use.
- D. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector
 - c. ERICO; brand of nVent Electrical plc
 - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - e. Panduit Corp
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 4. Standard Features:
 - a. Clamp Material: Tinned copper.
 - b. Listed for outdoor use.
- E. UL KDER - Beam Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Anderson; brand of Hubbell Utility Solutions; Hubbell Incorporated
 - c. Panduit Corp
 - d. Penn-Union Corp.; subsidiary of Nesco, Inc.
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 - 4. Standard Features: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.
- F. UL KDER - Exothermically Welded Connection:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. ALLTEC LLC
 - c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector
 - e. ERICO; brand of nVent Electrical plc
 - f. Harger Lightning & Grounding; business of Harger, Inc.
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 - 4. Standard Features: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. UL KDER - Bonding Bushing:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Arlington Industries, Inc.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - 4. Standard Features: Threaded bushing with insulated throat.
- C. UL KDER - Grounding Bushing:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Arlington Industries, Inc.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated

2. Source Limitations: Obtain products from single manufacturer.
3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
4. Standard Features: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.5 GROUNDING AND BONDING HUBS

- A. UL KDER - Grounding and Bonding Hub:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Arlington Industries, Inc.
 - c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector
 - e. Greaves Corp.; Essex Products Group, Inc.
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - g. Penn-Union Corp.; subsidiary of Nesco, Inc.
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 4. Standard Features: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.6 GROUNDING AND BONDING CONNECTORS

- A. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 4. Standard Features: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.
- B. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Chatsworth Products, Inc.
 - c. Greaves Corp.; Essex Products Group, Inc.
 - d. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 4. Standard Features: Mechanical-type, copper rated for direct burial terminal with set screw.

- C. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Harger Lightning & Grounding; business of Harger, Inc.
 - c. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 - 4. Standard Features: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch centers for two-bolt connection to busbar.
- D. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Panduit Corp
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 - 4. Standard Features: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.
- E. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. allG Fabrication (formerly ALT)
 - c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - d. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
 - 4. Standard Features: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
 - a. Tinned copper, C and H shaped.
- F. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. allG Fabrication (formerly ALT)
 - c. ERICO; brand of nVent Electrical plc
 - d. Greaves Corp.; Essex Products Group, Inc.
 - 2. Source Limitations: Obtain products from single manufacturer.

3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
4. Standard Features: Bolts that surround cable and bond to cable under compression when nut is tightened.
 - a. Tinned copper.

2.7 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.
- B. UL KDER - Equipment Room Grounding and Bonding Busbar:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. allG Fabrication (formerly ALT)
 - b. Chatsworth Products, Inc.
 - c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated
 - d. Cooper B-line; brand of Eaton, Electrical Sector
 - e. ERICO; brand of nVent Electrical plc
 - f. Harger Lightning & Grounding; business of Harger, Inc.
 - g. Hoffman; brand of nVent Electrical plc
 - h. ILSCO; brand of ECM Industries LLC; division of nVent Electric plc
 - i. Panduit Corp
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 4. Standard Features:
 - a. Bus: Rectangular bar of annealed copper.
 - b. Mounting Stand-Off Insulators: Lexan or PVC.
 - 1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
 5. Other Available Features Required by the Project:
 - a. Dimensions: 1/4 by 4 inch in cross section; length as indicated on the Drawings.
 - b. Predrilled Hole Pattern: 9/32 inch holes spaced 1-1/8 inch apart.
 - c. Mounting Hardware: Stand-off brackets that provide 2 inch clearance to access rear of bus. Brackets and bolts must be stainless steel.

2.8 GROUNDING (EARTHING) ELECTRODES

- A. UL KDER - Rod Electrode:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. allG Fabrication (formerly ALT)
 - c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated
 - d. ERICO; brand of nVent Electrical plc
 - e. Galvan Industries, Inc.; Electrical Products Division, LLC
 - f. Harger Lightning & Grounding; business of Harger, Inc.
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

4. Standard Features: [**Copper-clad**] [**Zinc-coated**] [**Stainless**] steel[, **sectional type**]; 3/4 inch by 10 ft.
- B. UL KDER - Plate Electrode:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ALLTEC LLC
 - b. Galvan Industries, Inc.; Electrical Products Division, LLC
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 4. Standard Features: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

- A. Grounding and Bonding Conductors:
 1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
 2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
 3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
 4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
 7. Underground Grounding Conductors: Install bare tinned-copper conductor, 2/0 AWG minimum.
- B. Grounding and Bonding Connectors:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.
- C. Grounding and Bonding Busbars: Provide in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on the Drawings.

3.3 INSTALLATION OF GROUNDING AND BONDING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 2. Electrical Maintenance: NFPA 70B.

3. Electrical Safety: NFPA 70E.
4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Grounding and Bonding Conductors:
 - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
 - b. Underground Grounding Conductors:
 - 1) Bury at least 30 inch below grade.
 - 2) Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
 - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
 - g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft apart.
3. Grounding and Bonding Busbars:
 - a. Install busbar horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
 - b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.
4. Electrodes:
 - a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

- 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- 2) Use exothermic welds for below-grade connections.
- b. Concrete-Encased Electrode (Ufer Ground):
 - 1) Fabricate in accordance with NFPA 70; use minimum of 20 ft of bare copper conductor not smaller than 4 AWG.
 - a) If concrete foundation is less than 20 ft long, coil excess conductor within base of foundation.
 - b) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
5. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.
6. Grounding Separately Derived Systems:
 - a. Permanent Generators: Install grounding electrode(s) at location of permanent generators having switched neutral connections. Electrode must be connected to equipment grounding conductor and to frame of generator.
7. Equipment Grounding and Bonding:
 - a. Install insulated equipment grounding conductors with feeders and branch circuits.
 - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor and appliance branch circuits.
 - 5) Three-phase motor and appliance branch circuits.
 - 6) Flexible raceway runs.
 - 7) Armored and metal-clad cable runs.
 - 8) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
 - d. Water Heater: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
 - e. Poles Supporting Outdoor Lighting Fixtures: Bond insulated equipment grounding conductor to equipment grounding terminal inside pole base.

3.4 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

- A. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- B. Nonconforming Work:
 - 1. Grounding system will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective components and retest.
- C. Collect, assemble, and submit test and inspection reports.

