MICHIGAN STATE
UNIVERSITY

ELECTRONIC BIDDING

PUBLICLY BID AND ADVERTISED
SPECIFICATION FOR

WHARTON - MASONRY RESTORATION TO SW EXTERIOR STAIRS (FY24)

PROJECT NUMBER

CP23026

Friday, December 01, 2023

AT

MICHIGAN STATE UNIVERSITY
EAST LANSING, MICHIGAN

Infrastructure Planning and Facilities
Planning, Design and Construction

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TABLE OF CONTENTS

ADVERTISEMENT FOR BIDS

INSTRUCTIONS TO BIDDERS

CONTRACT AND GENERAL CONDITIONS ConsensusDocs 200 – Standard Agreement and General Conditions between Owner and Constructor.

CONTRACTOR'S AFFIDAVIT, WAIVER OF LIEN AND WAGE STATEMENT
MBE WBE VERIFICATION FORM
GUARANTEES
CHANGE ORDER QUOTATION FORMAT
CERTIFICATE OF INSURANCE FOR PURCHASE ORDER PROJECTS

DIVISION 01 - GENERAL REQUIREMENTS

- 011000 SUMMARY
- 012000 PRICE AND PAYMENT PROCEDURES
- 013000 ADMINISTRATIVE REQUIREMENTS
- 014000 QUALITY REQUIREMENTS
- 015000 TEMPORARY FACILITIES AND CONTROLS
- 016000 PRODUCT REQUIREMENTS
- 017000 EXECUTION REQUIREMENTS

TECHNICAL SPECIFICATIONS

DIVISION 02 - EXISTING CONDITIONS

- 024113 SITE DEMOLITION
- 024200 CONSTRUCTION WASTE MANAGEMENT FOR MINOR AND MAJOR PROJECTS

DIVISION 03 - CONCRETE

- 033015 CONCRETE FOR BUILDING CONSTRUCTION
- 036000 GROUTING

DIVISION 04 - MASONRY

- 042000 UNIT MASONRY

DIVISION 05 - METALS

- 051200 STRUCTURAL STEEL FRAMING
- 055213 PIPE AND TUBE RAILINGS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

- 071326 SELF-ADHERING SHEET WATERPROOFING
- 072100 THERMAL INSULATION
- 072400 DIRECT-APPLIED EXTERIOR FINISH SYSTEMS
- 072700 AIR BARRIERS
- 076200 SHEET METAL FLASHING AND TRIM
- 079200 JOINT SEALANTS

DIVISION 09 - FINISHES

- 092113 GYPSOM BOARD ASSEMBLIES

DIVISION 22 - PLUMBING

- 220500 COMMON WORK RESULTS FOR PLUMBING
- 220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
- 220700 PLUMBING INSULATION
- 221413 FACILITY STORM DRAINAGE PIPING
- 221423 STORM DRAINAGE PIPING SPECIALTIES

DIVISION 26 - ELECTRICAL

- 260500 COMMON WORK RESULTS FOR ELECTRICAL
- 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
- 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 260800 COMMISSIONING OF ELECTRICAL SYSTEMS
- 265600 EXTERIOR LIGHTING

SCHEDULE OF DRAWINGS

Project Title: **WHARTON - MASONRY RESTORATION TO SW EXTERIOR STAIRS (FY24)**

Capital Project Number: **CP23026**

No. of Sheets: **13**

ADVERTISEMENT FOR BIDS

DATE: **December 1, 2023**

PROJECT TITLE: **WHARTON - MASONRY RESTORATION TO SW EXTERIOR STAIRS (FY24)**

PROJECT NUMBER: **CP23026**

for

MICHIGAN STATE UNIVERSITY

located at

EAST LANSING, MICHIGAN

OWNER: BOARD OF TRUSTEES
MICHIGAN STATE UNIVERSITY

ENGINEER/ARCHITECT: PLANNING, DESIGN AND CONSTRUCTION
Infrastructure Planning and Facilities
Michigan State University

DESIGN REPRESENTATIVE: **Brandon Charland PHONE: 810-836-4594**

PROJECT MANAGER: **Tonino Pacifico 517-243-0260**

Fishbeck Architects
39500 MacKenzie Dr. #100
Novi, MI 48377

BID DUE DATE: Until **3:00 p.m.** on **Wednesday, January 24, 2024**, the Owner will receive bids for the work as set forth in the Bidding Documents at via the Owner's Oracle Primavera Unifier Bid Manager, at which time and place all proposals will be publicly opened. Bidders are responsible for properly registering for this process, and familiarizing themselves with the system and its requirements. Registration information can be found at https://ipf.msu.edu/construction/partners/prospective-partners.

Proposals are invited for the following work:
Proposal 1 – General Construction Work

This project involves • Replace southwest concrete entry steps and brick sidewalls at same steps per construction documents • Install new exterior lighting per construction documents • Replace soffit ceiling under landing on ground floor • Install new floor storm drains in landing per construction documents • Install new metal handrails per construction documents • Match existing brick. Provide alternate pricing for replacing all caulk expansion joints around the entire building.

Publicly Bid and Advertised: This project is publicly bid and advertised.

The substantial construction completion date for the project, as set forth in the project manual and drawings is **August 27, 2024**. See applicable start date and interim completion dates in the General Requirements (Division One) – Part 1 Work Sequence section.

LIQUIDATED DAMAGES:
☐ Shall, or ☒ Shall not be assessed for Substantial Completion at:
$_____PER DAY

☐ Shall, or ☒ Shall not be assessed for Final Completion at:
$_____PER DAY

EXCLUSIONS FROM MUTUAL WAIVERS OF CONSEQUENTIAL DAMAGES:
DEFAULT IS NONE. (If exclusions apply, project team to insert applicable exclusions below).

The complete set of documents is also available for viewing through our new MSU Plan Room or via the MSU Planning, Design and Construction (PDC) web page at https://ipf.msu.edu/construction/partners/prospective-partners and then select “dedicated plan room”.