3.5 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Support systems.
 - 2. Mounting, anchoring, and attachment components.
 - 3. Installation of fabricated metal supports.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT SYSTEMS

- A. Steel Slotted Support Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Allied Tube & Conduit; Atkore International
 - c. Atkore Unistrut
 - d. CADDY; brand of nVent Electrical plc
 - e. Cooper B-line; brand of Eaton, Electrical Sector
 - f. Flex-Strut Inc.
 - g. G-Strut
 - h. Gripple Inc.
 - i. Haydon Corporation

- j. Metal Ties Innovation
- k. MIRO Industries Inc.
- l. Rocket Rack; Robroy Industries
- m. Wesanco/ZSi-Foster; an Ideal Tridon Group Company
- 2. Standard Features: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
 - a. Referenced Standard: MFMA-4 factory-fabricated components for field assembly.
 - b. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - c. Channel Width: Selected for applicable load criteria.
 - d. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - e. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - f. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- B. Aluminum Slotted Support Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Atkore Unistrut
 - c. Eaton
 - d. Flex-Strut Inc.
 - e. Haydon Corporation
 - f. MKT Metal Manufacturing
 - 2. Standard Features: Extruded-aluminum channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
 - a. Referenced Standard: MFMA-4 factory-fabricated components for field assembly.
 - b. Channel Material: 6063-T5 aluminum alloy.
 - c. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - d. Channel Width: Selected for applicable load criteria.
 - e. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - f. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- C. Conduit and Cable Support Devices:
 - 1. Standard Features: hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit:
 - 1. Standard Features: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints:
 - 1. Standard Features: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

2.3 MOUNTING, ANCHORING, AND ATTACHMENT COMPONENTS

- A. Mechanical-Expansion Anchors:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC

2. Standard Features: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
- B. Clamps for Attachment to Steel Structural Elements:
 1. Standard Features: MSS SP-58 units are suitable for attached structural element.
- C. Through Bolts:
 1. Standard Features: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
- D. Toggle Bolts:
 1. Standard Features: All steel springhead type.
- E. Hanger Rods:
 1. Standard Features: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION OF HANGERS AND SUPPORTS

- A. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as scheduled in NECA NEIS 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size must be 1/4 inch in diameter.
- B. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 2. Hot Work: NFPA 51B.
 3. Work in Confined Spaces: NFPA 350.
 4. Installation of Steel Conduit: NECA NEIS 101.
 5. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 1. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.
 2. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
 3. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - a. To Wood: Fasten with lag screws or through bolts.
 - b. To New Concrete: Bolt to concrete inserts.
 - c. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

- d. To Existing Concrete: Expansion anchor fasteners.
 - e. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - f. To Light Steel: Sheet metal screws.
 - g. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
 - 4. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.
- D. Interfaces with Other Work:
- 1. Provide vibration controls with hangers and supports.
 - 2. Touchup Finishes:
 - a. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1) Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
 - b. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
 - c. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.
 - 3. Installation of Fabricated Metal Supports:
 - a. Provide site-fabricated metal supports.
 - b. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
 - c. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Type EMT duct raceways and elbows.
 - 2. Type ERMC duct raceways, elbows, couplings, and nipples.
 - 3. Type FMC duct raceways.
 - 4. Type IMC duct raceways.
 - 5. Type LFMC duct raceways.
 - 6. Type PVC duct raceways and fittings.
 - 7. Fittings for conduit, tubing, and cable.
 - 8. Joint compounds.
 - 9. Solvent cements.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
 - 2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
 - 3. Section 260529 "Hangers and Supports for Electrical Systems" specifies conduit hangers and supports referenced by this Section.
 - 4. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels.

1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Raceway Types:
 - 1. EMT: Electrical metallic tubing.
 - 2. EMT-A: Aluminum electrical metallic tubing.
 - 3. EMT-S: Steel electrical metallic tubing.
 - 4. EMT-SS: Stainless steel electrical metallic tubing.
 - 5. ERMC: Electrical rigid metal conduit.
 - 6. ERMC-A: Aluminum electrical rigid metal conduit.
 - 7. ERMC-S: Steel electrical rigid metal conduit.
 - 8. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
 - 9. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
 - 10. ERMC-SS: Stainless steel electrical rigid metal conduit.
 - 11. FMC: Flexible metal conduit.
 - 12. FMC-A: Aluminum flexible metal conduit.
 - 13. FMC-S: Steel flexible metal conduit.
 - 14. IMC: Steel electrical intermediate metal conduit.
 - 15. LFMC: Liquidtight flexible metal conduit.
 - 16. LFMC-A: Aluminum liquidtight flexible metal conduit.
 - 17. LFMC-S: Steel liquidtight flexible metal conduit.
 - 18. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
 - 19. LFNC: Liquidtight flexible nonmetallic conduit.
 - 20. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
 - 21. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
 - 22. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
 - 23. PVC: Rigid PVC conduit.
 - 24. PVC-40: Schedule 40 rigid PVC conduit.
 - 25. PVC-80: Schedule 80 rigid PVC Conduit.
 - 26. PVC-A: Type A rigid PVC concrete-encased conduit.

- 27. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
- 28. RGS: See ERM-C-S-G.
- 29. RMC: See ERM-C.

B. Definitions:

- 1. Conduit: A structure containing one or more duct raceways.
- 2. Direct Buried: Installed underground without encasement in concrete or other protective material.
- 3. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.
- 4. Duct Raceway: A single enclosed raceway for conductors or cable.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's published instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Unless indicated otherwise on drawings, minimum conduit sizes shall be as listed for each conduit type.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

- A. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit; Atkore International
 - b. Calconduit; Atkore International
 - c. Emerson Electric Co., Automation Solutions
 - d. Picoma; Zekelman Industries
 - e. Republic Conduit; Nucor Corporation, Nucor Tubular Products
 - f. Topaz Lighting & Electric
 - g. Western Tube; Zekelman Industries
 - h. Wheatland Tube; Zekelman Industries
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FJMX; including UL 797.
 - 3. Standard Features:
 - a. Material: Steel.
 - b. Exterior Coating: Zinc.
 - c. Interior Coating: Zinc.
 - d. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE ERM-C DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

- A. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERM-C-S-G), Elbows, Couplings, and Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit; Atkore International
 - b. Calconduit; Atkore International

- c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. Patriot Aluminum Products, LLC
 - f. Republic Conduit; Nucor Corporation, Nucor Tubular Products
 - g. Rymco USA brand; manufactured and listed by subsidiary Conduit S.A. de C.V
 - h. Topaz Lighting & Electric
 - i. Western Tube; Zekelman Industries
 - j. Wheatland Tube; Zekelman Industries
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DYIX; including UL 6.
 - 3. Standard Features:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc.
 - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
- B. UL DYIX - PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Bluesteel Services LLC
 - c. Calbond; Atkore International
 - d. KorKap; Robroy Industries
 - e. Perma-Cote; Robroy Industries
 - f. Plasti-Bond; Robroy Industries
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DYIX; including UL 6.
 - 3. Standard Features:
 - a. Exterior Coating: PVC complying with NEMA RN 1.
 - b. Interior Coating: Zinc.
 - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE FMC DUCT RACEWAYS

- A. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Anaconda Sealtite; Anamet Electrical, Inc
 - c. Electri-Flex Company
 - d. International Metal Hose Co.
 - e. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway
 - f. Topaz Lighting & Electric
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DXUZ; including UL 1.
 - 3. Standard Features:
 - a. Material: Steel.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.5 TYPE IMC DUCT RACEWAYS

- A. UL DYBY - Steel Intermediate Metal Conduit (IMC):
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Allied Tube & Conduit; Atkore International
 - c. Calconduit; Atkore International
 - d. Republic Conduit; Nucor Corporation, Nucor Tubular Products
 - e. Rymco USA brand; manufactured and listed by subsidiary Conduit S.A. de C.V
 - f. Topaz Lighting & Electric
 - g. Western Tube; Zekelman Industries
 - h. Wheatland Tube; Zekelman Industries
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DYBY; including UL 1242.
 - 3. Standard Features:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc.
 - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.6 TYPE LFMC DUCT RACEWAYS

- A. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Anaconda Sealite; Anamet Electrical, Inc
 - c. Electri-Flex Company
 - d. International Metal Hose Co
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DXHR; including UL 360.
 - 3. Standard Features:
 - a. Material: Steel.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.7 TYPE PVC DUCT RACEWAYS AND FITTINGS

- A. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Calconduit; Atkore International
 - c. JM Eagle
 - d. NAPCO; Westlake Chemical Corp.
 - e. National Pipe and Plastic, Inc. (Oldcastle)
 - f. Opti-Com Manufacturing Network, Inc (OMNI)
 - g. Topaz Lighting & Electric
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DZYR; including UL 651.
 - 3. Standard Features:
 - a. Dimensional Specifications: Schedule 40.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

- c. Markings: For use with maximum 90 deg C wire.
- B. UL DZYR - Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Calconduit; Atkore International
 - c. JM Eagle
 - d. National Pipe and Plastic, Inc. (Oldcastle)
 - e. Opti-Com Manufacturing Network, Inc (OMNI)
 - f. Topaz Lighting & Electric
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DZYR; including UL 651.
 - 3. Standard Features:
 - a. Dimensional Specifications: Schedule 80.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - c. Markings: For use with maximum 90 deg C wire.
- C. UL DZYR - Type A Rigid PVC Concrete-Encased Conduit (PVC-A) and Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Southern Pipe, Inc.
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DZYR; including UL 651.
 - 3. Standard Features:
 - a. Dimensional Specifications: Type A.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
- D. UL DZYR - Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. JM Eagle
 - b. Southern Pipe, Inc.
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DZYR; including UL 651.
 - 3. Standard Features:
 - a. Dimensional Specifications: Type EB.
 - b. Minimum Trade Size: Metric designator 53 (trade size 2).

2.8 FITTINGS FOR CONDUIT, TUBING, AND CABLE

- A. UL DWTT - Fittings for Type ERM, Type IMC, and Type PVC Duct Raceways:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. Konkore Fittings; Atkore International
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated

- h. Southwire Company, LLC
 - i. Topaz Lighting & Electric
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DWTT; including UL 514B.
 - 3. Standard Features:
 - a. Type ERM and IMC
 - 1) Material: Steel.
 - 2) Coupling Method: Use threaded fittings only.
 - b. Type PVC
 - 1) Material: PVC
- B. UL FKAV - Fittings for Type EMT Duct Raceways:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Allied Tube & Conduit; Atkore International
 - c. Appleton; Emerson Electric Co., Automation Solutions
 - d. Calconduit; Atkore International
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. Southwire Company, LLC
 - i. Topaz Lighting & Electric
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FKAV; including UL 514B.
 - 3. Standard Features:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling or setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- C. UL ILNR - Fittings for Type FMC Duct Raceways:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Fittings Corp. (AMFICO)
 - b. Liquid Tight Connector Co.
 - c. Southwire Company, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN ILNR; including UL 514B.
- D. UL DXAS - Fittings for Type LFMC Duct Raceways:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arlington Industries, Inc.
 - b. Liquid Tight Connector Co.
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DXAS; including UL 514B.

2.9 JOINT COMPOUNDS

- A. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FOIZ; including UL Subject 2419.

2.10 SOLVENT CEMENTS

- A. UL VBEW - Solvent Cements for Nonmetallic Duct Raceways and Fittings:
 - 1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Solvent Cements: UL CCN VBEW; including UL 340.
 - b. Solvent Cement Compatibility with PVC Conduit Fittings: UL CCN DWTT; including UL 514B. Follow solvent manufacturer's published instructions.
 - c. Solvent Cement Compatibility with Rigid PVC Conduit: UL CCN DZYR; including UL 651. Follow solvent manufacturer's published instructions.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturer's published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 - 1. Exposed and Subject to Severe Physical Damage: ERM C.
 - 2. Exposed and Subject to Physical Damage: ERM C or IM C.
 - 3. Exposed and Not Subject to Physical Damage: ERM C, IM C, or PVC-80.
 - 4. Concealed Aboveground: ERM C, IM C, EMT, PVC-80, or PVC-40.
 - 5. Direct Buried: PVC-80.
 - 6. Concrete Encased: PVC-80 or PVC-40.
 - 7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- C. Indoors:
 - 1. Exposed and Subject to Severe Physical Damage: ERM C.
 - 2. Exposed and Subject to Physical Damage: ERM C or IM C.
 - 3. Exposed and Not Subject to Physical Damage: ERM C, IM C, or .
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Damp or Wet Locations: Corrosion-resistant EMT.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 - 1. ERM C and IM C: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.

2. Electrical Safety: NFPA 70E.
 3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
 4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 5. Communications Work: BICSI N1.
 6. Life Safety and Means of Egress Work: NFPA 101.
 7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
 8. Work in Confined Spaces: NFPA 350.
 9. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 10. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
 11. Type ERM-C-S: Article 344 of NFPA 70 and NECA NEIS 101.
 12. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
 13. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
 14. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
 15. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
 16. Expansion Fittings: NEMA FB 2.40.
 17. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. General Requirements for Installation of Duct Raceways:
 - a. Complete duct raceway installation before starting conductor installation.
 - b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
 - c. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
 - d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - f. Support conduit within 12 inch of enclosures to which attached.
 - g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
 - h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
 - 1) Where an underground service duct raceway enters a building or structure.
 - 2) Conduit extending from interior to exterior of building.
 - 3) Where otherwise required by NFPA 70.
 - i. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
 - j. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - k. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - l. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.
 - m. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger

- conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
2. Types ERM and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
 3. Type ERM-S-PVC:
 - a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
 - b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERM-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERM-S-PVC duct raceway.
 - c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
 4. Types FMC, LFMC:
 - a. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 5. Type PVC:
 - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's published instructions for solvent welding and fittings.
 - c. Join joints with solvent cement in accordance with manufacturer's published instructions and allowed to cure before handling. Joints to be bent, pushed, or pulled must set for minimum 24 h after joining.
 6. Duct Raceways Embedded in Slabs:
 - a. .
 - b. Do not embed conduit in concrete slabs. Route raceways below slabs.
 - c. Change from PVC to ERM or IMC before rising above floor.
 7. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT, IMC, or ERM for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 8. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
 9. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. ERM-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - b. EMT: Provide setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 - c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
 10. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty.
 11. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
- D. Interfaces with Other Work:
1. Firestop penetrations of fire-rated floor and wall assemblies.
 2. Provide conduit hangers and supports.