PLAN ROOMS

The Bidding documents are on file and may be examined at the following locations during regular business hours, Monday through Friday:

Builders Exchange of Lansing &
Central Michigan
1240 East Saginaw
Lansing, MI 48906

Dodge Data & Analytics
25330 Telegraph Road, Suite 350
Southfield, MI 48009

Dodge Data & Analytics
914 E. Vine Street
Kalamazoo, MI 49001

Dodge Data & Analytics
1311 South Linden Road, Suite B
Flint, MI 48532

Builders Exchange
P.O. Box 2031
Grand Rapids, MI 49501

Tri-City Builders & Traders Exchange
334 South Water
Saginaw, MI 48607

Construction Association of Michigan
43636 Woodward Avenue
P. O. Box 3204
Bloomfield Hills, MI 48302-3204

Builders Exchange
3431 East Kilgore
Kalamazoo, MI 49001

CNS Construction News Service
of West Michigan, Inc.
1793 R. W. Berends Dr. SW.
Wyoming, MI 49509-4993

MMSDC Michigan Minority Supplier
Development Council.
100 River Place STE 300
Detroit, MI 48207

Builders Exchange of NW MI, Inc.
1373 Barlow St. , Suite 4
Traverse City, MI 49686

Capital Imaging
2521 East Michigan Avenue
Lansing, MI 48912

A pre-bid site inspection will be held on **Tuesday, January 09, 2024** at **11:00 a.m.**. All interested Contractors or Bidders are encouraged to attend. Interested parties should meet at the **southwest exterior corner of Wharton Center off Wilson Rd**. All Contractors submitting bids for the work will be held to have visited the site prior to submitting bids.

Each proposal shall be accompanied by a bid security as set forth in the Instructions to Bidders.

The Owner reserves the right to reject any or all proposals either in whole or in part and to waive any irregularities.

Withdrawal of any proposal is prohibited for a period of 120 days after the actual date of the opening thereof.

Performance and Labor and Material Bonds are required as set forth in the Instructions to Bidders.

All prospective Bidders, their Subcontractors and suppliers must be awardable by and in compliance with the directives and guidelines of the Contract Compliance Division of the Michigan Civil Rights Commission.

SUBCONTRACTING AND SUPPLIER DIVERSITY

The University makes a continuous effort to broaden its business relationships with Minority Business Enterprise (MBE) contractors, Women Business Enterprise (WBE) contractors, and small business concerns (including veteran-owned small business, service-disabled veteran owned small business, HUB Zone small business, and small disadvantaged business concerns certified by the U.S. Small Business Administration). For the purposes of this provision, suppliers are considered subcontractors. If third parties are needed to fulfill contractual obligations to the University, you are strongly encouraged to consider all qualified sources, including WBE, MBE, and small business subcontractors. For purposes of this paragraph, MBE is defined as a business enterprise of which more than 50% of the voting shares or interest in the business is owned, controlled, and operated by individuals who are members of a minority and with respect to which more than 50% of the net profit or loss attributable to the business accrues to shareholders who are members of a minority. WBE is defined as a business enterprise of which more than 50% of the voting shares or interest in the business is owned, controlled, and operated by women and with respect to which more than 50% of the net profit or loss attributable to the business accrues to the women shareholders.

The apparent Low Bidder shall, within 24 hours, after receipt of bids, provide the names of any MBE/WBE/small business subcontractors, description of work to be done by each, dollar value of work, and percentage of contract price. This information shall be included with the contract breakdown specified in Section 012000.1.4 of the specifications.

The Michigan State University Purchasing Department maintains a list of known Minority and Women Business Enterprises in the region for informational purposes. Bidders can obtain a copy of this list by calling (517) 355-0357. This list is not intended to be comprehensive. Similarly, it does not constitute an endorsement or certification of acceptability of the contractors and vendors included.

INSTRUCTION TO BIDDERS

ARTICLE 1

DEFINITIONS

1.1 Bidding Documents include the Advertisement or Invitation to Bid, Instruction to Bidders, the Bid Form, other sample bidding and Contract forms and the proposed Contract Documents including any Addenda issued prior to receipt of Bids.

1.2 All definitions set forth in ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor (as modified by MSU) and in other Contract Documents are applicable to the Bidding Documents.

1.3 **Addenda** are written or graphic instruments, issued by the Architect prior to the receipt of Bids, which modify or interpret the Bidding Documents by addition, deletions, clarifications or corrections.

1.4 A **Bid** is a complete and properly signed proposal to do the Work or designated portion thereof, for the sums stipulated therein, supported by data called for by the Bidding Documents.

1.5 **Base Bid** is the sum stated in the Bid for which the Bidder offers to perform the Work described as the base, to which Work may be added or deducted for sums stated in Alternate Bids.

1.6 An **Alternate Bid** (or Alternate) is an amount stated in the Proposal to be added to or deducted from the amount of the Base Bid if the corresponding change in project scope or materials or methods of construction described in the Bidding Documents is accepted.

1.7 A **Unit Price** is an amount stated in the Bid as a price per unit of measurement for materials or services as described in the Contract Documents.

1.8 A **Bidder** is one who submits a Bid for a prime Contract with the Owner for the Work described in the proposed Contract Documents.

1.9 A **Sub-bidder** is one who submits a Bid to a Bidder for materials or labor for a portion of the Work.

1.10 **Bid Manager** is the Oracle Primavera Unifier Bid Manager application used the by the Owner to received competitive bids for this project.

ARTICLE 2

BIDDER'S REPRESENTATION

2.1 Each Bidder, by making his/her Bid, represents that:

2.1.1 They have read and understand the Bidding Documents and their Bid is made in accordance therewith.

2.1.2 They have visited the site and are familiar with the local conditions under which the Work is to be performed.

2.1.3 Their Bid is based upon the materials, systems and equipment described in the Bidding Documents, without exceptions.

ARTICLE 3

BIDDING DOCUMENTS

3.1 COPIES

3.1.1 Bidders may obtain complete sets of the Bidding Documents via the MSU PLANNING, DESIGN AND CONSTRUCTION web page at https://ipf.msu.edu/construction/partners/prospective-partners, or as outlined in the Advertisement for Bids, page AB-2.

3.1.2 Complete sets of Bidding Documents shall be used in preparing Bids; neither the Owner nor the Architect assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 The Owner or Architect, in making copies of the Bidding Documents available on the above terms, does so only for the purpose of obtaining Bids on the Work and does not confer a license or grant for any other use.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 Bidders shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover upon examination of the Bidding Documents or of the site and local conditions.

3.2.2 Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to be received by the Architect at least fourteen days prior to the date for receipt of Bids.