3.3 FIELD QUALITY CONTROL OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Tests and Inspections:
 - 1. Perform manufacturer's recommended tests and inspections.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
 - 3. Conduit Placement:
 - a. Verify that center-line location and offsets are in accordance with the Drawings.
 - b. Verify that hangers and supports for conduits are attached to structure.
 - c. Verify that nuts on bolts or hanger rods are secure.
 - d. Verify that space between raceways and cored holes are filled with non-shrinking grout or other approved material indicated on the Drawings and the Specifications.
 - e. Verify that expansion devices are installed at locations indicated on the Drawings and the Specifications.
 - f. Verify that ends are cut square to provide flush-butting surfaces when spliced and inside edges are free of burrs that could impede installation of cables.
 - g. Verify minimum separation of utilities, or that approved mechanical protection has been provided to surrounding conduit(s) where minimum separation cannot be achieved.
- B. Nonconforming Work:
 - 1. Conduit will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLEANING

- A. Verify that bentonite or other drilling fluids are contained and removed, and site is restored to its original or improved condition.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metallic outlet boxes, device boxes, rings, and covers.
 - 2. Junction boxes and pull boxes.
 - 3. Cover plates for device boxes.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
 - 2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
 - 3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 DEFINITIONS

- A. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - 1. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - 2. Concrete Box: A box intended for use in poured concrete.
 - 3. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - 4. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - 5. Cover Plate: A cover designed for protecting wiring devices installed in flush-mounted device boxes while permitting their safe operation; also called a faceplate or wallplate.
 - 6. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - 7. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - 8. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - 9. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - 10. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - 11. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - 12. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - 13. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - 14. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
- B. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.

- C. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of product requiring samples for source quality control.
- C. Shop Drawings: Prepare and submit the following:
 - 1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. .

2.2 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. UL QCIT - Metallic Outlet Boxes and Covers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Arlington Industries, Inc.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - f. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. MonoSystems, Inc
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - i. Pass & Seymour; Legrand North America, LLC
 - j. Patriot Aluminum Products, LLC
 - k. Plasti-Bond; Robroy Industries
 - l. Racor Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - m. Spring City Electrical Manufacturing Company
 - n. Topaz Lighting & Electric
 - o. Wiremold; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 3. Standard Features:
 - a. Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel or cast metal.
 - c. Sheet Metal Depth: Minimum 2 inch.
 - d. Cast-Metal Depth: Minimum 2.4 inch.
 - 4. Other Available Features Required by the Project:
 - a. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

B. UL QCIT - Metallic Conduit Bodies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Pass & Seymour; Legrand North America, LLC
 - g. Patriot Aluminum Products, LLC
 - h. Plasti-Bond; Robroy Industries
 - i. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - j. Topaz Lighting & Electric
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
3. Standard Features: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

C. UL QCIT - Metallic Device Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Arlington Industries, Inc.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector
 - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - i. Patriot Aluminum Products, LLC
 - j. Plasti-Bond; Robroy Industries
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - l. Topaz Lighting & Electric
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
3. Standard Features:
 - a. Box with provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel.
 - c. Sheet Metal Depth: minimum 2 inch.
 - d. Cast-Metal Depth: minimum 2.4 inch.

D. UL QCIT - Metallic Extension Rings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Cooper B-line; brand of Eaton, Electrical Sector
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group

- g. Pass & Seymour; Legrand North America, LLC
 - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - i. Topaz Lighting & Electric
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 3. Standard Features: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
- E. UL QCIT - Metallic Floor Boxes and Floor Box Covers:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. AFC Cable Systems; Atkore International
 - c. Arlington Industries, Inc.
 - d. Eaton, Wiring Devices; Arrow Hart
 - e. FSR Inc.
 - f. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. Leviton Manufacturing Co., Inc.
 - i. Pass & Seymour; Legrand North America, LLC
 - j. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - k. Wiremold; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 3. Standard Features: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
- F. UL QCIT - Metallic Concrete Boxes and Covers:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector
 - c. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. Topaz Lighting & Electric
 - f. Wiremold; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
 - 3. Standard Features: Box intended for use in poured concrete.

2.3 JUNCTION BOXES AND PULL BOXES

- A. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adalet; division of Scott Fetzer Co.
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Cooper B-line; brand of Eaton, Electrical Sector
 - d. FSR Inc.
 - e. Hoffman; brand of nVent Electrical plc

- f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. Milbank Manufacturing Company
 - i. N J Sullivan Company
 - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - l. Spring City Electrical Manufacturing Company
 - m. Square D; Schneider Electric USA
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
 - 3. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
- B. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adalet; division of Scott Fetzer Co.
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
 - 3. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
- C. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adalet; division of Scott Fetzer Co.
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Cooper B-line; brand of Eaton, Electrical Sector
 - d. FSR Inc.
 - e. Hoffman; brand of nVent Electrical plc
 - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. Milbank Manufacturing Company
 - i. N J Sullivan Company
 - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - l. Spring City Electrical Manufacturing Company
 - m. Square D; Schneider Electric USA
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
 - 3. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

- D. UL BGUZ - Outdoor Cast-Metal Junction and Pull Boxes:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adalet; division of Scott Fetzer Co.
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN BGUZ; including UL 50 and UL 50E.
 - 3. Standard Features:
 - a. Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4X.
 - 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 - 1. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
 - 4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 - 5. Life Safety and Means of Egress Work: NFPA 101.
 - 6. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
 - 7. Work in Confined Spaces: NFPA 350.
 - 8. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 - 9. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
 - 10. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
 - 2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
 - 3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a

raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 5. Locate boxes so that cover or plate will not span different building finishes.
 6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
 7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
 8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
 9. Set metal floor boxes level and flush with finished floor surface.
 10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
 11. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
 12. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for cover plates and covers.
- D. Interfaces with Other Work:
1. Identification: Provide labels for boxes and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Label each enclosure with engraved metal or laminated-plastic nameplate.
 - c. Provide warning signs and arc-flash hazard warning labels for electrical equipment.

3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing cover plates, covers, and hoods.