3.2.3 Any interpretation, correction or change of the Bidding Documents will be made by Addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

3.3.2 No substitution will be considered unless written request for approval has been submitted by the Bidder and has been received by the Architect at least fourteen days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data, and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require shall be included. It is the burden of the bidder proposing the substitution to establish its merits. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

3.3.3 If the Architect approves any proposed substitution, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

3.4 ADDENDA

3.4.1 The Architect and Owner will endeavor to notify all known plan holders of addenda issued, but it is the Bidder’s responsibility to verify receipt of all addenda.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 Normally Addenda will not be issued later than five days prior to the date for receipt of Bids except an Addendum, if necessary, postponing the date for receipt of Bids or withdrawing the request for Bids.

3.4.4 Each Bidder shall ascertain prior to submitting their Bid that they have received all Addenda issued, and receipt of all Addenda shall be acknowledged on their bid.

ARTICLE 4

BIDDING PROCEDURE

4.1 FORM AND STYLE OF BIDS

4.1.1 Bids shall be submitted via the Bid Manager on the form specified.

4.1.2 All fields on the Bid Form shall be completed.

4.1.3 All requested Alternates shall be listed and quoted in the Bid Manager. Failure to quote a requested Alternate will be cause to reject the Bid.

4.1.3.1 If an alternate is added via Addendum, bidders will include by [adding new line to bid form, clearly labeling ALTERNATE X(x being the number)] or [providing pricing on an attachment, also clearly labeling pricing for Alternate.]

4.1.4 All requested Unit Prices shall be listed and quoted via attachment in the Bid Manager. Failure to quote a requested Unit Price will be cause to reject the Bid.

4.1.5 Acknowledge the receipt of the last Addendum on the Bid Form. By acknowledging this addendum, Bidder also acknowledges receipt of all prior consecutive addenda (e.g., acknowledging Addendum 3 also acknowledges Addendum 1 and 2).

4.1.6 Bidder shall make no additional stipulations on the Bid Form nor qualify its Bid in any manner.

4.1.7 By submitting a Bid via the Bid Manager, the Bidder has committed the offer to perform the Work. The Owner will rely on this document as properly signed by the Bidder. The Owner may rely on this commitment, including submitting a claim on the Bidder's Bid Bond if they fail to enter into a contract per the project manual.

4.2 BID SECURITY

4.2.1 Any base bid greater than $50,000 shall be accompanied by a Bid Security in the form of a bid bond made payable to the Board of Trustees, Michigan State University, in the amount of not less than five percent (5%) of the Base Bid, as a proposal guarantee, pledging that the Bidder will enter into a Contract with the Owner on the terms stated in its Bid, and will furnish bonds as described hereunder in Article 8 covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Bidder shall attach a scanned copy of the bid bond to the bid in Unifier Bid Manager.

As an alternative to a bid bond, Bidders may provide certified check, cashiers' check, or money order made payable to the Board of Trustees, Michigan State University, in the amount of not less than five percent (5%) of the Base Bid, to be delivered to MSU Infrastructure Planning and Facilities, 1147 Chestnut Road, Room 101, East Lansing, MI 48824. The proposal guarantee of Bidders under consideration will be returned immediately after approval of contracts by the Owner; those of all others will normally be returned upon request within 48 hours after bid opening.

Should the Bidder refuse to enter into a Contract, or fail to furnish such bonds within 30 days of notification of intent to award, the amount of the Bid Security shall be forfeited to the Owner as liquidated damages, not as penalty.

4.2.2 The bonding firm must be listed on the current U.S. Department of Treasury Circular 570, rated A- or better by Best, and be licensed to do business in the State of Michigan. The bonds are to be made out to "Michigan State University, Board of Trustees."

4.2.3 The Owner will have the right to retain the Bid Security of Bidders under consideration until either (a) the Contract has been executed and bonds have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

4.3 SUBMISSION OF BIDS

4.3.1 Bids shall be completed prior to the time and date for receipt of Bids indicated in the Advertisement or Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will not be considered.

4.3.2 Bidder shall assume full responsibility for timely delivery at location designated for receipt of Bids.

4.3.3 Oral, telephone, paper, or faxed Bids are invalid and will not receive consideration.

4.4 MODIFICATION OR WITHDRAWAL OF BID

4.4.1 A Bid may not be modified, withdrawn, or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and Bidder so agrees in submitting his/her Bid.

4.4.2 Prior to the time and date designated for receipt of Bids, Bids submitted early may be modified or withdrawn only by withdrawing current Bid, and resubmitting within the Bid Manager.

4.4.3 Bid security shall be in an amount sufficient for the Bid as modified or resubmitted.

4.5 BIDDER REGISTRATION

4.5.1 The Owner will only receive Bids via the Bid Manager, which requires prior registration and invitation. The Bidder is responsible to familiarize itself with this system and request access in a timely manner.

4.5.2 The Owner will endeavor to maintain a list of all interested bidders, and invite to all public bids. Bidders interested in being added to this list must register. Registration information can be found at https://ipf.msu.edu/construction/partners/prospective-partners.

4.5.3 Bidders are encouraged to continue to monitor projects via plan rooms and other advertising venues. They must express interest to bid on MSU projects by request at least 7 days prior to a bid opening. Owner takes no responsibility for inviting a bidder after that date.

ARTICLE 5

CONSIDERATION OF BIDS

5.1 OPENING OF BIDS

5.1.1 Unless stated otherwise in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be opened publicly and will be read aloud. Opening will generally take place in MSU Infrastructure Planning and Facilities Building, 1147 Chestnut Road, East Lansing, Michigan 48824.

5.1.1.1 Unless stated otherwise in the Advertisement or Invitation to Bid, the Owner will endeavor to share bid results within 24 hours of opening.

5.1.1.2 The Owner will endeavor to stream the bid opening, and will share details in the bid invitation

5.2 REJECTION OF BIDS

5.2.1 The Owner shall have the right to reject any or all Bids.

5.3 ACCEPTANCE OF BID (AWARD)

5.3.1 The Owner shall have the right to waive any informality or irregularity in any Bid received.

5.3.2 If the University accepts any alternates, it will do so in the order representing the Owner's opinion of the best value to Michigan State University. The Owner shall be the sole judge of value. The low bidder will be determined on the basis of the sum of the base bid and the alternates accepted.

5.4 ACCEPTANCE OF CONTRACTOR AND SUBCONTRACTORS

5.4.1 Each portion of the Work shall be performed by an organization equipped and experienced to do the Work in each particular field, and no portion shall be reserved by the Contractor unless they are so equipped and experienced. Within 24 hours after the receipt of Bids, the successful Contractor shall submit a list of each Subcontractor proposed for each section of the Work. Subcontractors shall be satisfactory to the Owner. Unless authorized to the contrary in writing from the Owner, Subcontracts shall be awarded to the firms named in this list. Acceptance of the Bid does not imply approval of the Subcontractors subsequently named, but each Subcontractor shall be approved individually.

ARTICLE 6

QUALIFICATION OF CONTRACTORS

6.1 SUBMISSION OF QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall submit to the Architect upon his/her request, a properly executed Contractor's Qualification Statement, Consensus Docs 221 – Constructor's Statement of Qualifications for a Specific Project, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

6.2 NONDISCRIMINATION

6.2.1 In performing under this Contract, the Contractor agrees not to discriminate against any employee, or applicant for employment, with respect to hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, religion, national origin, age, sex, height or weight, marital status or handicap. Subcontracts with each Subcontractor will contain a provision requiring nondiscrimination in employment, as herein specified. Any breach of this covenant may be regarded as a material breach of this Contract. The foregoing is included as a part of the University's institutional Affirmative Action/Equal Opportunity commitment.

6.3 APPROVED ASBESTOS ABATEMENT CONTRACTORS

6.3.1 The Department of Environmental Health and Safety (EHS) annually prequalifies asbestos abatement contractors to perform asbestos abatement work on Campus. Asbestos abatement work shall only be performed by one of the asbestos abatement contractors on the approved list. The current list is available from the PDC Project Representative, the Environmental Coordinator for EHS, and at https://ehs.msu.edu/enviro/asbestos/index.html.

ARTICLE 7

POST-BID INFORMATION

7.1 SUBMISSIONS

7.1.1 Unless waived by the Architect, the apparent low Bidder shall, within 24 hours after receipt of bids, submit the following information to the Architect:

7.1.1.1 A designation of the Work to be performed by the Bidder with their own forces.

7.1.1.2 The proprietary names and the suppliers of principal items or systems of material and equipment proposed for the Work.

7.1.1.3 A list of names of the Subcontractors or other persons or organizations (including those who are to furnish materials or equipment fabricated to a special design) proposed for each division and/or major subdivision, for the Owner’s approval.

7.1.1.4 The names of the MBE/WBE and a description of work to be done by each, dollar value of Work and percentage of Contract price.

7.1.1.5 List of representatives authorized to perform Unifier functions on behalf of the contractor using the Unifier New Company Request, available at Unifier System Vendor Information Form.

7.1.1.6 Certificate of Insurance demonstrating compliance with project requirements.

7.1.2 At the option of the Owner, the Bidder may be required to establish to the satisfaction of the Architect and the Owner the capability, reliability, and responsibility of the proposed Contractor and Subcontractors to furnish and perform the Work.

7.1.3 Subcontractors and other persons and organizations proposed by the Bidder and accepted by the Owner and the Architect must be used on the Work for which they were proposed and accepted and shall not be changed except with the written approval of the Owner and the Architect.

ARTICLE 8

PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

8.1 OWNER'S RIGHT TO REQUIRE BONDS

8.1.1 Each Bidder under a proposal in which the base bid exceeds $50,000, shall include the premiums for furnishing a Performance Bond and also Labor Material Bond, each in the full amount of the proposal sum as specified in the Owner / Constructor Agreement.

8.1.2 The bonding firm must be listed on the current U.S. Department of Treasury Circular 570, rated A- or better by Best, and be licensed to do business in the State of Michigan. The bonds are to be made out to "Michigan State University, Board of Trustees."

8.1.3 In assuming assigned Subcontractor by the successful Bidder for general building work as specified, each assigned Subcontractor for each Subcontract shall reimburse the General Contractor his/her proportionate share of the premiums for bonds.

8.2 TIME OF DELIVERY AND FORM OF BONDS AND INSURANCE

8.2.1 The Bidder shall deliver two (2) copies of the required bonds and insurance to the Owner not later than the date of execution of the Contract.

8.2.2 The Bidder shall require the Attorney-In-Fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his/her Power of Attorney.

ARTICLE 9

FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

9.1 FORM TO BE USED

9.1.1 The Agreement for the Work will be governed by the project manual, and by the terms and conditions of ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor (as modified by MSU).

9.1.2 If the project is under $250,000, an MSU Purchase Order will be used and the terms and conditions of ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor (as modified by MSU), will serve as the applicable General Conditions for administration of the Work.

9.1.3 If the project is over $250,000, the ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor will be used and the terms and conditions of that Agreement will be formalized through the execution of a Contract Finalization Form.

ARTICLE 10

APPLICATION FOR PAYMENT

10.1 FORM TO BE USED

10.1.1 Applications for Payment shall be submitted in Unifier in accordance with the Pay Apps (Pay Applications) business process. Refer to the MSU IPF website for more information

ARTICLE 11

ELECTRONIC TRANSACTIONS

11.1 UNIFIER

11.1.1 The Owner reserves the right to require that any or all transactions and submissions be conducted and delivered electronically through Unifier, a web-based project management software system. Unifier functions on most popular web browsers. If the owner requires the use of Unifier, the owner will provide the necessary licenses for access into Unifier and the initial training necessary to use Unifier. Access to Unifier will be password restricted, and any proposal, acceptance, quote or other information submitted through Unifier through the use of a party's password shall be deemed to be the submission of such party and any proposal, acceptance, quote or other information in the submission shall be binding on such party as if such proposal, acceptance, quote or other information was in a writing signed by such party. Owner shall not be required to verify the validity of any such submission or inquire as to the authority of the user gaining access to Unifier through the use of a party's password. The following are the minimum Unifier user software and hardware requirements. It is the responsibility of the vendor to verify compatibility of their systems with Unifier. For more information, see Unifier System Vendor Information Form.