3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Round sleeves.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Pourable sealants.
 - 6. Foam sealants.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Steel Wall Sleeves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, LLC
 - b. CCI Piping Systems
 - c. Flexicraft Industries
 - d. GPT; a division of EnPRO Industries
 - e. Specified Technologies Inc.
 - 2. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Cast-Iron Wall Sleeves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company
 - b. Flexicraft Industries
 - c. McWane Ductile; a part of the McWane family of companies
 - 2. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, LLC
 - 2. American Polywater Corporation
 - 3. BWM Company
 - 4. CALPICO, Inc.
 - 5. Flexicraft Industries
 - 6. GPT; a division of EnPRO Industries
 - 7. Metraflex Company (The)
 - 8. Proco Products, Inc

9. Roptec Inc.
- B. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- C. Options:
 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Stainless steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Holdrite; a division of Reliance Worldwide Corporation
- B. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000 psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Carlisle Syntec Systems
 2. GAF
 3. Johns Manville; a Berkshire Hathaway company
 4. Specified Technologies Inc.
- B. Performance Criteria:
 1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.6 FOAM SEALANTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Innovative Chemical Products (Building Solutions Group)
 2. The Dow Chemical Company
- B. Performance Criteria:
 1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07900 "Joint Sealers."
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- D. Underground, Exterior-Wall and Floor Penetrations:
 - 1. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Labels.
 - 2. Extruded insulating tubing.
 - 3. Bands.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 LABELS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN PGDQ2 for components; including UL 969.
- B. UL PGDQ2 - Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Champion America
 - c. emedco
 - d. Grafoplast Wire Markers
 - e. HellermannTyton
 - f. LEM Products Inc.
 - g. Marking Services Inc.
 - h. Panduit Corp
 - i. Seton Identification Products; a Brady Corporation company
- C. UL PGDQ2 - Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, flexible label with acrylic pressure-sensitive adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A'n D Cable Products

- b. Brady Corporation
 - c. Brother International Corporation
 - d. emedco
 - e. Grafoplast Wire Markers
 - f. Ideal Industries, Inc.
 - g. LEM Products Inc.
 - h. Marking Services Inc.
 - i. Panduit Corp
 - j. Seton Identification Products; a Brady Corporation company
 - 2. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
 - 3. Marker for Labels:
 - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. UL PGDQ2 - Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A'n D Cable Products
 - b. Brady Corporation
 - c. Brother International Corporation
 - d. emedco
 - e. Grafoplast Wire Markers
 - f. HellermannTyton
 - g. Ideal Industries, Inc.
 - h. LEM Products Inc.
 - i. Marking Services Inc.
 - j. Panduit Corp
 - k. Seton Identification Products; a Brady Corporation company
 - 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inch for raceway and conductors.
 - b. 3-1/2 by 5 inch for equipment.
 - c. As required by authorities having jurisdiction.

2.2 EXTRUDED INSULATING TUBING

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN YDPU2 for components; including UL 224.
- B. UL YDPU2 - Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Panduit Corp

2.3 BANDS

- A. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. HellermannTyton

- c. Marking Services Inc.
 - d. Panduit Corp
 - e. Seton Identification Products; a Brady Corporation company
- B. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. HellermannTyton
 - c. Marking Services Inc.
 - d. Panduit Corp

2.4 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America
 - d. HellermannTyton
 - e. Ideal Industries, Inc.
 - f. Marking Services Inc.
 - g. Panduit Corp
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. emedco
 - d. Marking Services Inc.
- C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. HellermannTyton
 - b. LEM Products Inc.
 - c. Marking Services Inc.
 - d. Pipemarker.com; Brimar Industries, Inc.
 - e. Seton Identification Products; a Brady Corporation company
- D. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Seton Identification Products; a Brady Corporation company
- E. Underground-Line Warning Tape:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation

- b. Ideal Industries, Inc.
 - c. LEM Products Inc.
 - d. Marking Services Inc.
 - e. Pipemarket.com; Brimar Industries, Inc.
 - f. Reef Industries, Inc.
 - g. Seton Identification Products; a Brady Corporation company
2. Tape:
- a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape must be permanent and may not be damaged by burial operations.
 - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
- a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
 - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
4. Nonconducting Line-Warning Tape :
- a. Pigmented polyolefin, bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch.
 - c. Thickness: 4 mil.
 - d. Weight: 18.5 lb/1000 sq. ft.
 - e. Tensile in accordance with ASTM D882: 30 lbf and 2500 psi.
5. Reinforced Nonconducting Line-Warning Tape :
- a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch.
 - c. Thickness: 12 mil.
 - d. Weight: 36.1 lb/1000 sq. ft.
 - e. Tensile in accordance with ASTM D882: 400 lbf and 11,500 psi.
6. Detectable Line-Warning Tape :
- a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch.
 - c. Overall Thickness: 5 mil.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 28 lb/1000 sq. ft.
 - f. Tensile in accordance with ASTM D882: 70 lbf and 4600 psi.
7. Reinforced Detectable Line-Warning Tape :
- a. Reinforced, detectable three-layer laminate, consisting of printed pigmented woven scrim, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright-colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch.
 - c. Overall Thickness: 8 mil.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 34 lb/1000 sq. ft.
 - f. Tensile in accordance with ASTM D882: 300 lbf and 12,500 psi.

2.5 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Brady Corporation
 - b. Carlton Industries, LP
 - c. emedco
 - d. Marking Services Inc.
 - e. Seton Identification Products; a Brady Corporation company
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. emedco
 - d. Grafoplast Wire Markers
 - e. LEM Products Inc.
 - f. Marking Services Inc.
 - g. Panduit Corp
 - h. Seton Identification Products; a Brady Corporation company

2.6 SIGNS

- A. Baked-Enamel Signs:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. Champion America
 - d. emedco
 - e. Marking Services Inc.
 - 2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 3. 1/4 inch grommets in corners for mounting.
 - 4. Nominal Size: 7 by 10 inch.
- B. Metal-Backed Butyrate Signs:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Champion America
 - c. emedco
 - d. Marking Services Inc.
 - 2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 3. 1/4 inch grommets in corners for mounting.
 - 4. Nominal Size: 10 by 14 inch.
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation
 - b. Carlton Industries, LP
 - c. emedco
 - d. Marking Services Inc.
 - e. Seton Identification Products; a Brady Corporation company
 - 2. Engraved legend.
 - 3. Thickness:
 - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.

- b. For signs larger than 20 sq. inch, 1/8 inch thick.
- c. Engraved legend with black letters on white face.
- d. Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

- A. Comply with 29 CFR 1910.144 for color identification of hazards, and the following:
 - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - 1. Color must be factory applied or field applied for sizes larger than 6 AWG when permitted by authorities having jurisdiction.
 - 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral (Grounded Conductor): White.
 - 5. Color for Equipment Ground: Bare copper or Green.
- C. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- D. Locations of Underground Lines: Underground-line warning tape for power and lighting.
- E. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
 - 2. Identify system voltage with black letters on orange field.
- F. Cover Plates: Label inside of individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:
 - 1. Panelboard designation.
 - 2. Colon or dash.
 - 3. Branch circuit number.
- G. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Equipment Identification Labels:
 - 1. Black letters on white field.