11.2 CONTRACT EXECUTION

11.2.1 The Owner may choose to accept a scanned signed contract, provided through Unifier, as acceptance of the agreement. The Owner will rely on this document as properly signed by the Constructor.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Work Under This Contract

- *Replace southwest concrete entry steps and brick sidewalls at same steps per plans*
- *Install new exterior lighting per plans*
- *Replace soffit ceiling under landing on ground floor*
- *Install new floor storm drains in landing per plans*
- *Install new metal handrails per plans*
  Match existing brick

1. This Contract encompasses the furnishing of all labor, materials, services, equipment, and insurance to complete the following as shown on drawing and specified herein:

2. Any premium time necessary to complete this project as scheduled, shall be included in the Base Bid.

3. All pertinent requirements of the Invitation to Bidders, Instructions to Bidders, and General Conditions shall form a part of these specifications and the Contractor shall consult them in detail for instructions pertaining to the work in the following divisions.

B. Pre-Ordered Products

1. The Contractor shall assume full responsibility for all pre-ordered products after their arrival at MSU. This includes transportation, handling, storage, start-up, warranty services, and installation in accordance with the General Conditions unless otherwise specified.

C. Work Sequence

Specific start date for the project is June 17, 2024

1. The Substantial construction completion date for this project is as specified in the Advertisement for Bids.

The desired completion date is August 26, 2024.

Please communicate to MSU Project Representative if, based on the scope of work, the desired completion date is not feasible and propose an alternative completion date for this project.

1.2 WORK RESTRICTIONS

A. Access Routes

1. All materials and equipment (new and demolition), including mechanical and electrical, shall be transported through a building via the designated building receiving area (usually the loading dock), and through main corridor to rooms or areas. Alternate routes may be used only with the approval of the Project Representative.

B. Owner Occupancy

1. Unless otherwise stated, University buildings will continue to function and remain occupied during the construction process.

Note – The Wharton Center will not be open from 6/17/24 through 8/26/24

2. On every project involving new construction, additions or alterations to existing facilities, M.S.U. requires the ability of a person with physical disabilities to independently get to, enter, and use the site, facility, building or element. In no way shall a site, building or facility be restricted to individuals with disabilities, due to alterations or construction, which would normally be made accessible to individuals with no disabilities. Alternate routes for all new and alterations of existing facilities shall incorporate the latest federal, state and local barrier free standards and include temporary access accommodations for individuals with disabilities.

C. Use of Site

1. There shall be a pre-construction site walk-thru with the Project Representative to clarify and discuss limitations and concerns prior to construction.

2. Construction fence

a. A construction fence shall be placed around the construction site as shown on the drawings and as approved by the Project Representative.

b. The Contractor is responsible for installing and maintaining the construction fence and gates to restrict access by the public to the area under construction. The Contractor may be required to reposition the fence and/or gate(s) during the course of construction to accommodate the construction activities in order to minimize the inconvenience to the public.

c. The fence shall be constructed of chain link fabric with a minimum height of 6', with metal or wood posts at not to exceed 8' spacing. Fence fabric shall be supported by either a top bar or tension cable. Gates (where specified) will be constructed of a suitable metal frame with chain link fabric with a height of not

less than 6'. This fence shall be installed before work commences.

d. Metal signs reading "Construction Area - Keep Out" must be attached to the fence at not more than 20' spacing and to the gate(s).

e. Where any fence crosses an existing walk, drive, or road, a lighted MDOT Type 1 barricade or larger shall be attached to the inside of the fence facing on-coming pedestrian and/or vehicular traffic.

f. No construction work, parking, storage of materials or related activities shall occur beyond this boundary fencing.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 012000 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 PROPOSAL QUOTATION REQUIREMENTS

A. Projects to be bid will be quoted as required by the front-end documents on the specification.

1.3 SCHEDULE OF ALTERNATES

A. Alternate Item: Drawing number A-1 including:
a. Around entire exterior perimeter of Wharton Center: Remove all cracked, damaged or failing sealant from brick veneer control joints, clean joints and reseal joints.
b. Provide linear foot unit cost for replacement of control joints from grade to 16 feet above grade (joints accessible by ladder or at grade).
c. Provide linear foot unit cost for replacement of control joints from 16 feet above grade to roof parapet (joints accessible by lift).

1.4 CONTRACT BREAKDOWNS

A. Within twenty-four (24) hours after receipt of Bids, the apparent Low Bidder shall submit to the Architect/Engineer, the following:

1. A Schedule of Values (SOV), indicating the cost of each specified Division and/or Major Subdivision of the Bid. The approved SOV will be used as the basis for estimating partial payments to the Contractor when allowed per the front-end documents.

a. All contracts shall assign a minimum of 1% of the contract value for final completion and project closeout. This item must be identified as a separate line item labeled *Closeout* on the SOV. Exceptions must be approved by the Construction Superintendent.

b. Due to changes to Generally Accepted Accounting Practices, environmental remediation must be separately reported in the Owner's financial statements. Accordingly, all contracts shall carry remediation costs in separate lines clearly marked *remediation*. These titles should not be used in other line descriptions.

c. Construction Management contracts shall carry separate detail lines for at least the following lines:

i. Preconstruction Services
ii. Construction phase staffing
iii. General conditions
iv. Bonds and Insurance. Note that subcontractor bonds are not required to be separately listed.
v. Fee

vi. Closeout

2. Identify a Subcontractor for each Division and/or Major Subdivision for the Owner's approval. Once approved, no Subcontractors will be changed without the Owner's written consent. The List of Subcontractors will have indicated the MBE/WBE Contractors and their percentages of the Contract Price as specified in the "Cover Letter" or "Advertisement for Bids" of this project.

3. A list of representatives authorized to perform Unifier functions on behalf of the Contractor using the Unifier System - Vendor Information available at http://ipf.msu.edu/index.cfm/capital-project-procedures/documents/unifier-system-vendor-information/.

1.5 CONTRACT MODIFICATION PROCEDURES

A. Change Management Quotation Requirements

1. Quotations for changes in the Contract will be submitted via Unifier when requested, as outlined in Section 012000-1.5.B, Change Management Procedures. This section will not prohibit the Project Representative from requesting and receiving verbal quotations. It is intended that mutual cooperation will keep any changes to an absolute minimum. The Contractor shall promptly document any verbal request by initiating a Change Management or Change Request record in Unifier. The Contractor shall not engage in added work without proper authorization by the Owner. Any added work the Contractor engages in without authorization shall be at the Contractor's risk. In no event shall the failure of the Construction Representative to initiate a change constitute authorization for the Contractor to proceed with work.

2. The Change Order Quotation Format Form is available on the MSU Capital Project Delivery Procedures website (http://procedures.ipf.msu.edu/index.cfm/capital-project-delivery-procedures/). This Form shall be forwarded to each required Subcontractor, and is recommended as an outline of the information required by this Contract.

3. The Contractor will submit quotations through Unifier, including detailed breakdowns. Upon request, originals of any documents shall be provided to the Owner. The Project Representative will receive quotations from the Contractor only. Subcontractors will submit quotations through the Contractor. All Contractors will submit quotations with information and back-up data as indicated on the quotation form.

B. Change Management Procedures

1. Change Orders shall be issued as required to alter the Contract, (i.e. change the work scope, materials, dates, etc.), in accordance with the General Conditions of the Contract, and the following procedure:

   a. The Contractor or the Project Representative shall initiate a Change Request in the Unifier Project Management System. Each Change Request will consist of only one change item of work.

b. Items brought up by the Department or Contractor shall be reviewed first with the Project Representative.

c. The Architect/Engineer will review the Change Request, and with the Project Representative, will determine the need for an item to be changed in the Contract by Change Order.

d. If the Change Request is approved, the Contractor will receive a request through Unifier to proceed with the work and/or provide pricing, as applicable. Provide a quotation for the item requiring change, unless the Change Request is submitted as a lump sum with a quotation attached

e. The Contractor will submit a quotation for each Change Request item in accordance with the applicable Unifier business process. Overhead and profit shall be applied consistent with the General Conditions.

f. The Project Representative and Architect/Engineer will evaluate the quotations and accept or reject each item quoted. A Change Order will be created within the Unifier system and will be issued through the MSU Purchasing Department to change the contract amount if required.

g. The Construction Supervisor or Director of Planning, Design and Construction has approval authority for the Contract Change.

1.6 CONTRACT PAYMENT PROCEDURES

A. Payment application requirements
1. Payment applications shall be submitted in Unifier, consistent with the contract documents.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

A. Project Meetings

1. Project meetings may be called as deemed necessary by the Project Manager.

B. Project Scope Documentation

1. The Contractor shall use PlanGrid for coordination of changes in the field, punch list items, and potential use for plan review comments.

C. Project Coordination

1. The Contractor is ultimately responsible for coordination to complete all work shown on drawings and specified herein independent of the location of the work on drawings and within the specifications. The arrangement of work within the specification into Divisions and Sections shall be considered as given for convenience of reference only and shall not be held to conform to jurisdictional rules which may prevail in any particular trade. It shall be the responsibility of the Contractor to so arrange or group items of work under a particular trade to conform to the prevailing customs of that trade and best interest of the Owner. Specific items of work will be performed by specific subcontractors or workmen when so specified herein or subsequently deemed necessary by the Project Representative to produce competent results.

2. The Contractor shall lay out the work and be responsible for all lines and measurements of the work. Before ordering material or executing work the Contractor shall obtain field measurements and prepare the work to fit conditions properly.

3. The Contractor will be held responsible for any error resulting from his/her failure to verify the figures shown on the drawing before laying out the work.

4. No extra charge will be allowed on account of slight variations between field dimensions and dimensions given on the drawings.

D. Mechanical and Electrical Coordination

1. Connection to Existing Equipment

a. The Contractor shall make arrangements with Planning, Design and Construction, through the Project Representative, before connecting to existing facilities. Unless otherwise noted, if interruption of service is required it shall be done at the convenience of the Owner.

1.2 CONSTRUCTION PROGRESS DOCUMENTATION

A. Construction Schedule Development/Coordination Responsibilities.

1. The Critical Path Method (CPM) will be used to plan, schedule, execute and report status of work under this contract. It shall include and properly coordinate dates for performance of all divisions for each major portion of the Work, and including completion of off-site requirements and tasks if request by Project Representative.

   a. Within fourteen (14) calendar days of the Letter of Intent or contract award, the Contractor shall develop a proposed Baseline schedule for the Work, and submit it to each subcontractor to incorporate their own work.

   b. All subcontractors, both direct and indirect, shall, within seven (7) calendar days of receipt of the Contractor's Schedule, submit revisions, comments and feedback to the Contractors, which shall be incorporated into the proposed schedule.

   c. Upon receipt of the schedule from the Subcontractors, the Contractor will incorporate Subcontractors information into the Baseline Construction Schedule with appropriate logic ties and Contract Milestones, and distribute to the Architect/Engineer and Owner within seven (7) calendar days. Thus the Contractor Schedule development will be completed within twenty-eight (28) calendar days from Letter of Intent or Contract, awaiting Owner approval.

   d. After project schedule has been accepted by the Owner the Contractor within five days (5 days) schedule a meeting with all subcontractors to review and encourage schedule compliance.

2. **All Subcontractors shall cooperate with the General Contractor to prepare and maintain the Construction Schedule, which shall include, without limitation, the following information at the General Contractor request.**

   a. Shop Drawing review and approval, product procurement, fabrication, shop inspection, and delivery dates including lead times. Note: A/E shall be given 14 days upon receipt of submittal to review and return submittal.

   b. Each phase of the Work, including the Punch List, Project Closeout requirements, Contract Completion and Occupancy;

   c. Milestone dates that are required by the Contract Documents and Progress Milestones. Milestones should typically be based on the critical path and not exceed one (1) month between milestones.

   d. The critical path of the Work

e. Planned disruptions and shutdowns due to other operations, facilities and functions, if any.

3. Upon receipt of the proposed Construction Schedule, the Architect/Engineer (A/E) and Owner (or other designee of the Owner), shall review the Construction Schedule and submit a copy of the Construction Schedule with comments to the Contractor within seven (7) calendar days. Within five (5) calendar days of review of comments from the Owner, all requested changes shall be incorporated in to the baseline Construction Schedule and a printout and electronic copy shall be provided to the Owner. Thus, the Contractor Schedule development with Owner review and Contractor modifications/changes shall not exceed forty (40) calendar days from the Letter of Intent.

4. **No progress payments will be made to the Contractor without a Baseline Construction Schedule approved by the Owner (or other designee of the Owner).**

5. Unless otherwise specified in the Contract Documents or waived in writing by the Owner, the Contractor shall provide **monthly progress reports, at a minimum,** to the Architect/Engineer and the Owner, which shall include recommendations for adjusting the construction schedule to meet Milestone Completion dates and contract completion dates.