2. Indoor Equipment: Self-adhesive label.
3. Outdoor Equipment: Laminated acrylic or melamine sign.
4. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Enclosed switches.
 - e. Enclosed circuit breakers.
 - f. Power-transfer equipment.

3.3 SELECTION OF SIGNS AND HAZARD MARKINGS

- A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.
- B. Signs, labels, and tags required for personnel safety must comply with the following standards:
 1. Safety Colors: NEMA Z535.1.
 2. Facility Safety Signs: NEMA Z535.2.
 3. Safety Symbols: NEMA Z535.3.
 4. Product Safety Signs and Labels: NEMA Z535.4.
 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- C. Electrical Hazard Warnings:
 1. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. OSHA Workspace Clearance Warning Legend: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 1. Apply to exterior of door, cover, or other access.

3.4 INSTALLATION

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- C. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.
- D. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- E. Install identifying devices before installing acoustical ceilings and similar concealment.
- F. Verify identity of item before installing identification products.
- G. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- H. Apply identification devices to surfaces that require finish after completing finish work.
- I. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- K. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- L. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- T. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch directly above cables or raceways buried 18 inch or more below grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- V. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- W. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION 260553

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - b. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Field Quality-Control Submittals:
 - 1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
 - 1. Transformer temporary heating, working clearances, anchoring, torque values, and insulation-resistance testing.
- B. Source quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note shipping damage to packaging and transformer.
 - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Siemens Industry, Inc., Energy Management Division
 - 3. Square D; Schneider Electric USA
- B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60 Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

2.3 IDENTIFICATION

- A. Nameplates:
 - 1. Self-adhesive label for distribution transformers. Self-adhesive labels are specified in Section 260553 "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests and Inspections: Test and inspect assembled system, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with IEEE C57.12.01 and IEEE C57.12.91 before delivering to site. Affix label with name and date of manufacturer's certification of system compliance on control units.
 - 1. Resistance measurements of windings at rated voltage connections and at tap connections.
 - 2. Ratio tests at rated voltage connections and at tap connections.
 - 3. Phase relation and polarity tests at rated voltage connections.
 - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
 - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
 - 6. Applied and induced tensile tests.
 - 7. Regulation and efficiency at rated load and voltage.
 - 8. Insulation-Resistance Tests:
 - a. Line-side to ground.
 - b. Load-side to ground.
 - c. Line-side to load-side.
 - 9. Temperature tests.
- B. Nonconforming Work:
 - 1. System equipment that does not pass tests and inspections will be considered defective.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at location of transformer.
- E. Environment: Enclosures must be rated for environment in which they are located. Covers for UL 50E, Type 4X enclosures may not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Construct concrete bases and anchor floor-mounted transformers in accordance with manufacturer's published instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Secure transformer to concrete base in accordance with manufacturer's published instructions.
- C. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.
- D. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Small (Up to 167 kVA Single-Phase or 500 kVA Three-Phase) Dry-Type Transformer Field Tests:
 - a. Visual and Mechanical Inspection.
 - 1) Inspect physical and mechanical condition.
 - 2) Inspect anchorage, alignment, and grounding.
 - 3) Verify that resilient mounts are free and that shipping brackets have been removed.
 - 4) Verify that unit is clean.
 - 5) Perform specific inspections and mechanical tests recommended by manufacturer.
 - 6) Verify that as-left tap connections are as specified.

- 7) Verify presence of surge arresters and that their ratings are as specified.
- b. Electrical Tests:
 - 1) Measure resistance at windings, taps, and bolted connections.
 - 2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.
 - 3) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
 - 4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- B. Nonconforming Work:
 1. Transformer will be considered defective if it does not pass tests and inspections.
 2. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Assemble and submit test and inspection reports.

3.5 ADJUSTING

- A. Record transformer secondary voltage at unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 MAINTENANCE

- A. Infrared Scanning: Two months after Substantial Completion, perform infrared scan of transformer connections.
 1. Use infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 2. Perform two follow-up infrared scans of transformers, one at four months and another at 11 months after Substantial Completion.
 3. Prepare certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262213

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Panelboards.
 - 2. Disconnecting and overcurrent protective devices.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other requirements applicable to the Work for electrical, communications, and electronic safety and security systems on Project, including wiring methods.
 - 2. Section 260529 "Hangers and Supports for Electrical Systems" specifies concrete bases and supports for panelboards installed by this Section.
 - 3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product submit the following:
 - 1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
- B. Shop Drawings: For each panelboard and related equipment:
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.
 - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
 - 7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
 - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 9. Include wiring diagrams for power, signal, and control wiring.
- C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- B. Manufacturer's published instructions.
- C. Field Reports:
 - 1. Manufacturer's field reports for field quality-control support.
 - 2. Field reports for voltage monitoring and adjusting.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Special tools.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards
- B. Handle and prepare panelboards for installation in accordance with NECA 407.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Comply with NEMA PB 1.
- D. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
 - 2. Height: 7 ft maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
 - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 7. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
- E. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - a. Plating must run entire length of bus.
 - b. Bus must be fully rated for entire length.
 - 2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Terminations must allow use of 75 deg C rated conductors without derating.
 - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 - 4. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
 - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.

- G. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- H. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating:
 - 1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.
 - a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
 - b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2.2 PANELBOARDS

- A. UL QEUY - Distribution Panelboard:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton
 - b. Siemens Industry, Inc., Energy Management Division
 - c. Square D; Schneider Electric USA
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Distribution Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.
 - 4. Standard Features:
 - a. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1) For doors more than 36 inch high, provide two latches, keyed alike.
 - b. Mains: as indicated on drawings.
 - 1) Location: Convertible between top and bottom.
 - 2) Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
 - c. Branch Overcurrent Protective: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 5. Other Available Features Required by Project:
 - a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
- B. UL QEUY - Lighting and Appliance Branch-Circuit Panelboard:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton
 - b. Siemens Industry, Inc., Energy Management Division
 - c. Square D; Schneider Electric USA
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Lighting and Appliance Branch-Circuit Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.

4. Standard Features:
 - a. Mains: Circuit breaker or lugs only.
 - 1) Location: Convertible between top and bottom.
 - 2) Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
 - b. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
5. Other Available Features Required by Project:
 - a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
 - b. Doors: Door-in-door construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton
 2. Siemens Industry, Inc., Energy Management Division
 3. Square D; Schneider Electric USA
- B. MCCB: Comply with UL 489, with series-connected rating interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long- and short-time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
 6. GFPE Circuit Breakers: Class B ground-fault protection (30 mA trip).
 7. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

- g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
 - h. Multipole units enclosed in single housing with single handle.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Provide fuses and spare fuse cabinet.
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with manual interlock override, to prevent opening of cover when switch is in on position. Interlock must prevent switch from being turned on with cover open. Operating handle must have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.4 MAINTENANCE MATERIAL ITEMS

- A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
- 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Equipment Mounting:
 - a. Install floor-mounted panelboards on cast-in-place concrete equipment base(s).
 - b. Attach panelboard to vertical finished or structural surface behind panelboard.
 - c. Mount surface-mounted panelboards to steel slotted supports 1-1/4 inch in depth. Orient steel slotted supports vertically.
 - 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
 - 3. Provide mounting and anchoring devices.
 - 4. Mount top of trim 7.0 ft above finished floor unless otherwise indicated.
 - 5. Mount panelboard cabinet plumb and rigid without distortion of box.

6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 7. Install overcurrent protective devices and controllers not already factory installed.
 - a. Set field-adjustable, circuit-breaker trip ranges.
 - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
 8. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
 9. Install filler plates in unused spaces.
 10. Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future.
 11. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
 12. Mount spare fuse cabinet in accessible location.
- D. Interfaces with Other Work:
1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components.
- B. Install warning signs.
- C. Panelboard Nameplates: Label each panelboard with nameplate.
- D. Device Nameplates: Label each branch circuit device in power panelboards with nameplate.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- G. Circuit Directory:
 1. Provide directory card inside panelboard door, mounted in transparent card holder.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
 2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
 3. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- B. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
 2. Remove and replace defective units and retest.
- C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.
1. Include certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General-use switches, dimmer switches, and fan-speed controller switches.
 - 2. General-grade duplex straight-blade receptacles.
 - 3. Receptacles with arc-fault and ground-fault protective devices.
 - 4. Special-purpose power outlet assemblies.
 - 5. Connectors, cords, and plugs.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional coordination, scheduling, sequencing, submittal, and installation requirements applicable to the Work for electrical, communications, and electronic safety and security systems on the Project, including wiring methods.
 - 2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.
 - 3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs referenced by this Section.

1.2 DEFINITIONS

- A. GFCI: Ground-Fault Circuit Interrupter.
- B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
 - c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are not acceptable for submitted product.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Special tools.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 GENERAL-USE SWITCHES AND DIMMER SWITCHES

- A. Toggle Switch:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Eaton, Wiring Devices; Arrow Hart
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: UL CCN WMUZ and UL 20.
 - 4. Standard Features:
 - a. Device Color: Ivory.
 - b. Provide toggle type for general duty, toggle type where keyed operation is required.
 - c. Configuration:
 - 1) General-duty, 120-277 V, 20 A, single pole, and three way.
 - a) Provide with forked key lock where indicated.
 - 5. Accessories:
 - a. Cover Plate: stainless steel.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- B. Type I Dimmer Switch:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton, Wiring Devices; Arrow Hart
 - b.
 - c. Current HLI
 - d.
 - e. Leviton Manufacturing Co., Inc.
 - f.
 - g. Pass & Seymour; Legrand North America, LLC
 - h. Sensorworx
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: UL CCN EOYX and UL 1472.
 - 4. Standard Features:
 - a. UL 1472 Type I dimmer.
 - b. Device Color: Ivory.
 - c. Switch Style: Push button.
 - d. Dimming Control Style: Slide.
 - 5. Accessories:
 - a. Cover Plate: stainless steel.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

- A. Single Straight-Blade Receptacle:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton, Wiring Devices; Arrow Hart
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - 3. Standard Features:
 - a. Device Color: Ivory .
 - 4. Accessories:
 - a. Cover Plate: stainless steel.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.4 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

- A. Duplex Straight-Blade Receptacle:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton, Wiring Devices; Arrow Hart
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC
 - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - 3. Standard Features:
 - a. Device Color: Ivory.
 - b. Configuration:
 - 1) General-duty, smooth face, NEMA 5-20R.
 - 4. Accessories:
 - a. Cover Plate: Stainless steel.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.5 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

- A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton, Wiring Devices; Arrow Hart
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacle GFCIs: UL CCN KCXS, UL 498, and UL 943.
 - 3. Standard Features:
 - a. Device Color: Ivory.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
 - 4. Accessories:
 - a. Cover Plate: **stainless steel**.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- B. General-Grade, Weather-Resistant, Tamper-Resistant, Duplex Straight-Blade Receptacle with GFCI Device:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton, Wiring Devices; Arrow Hart
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacle GFCIs: UL CCN KCXS, UL 498, and UL 943.
 - 3. Standard Features:

- a. Device Color: Ivory.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
- 4. Accessories:
 - a. In-use cover:
 - 1) Type: Extra-duty, weather-while-in-use (bubble type) cover with gasketed perimeter and hinged cover.
 - 2) Configuration: Compatible with duplex, Decora (rectangular), and GFCI receptacles as indicated on drawings.
 - 3) Material: UV-resistant, impact-resistant polycarbonate or die-cast aluminum with clear or opaque hinged cover.
 - 4) Listings: UL 514D/514C listed, evaluated to UL 50E for enclosures in wet locations.
 - 5) Compliance: NEC 406.9(B)(1) requirements for receptacles in wet locations (extra-duty type).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Wall Dimmers: 48 inches above finished floor.
 - c. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles or wall switches are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- B. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- C. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- D. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- E. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized coverplates in lieu of meeting this requirement.
- F. Install blank wall plates on junction boxes and on outlet boxes with no wiring device installed or where designated for future use.
- G. Identify each wiring device per Section 260553.

3.2 INSTALLATION OF SWITCHES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Life Safety and Means of Egress Work: NFPA 101.
 - 4. Wiring Devices: NECA NEIS 130.

5. Mounting Heights: NECA NEIS 1.
 6. Install with OFF position down.
 7. Consult Architect for resolution of conflicting requirements.
- C. Interfaces with Other Work:
1. Identification:
 - a. Identify cover or cover plate for device with panelboard identification and circuit number.

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 2. Electrical Safety: NFPA 70E.
 3. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 4. Installing and Maintaining Wiring Devices: NECA NEIS 130.
 5. Mounting Heights: Unless otherwise indicated in the Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 6. Receptacle Orientation: Unless otherwise indicated in the Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6. Where installed horizontally, locate grounding terminal on left.
 7. Where split-wired receptacles are indicated, remove tabs connection top and bottom receptacles.
 8. Where GFCI receptacles are indicated, utilize GFCI receptacles at each location. Do not use feed-through wiring to protect downstream devices.
 9. Consult Architect for resolution of conflicting requirements.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch to verify proper operation.
- C. Test each receptacle for proper operation and polarity.
- D. Test each GFCI device for proper tripping according to manufacturer's directions.
- E. Correct deficiencies and replace damaged or defective devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust coverplate screws to be uniformly perpendicular to the axis of the device.
- C. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.6 PROTECTION

- A. Devices:
1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
 2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

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SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Luminaires.
 - 2. Luminaire fittings.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional requirements applicable to coordinating, scheduling, and sequencing of the Work specified in this Section.
 - 2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" specifies wiring connections installed by this Section.
 - 3. Section 260529 "Hangers and Supports for Electrical Systems" specifies channel and angle supports installed by this Section.
 - 4. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.