6. An updated construction schedule shall be submitted each month to the Project Rep. The Project Rep shall review the submittal, provide comments as necessary. No **payment will be made without an updated construction schedule approved by the Project Representative.**

7. When it is apparent to the contractor and A/E that critical path activities, scheduled Milestone completion dates, or contract completion dates will not be met, the Contractor shall submit to the Owner for review and approval, a plan to avoid or minimize any delay. Such a plan may include, without limitation, increasing the Contractor's workforce; increasing the number of working hours per shift, shifts per workday, workdays per week, the amount of construction equipment, and rescheduling of activities, or any combination thereof; to achieve maximum practical concurrency of work efforts and eliminate the cause of such delay. The Contractor agrees that such actions as described in this paragraph or other action deemed necessary by the Contractor will be taken promptly and without additional cost to the Owner.

8. Any request for time extensions or damages due to delay will only be considered where it is proven by the Contractor, using acceptable scheduling techniques, that the project's contractual intermediate milestones or contract completion dates have been directly impacted by the alleged issue causing the delay. This does not preclude the Contractor's right to finish the Project early. It does explicitly establish the condition upon which the Contractor shall be entitled to request time extensions or delay damages.

B. Construction Schedule Technical Requirements

1. A simple bar chart construction schedule shall be prepared by the Contractor an initially submitted to the Owner prior to or at the first Pre-Construction Meeting.

2. The Construction Schedule shall include without limitation, milestones, shop drawing submittals with time allowed for Owner approval, procurement and construction of all major items of work, depicted in weekly increments.

3. The Contractor shall submit updates to the Construction Schedule on no less than a monthly basis and shall submit updates with each Application for Payment, as required by paragraph 3.10 of the Conditions of the Contract.

4. The Contractor shall coordinate its work with the Owner and other Subcontractors and shall cooperate with other Subcontractors by utilizing orderly progress toward completion in accordance with the work scheduled.

1.4 SUBMITTALS

A. Submittal Schedule

1. Concurrently with the development of the Contractor's Construction Schedule, the Contractor shall prepare a complete schedule of submittals. Submit the initial Submittal Schedule along with the Construction Schedule, at, or prior to, the Pre-Construction Conference.

   a. Coordinate the Submittal Schedule with the list of subcontracts, Schedule of Values, and the list of products, as well as the Contractor's Construction Schedule.

   b. Prepare the schedule in chronological order. Provide the following information:
      - Scheduled date for the first submittal
      - Related section number or specification number
      - Submittal category (Shop Drawing, Product Data, Calculations, Test Results or Samples.
      - Name of the subcontractor
      - Scheduled date for resubmittal
      - Scheduled date for completion of the A/E's review

2. Distribution: Following the Owner's response to the initial submittal, print and distribute copies to the Project representative, A/E, Owner, subcontractors, suppliers and other parties required to comply with the submittal dates indicated. Keep copies at the Project Site at all times.

   a. When revisions are made, distribute to the same parties and post at the same locations. Delete parties for distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

3. Schedule Updating: Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting, or as requested by the Project Representative.

A. Submittals are required for, but are not limited to, each of the following. The Contractor should refer to each of the following referenced sections for additional requirements of each submittal. All submittals are to be processed electronically using Unifier.

1. GENERAL SUBMITTALS
Section 012000 for Contract Breakdowns
Section 013000 for Safety Documentation
Section 017000 for FADE Log

2. AS-BUILT DRAWINGS
As-built Drawings are required as specified in Section 017000.

3. CERTIFICATES OF INSPECTION
Certificates of Inspection are required as specified in Section 017000.

220500 for Plumbing Permits and Inspection
223500 for Boiler Permits and Inspection
260500 for Electrical Permits and Inspection

4. OPERATION AND MAINTENANCE DATA
Operation and maintenance data is required as specified in Section 017000.

5. GUARANTEES
Guarantees are required as specified in Section 017000.

6. SAMPLES
Samples are required as specified in Section 013000 for the following items:

7. SHOP DRAWINGS
Shop drawings are required as specified in Section 013000 for the following items:

8. TEST AND BALANCE REPORTS
Test and balance reports are required as specified in TESTING, ADJUSTING, AND BALANCING FOR HVAC, Section 230593.

B. Shop Drawings and Samples

1. The Contractor shall review, stamp with their approval, and submit via the Unifier Submittal process to the Project Representative all Shop Drawings and Samples asked for in these specifications, or deemed necessary by the Architect/Engineer.

2. Work will not begin on any item requiring Shop Drawings or samples until the Contractor receives approval in writing from the Architect/Engineer. Any material or item, ordered or fabricated prior to final approval shall be at the Contractors' risk. No changes shall be made on the approved drawings or samples without the written consent of the Architect/Engineer. Each Shop Drawing or Sample shall be properly identified as to MSU project title and number, Contractor, item, etc., with cover sheet, stamp, tag, etc., so as not to be confused with any other. The Contractor shall direct specific attention with written explanation to any deviation from what is specified or shown on the drawing.

C. Shop Drawings

1. The Shop Drawing will be identified by job name, date, Contractor name and name of person reviewing for compliance with Contract Documents. Shop Drawings are drawings, diagrams, schedules and other data specifically prepared by the Contractor to illustrate some portion of the Work for which submittals are required by the Contract Documents. The purpose of their submittal is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

2. The Contractor shall review for compliance with the Contract Documents, approve and submit to the Owner all Shop Drawings required by the Contract Documents. Submittal shall be with reasonable promptness and in such sequence as to cause no delay in the Work or in activities of the Owner or their separate Contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Owner without action.

3. By approving and submitting Shop Drawings the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

4. The Owner will review and approve or take other appropriate action on the Shop Drawings submitted by the Contractor only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Review of Shop Drawings 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 Owner's review shall not constitute approval of safety precautions or, unless otherwise stated by the Owner, of any construction means, methods, techniques, sequences or procedures. The Owner's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

E. Samples

1. Samples shall be submitted as directed to provide a representative sample. Samples shall be physical examples, from the actual materials, to be used whenever practical. All packing and transportation charges on samples shall be paid by the Contractor.

2. A Submittal record shall be created in Unifier for each sample, indicating the manufacturer and specifications, and informing the Owner of the status of delivery of the physical sample. The physical sample will be retained by the Owner. The Submittal record will be returned to the Contractor with a review status by the Owner.