1.2 DEFINITIONS

- A. BUG Rating: Backlight, uplight, and glare rating for light pollution from exterior luminaires.
- B. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.
- C. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.
- D. IDA: International Dark-Sky Association.
- E. IES: Illuminating Engineering Society.
- F. LPD: Lighting power density.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Luminaires: Include the following additional information:
 - a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
 - b. Product Certificates: Include product certificates stating compliance with standards listed below, signed by manufacturer or fabricator.
 - 1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
 - 2) Testing Agency Certified Data: For luminaires indicated on Lighting Fixture Schedule on the Drawings, photometric data certified by qualified independent

testing laboratory. Photometric data for remaining luminaires must be certified by manufacturer.

- c. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - d. Include operating characteristics, electrical characteristics, and furnished accessories.
 - e. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
 - f. Include battery and charger data for emergency lighting units.
 - g. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - h. Include photometric data and adjustment factors obtained from qualified laboratory tests.
 - i. Include manufacturer's sample warranty language.
2. Luminaire Fittings: Include the following additional information:
- a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
 - b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - c. Include operating characteristics, electrical characteristics, and furnished accessories.
 - d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on the Drawings.
 - e. Include manufacturer's sample warranty language.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers' published instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

1.7 WARRANTY FOR LUMINAIRES

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed luminaires perform in accordance with specified requirements and agrees to repair or replace products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
 - 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

1.8 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.
 - 1. Initial Extended-Warranty Period for Li-ion Batteries: Five years from date of Substantial Completion; full coverage for materials only, freight prepaid.
 - 2. Initial Extended-Warranty Period for Ni-Cd Batteries: Five years from date of Substantial Completion; full coverage for materials only, freight prepaid.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 LUMINAIRES

- A. Light Fixture Schedule contains basis of design. Provide fixtures as scheduled or submit substitute equivalent fixtures from alternate manufacturers for review a minimum of ten days prior to bid date.
 - 1. Source Limitations: Obtain products for similar luminaire types from single manufacturer.
 - 2. Listing Criteria:
 - a. LED Luminaires: UL CCN IFAM; including UL 1598.
 - b. Outdoor Canopy Luminaires: UL CCN IFAW; including UL 1598.
 - c. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
- B. UL FTBR or FTBV - Emergency Lighting and Power Equipment:
 - 1. Source Limitations: Obtain products from single manufacturer.
 - 2. Listing Criteria:
 - a. Emergency Lighting and Power: UL CCN FTBR or UL CCN FTBV; including UL 924, NFPA 101, and ICC IBC.
 - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
 - 3. Standard Features:
 - a. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - b. Status and Test Indication: Visible and accessible without opening luminaire or entering ceiling space.
 - 1) Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 2) Test Push-Button: Push-to-test button in unit housing simulates loss of normal power and demonstrates unit operability.
 - c. Nominal Operating Voltage: 120 V(ac).
 - d. Mounting: Ceiling or Wall with universal junction box adaptor.
 - e. Enclosure: UV stable thermoplastic housing .
 - f. Light Source: Two LED head(s).
 - 4. Other Available Features Required by the Project:
 - a. Mounting Height: As indicated on drawings.
- C. UL FWBO - Exit Fixture:
 - 1. Source Limitations: Obtain products from single manufacturer.
 - 2. Listing Criteria:
 - a. Exit Fixtures: UL CCN FWBO; including UL 924, NFPA 101, and ICC IBC.
 - b. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
 - 3. Standard Features:
 - a. Nominal Operating Voltage: 120 V(ac).
 - b. Light Source: LED; 50,000 hours minimum rated life.
 - c. Internal emergency power unit.
 - d. Master/Remote Sign Configurations:
 - 1) Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
 - 2) Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power

requirements from master unit. Connect for testing concurrently with master unit as a unified system.

4. Other Available Features Required by the Project:
 - a. Mounting Height: As indicated on drawings.

2.3 LUMINAIRE FITTINGS

- A. Luminaire Support Accessories:
 1. Standard Features:
 - a. Sized and rated for luminaire weight.
 - b. Capable of maintaining luminaire position after cleaning and relamping.
 - c. Capable of supporting luminaire without causing deflection of ceiling or wall.
 - d. Capable of supporting horizontal force equal to 100 percent of luminaire weight and vertical force equal to 400 percent of luminaire weight.
 2. Other Available Features Required by the Project:
 - a. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage wire supports adjustable to 10 ft in length.
 - b. Aircraft Cables: 5/32 inch diameter aircraft cable supports adjustable to 10 ft in length.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LIGHTING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 2. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 3. Work in Confined Spaces: NFPA 350.
 4. Installation of Indoor Lighting Systems: NECA NEIS 500.
 5. Installation of Exterior Lighting Systems: NECA NEIS 501.
 6. Installation of Luminaires, Lampholders, and Lamps: Article 410 of NFPA 70.
 7. Installation of Emergency Lighting and Exit Signs: ICC IBC, NFPA 101, and Parts IV and V in Article 700 of NFPA 70.
 8. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
 2. Install luminaires at height and aiming angle as indicated on the Drawings.
 3. Coordinate layout and installation of luminaires with other construction.
 4. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
 5. Exterior Corrosion Prevention:
 - a. Do not use aluminum in contact with earth or concrete. When in direct contact with dissimilar metals, protect aluminum with insulating fittings or treatment.
 - b. When embedding steel conduits in concrete, wrap conduit with 10 mil thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
 6. Flush-Mounted Luminaire Support:

- a. Secured to outlet box.
 - b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - c. Trim ring flush with finished surface.
- 7. Wall-Mounted Luminaire Support: Attached to structural members in walls.
 - a. Do not attach luminaires directly to gypsum board.
- 8. Suspended Luminaire Support:
 - a. Ceiling Mount:
 - 1) Two aircraft cables.
 - b. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
- 9. Ceiling-Grid-Mounted Luminaire Support:
 - a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inch from luminaire corners.
 - b. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for application.
 - c. Luminaires of Sizes Smaller than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with no fewer than two 3/4 inch metal channels spanning and secured to ceiling tees.
- 10. Remote Mounting of Ballasts or Drivers: Do not exceed distance between ballast or driver and luminaire recommended by ballast or driver manufacturer.
- 11. Emergency Power Units: Secure with approved fasteners in four or more locations, spaced near corners of unit.
- 12. Install wiring connections for luminaires.
- 13. Identification: Provide labels for luminaires and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
 - c. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL OF LIGHTING

- A. Tests and Inspections:
 - 1. Perform manufacturer's recommended tests and inspections.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
 - 4. Verify operation of photoelectric controls.
- B. Nonconforming Work:
 - 1. Luminaire will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.

3.4 PROTECTION

- A. After installation, protect lighting equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 265000

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