3. Approval of Samples shall be generally for quality, color, and finish, and shall not modify the requirements of any of the Contract Documents as to dimensions or design.

1.5 SPECIAL PROCEDURES

A. Constructor Safety Requirements

1. MIOSHA regulations apply to all university projects. Each constructor is responsible for ensuring compliance with "all applicable requirements" that govern their work, including any additional regulations, interpretations, clarifications, and consensus standards incorporated therein by reference.

2. MSU-specific safety requirements are published in the Constructor Safety Requirements Manual. The most current version of this manual is available at http://www.ehs.msu.edu/contractors. Constructors will be held to the version of the manual in effect at the time of contract execution.

3. Requirements specific to work at Michigan State University generally fall into one of two categories:

    a. Administrative Requirements, such as but not limited to communication, planning, documentation, submittals, notifications, reporting, and inspections.

    b. Safety Requirements unique to work at MSU, such as but not limited to Control of Hazardous Energy/Lock Out Tag Out, Confined Space, Electrical, Excavations, Fall Protection, Hot Work, etc.

4. Constructor shall submit a Site-Specific Safety Plan or work under an existing Area-Specific Safety Plan where allowed, as described in the MSU Contractor Safety Requirements Manual.

B. Hazardous Materials

1. If the Contractor suspects a material, preexisting or newly discovered, within the scope of this project to be a hazardous material such as, asbestos, lead, polychlorinated biphenyl or any other potentially hazardous material, that has not already been identified and/or in the scope of work for the Contractor to abate, notify the Project Representative immediately. Do not impact or disturb the material in question until it has been determined to either be non-hazardous, included in the original scope of work, or until other arrangements can be made with the project representative and the MSU Department of Environmental Health and Safety (EHS).

2. Due to the age of buildings on the Michigan State University campus, all coated surfaces shall be assumed to contain lead-based paint. This includes but is not limited to any type of paint, primer, coating, lacquer, or varnish on any building component. Proper precautions must be taken to ensure that workers and building occupants are not exposed to airborne lead concentrations at or above the OSHA Action Level (AL) of 30 ug/m3.

3. If work will be conducted on any coated surface at MSU, the contractor must submit to the Department of Environmental Health and Safety (EHS) and Infrastructure Planning and Facilities Project Representative current proof of appropriate detailed written lead work plan in accordance with 29 CFR § 1926.62 (Michigan Part 603). This submittal will include proof of training, written respirator program, and negative exposure assessments from projects with similar conditions at a minimum. Contractors performing work on campus must follow the provisions of the MSU Lead Management Program from EHS.

4. Any work that impacts Lead shall comply with the provisions of the MSU EHS Lead Management Plan.

5. Any work that impacts Asbestos shall comply with the provisions of the MSU EHS Asbestos Management Plan.

1.6 Requests for Information

A. Requests for Information (RFI's) shall be processed within PlanGrid, using the RFI business process in the IPF PlanGrid Standardization Guide. Failure to complete the tasks within the Plangrid time frames shall not be a basis for a delay claim.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used

END OF SECTION

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 REGULATORY REQUIREMENTS

A. Applicable Codes, Standards, and Regulations

1. The following list of codes and regulations, establish the minimum requirements applied to work done at MSU. Where the specifications or plans, exceed the applicable code, the specifications and plans shall be followed.

a. NFPA National Fire Codes.
b. NFPA National Electrical Code.
c. ICC International Building Code.
d. ICC International Plumbing Code.
e. ICC International Mechanical Code.
f. State of Michigan Elevator Safety Act - Act 227, P.A. 1967.
g. State of Michigan Boiler Act - Act 290, P.A. 1965.
h. State of Michigan Construction Code Act - Act 230, P.A. 1972, as amended.
i. State of Michigan Occupational Safety and Health Act - Act 154, P.A. 1974, as amended.
j. Americans With Disabilities Act (ADA) Public Law 101-336.
k. Regulations of Air Pollution Control Commission State of Michigan, and the Federal Clean Air Act (42 U.S.C. 1857C - 8 © (1)).
l. Soil Erosion and Sedimentation Control - Act 451 of 1994, parts 31 and 91, as amended.
m. Environmental Impact Statement Executive Order 1974-4.
n. State Fire Safety Board's New Rules for Schools, Colleges, and Universities.
o. State of Michigan Safe Drinking Water Act, P.A. 339 of 1976, and Federal Water Pollution Control Act (33 U.S.G. 1319 ©).
p. State of Michigan Energy Code (Adopting ASHRAE 90 by reference).

1.2 REFERENCES

A. Abbreviations and Symbols

1. AIA - American Institute of Architects
2. ACI - American Concrete Institute
3. AISC - American Institute of Steel Construction
4. ANSI - American National Standards Institute
5. ASTM - American Society for Testing Materials
6. BOCA - Building Officials and Code Administrators
7. LEED - Leadership in Energy and Environmental Design
7. NFPA - National Fire Protection Association
8. OSHA - Occupational Safety and Health Act
9. SMACNA - Sheet Metal and Air Conditioning Contractors National Association

10. MDOT - Michigan Department of Transportation
11. USGBC - U.S. Green Building Council

1.3 QUALITY CONTROL

A. Testing Laboratory Services

1. All work (materials and installation procedure) shall be tested and inspected by an independent testing and inspection agency, approved by the Project Representative to provide the quality control requirements in accordance with these specifications. Results of these tests and inspections when performed in accordance with these specifications will not be disputed by either party. Failure of the Contractor to provide quality control in accordance with this specification may result in the replacement of the work at the Contractor's expense.

B. Contractor's Responsibilities

1. Submit the name of the proposed testing and inspection agency(s) to the Project Representative for review and approval prior to contracting for such services.

2. Employ and pay the cost of independent testing and inspection as required in this specification. Pay applications from the testing/inspection agency shall be reviewed by the Owner before the Contractor's pay request for testing/inspection services is approved.

3. Advise the testing and inspection agency sufficiently in advance of the work to be inspected in the field to allow time to schedule personnel and equipment to perform the required inspections. Failure of the work to be inspected shall be the sole responsibility of the Contractor regardless of the fault of the testing and inspection agency.

4. Furnish certificates to authenticate the type and or quality of products furnished for installation as required in these specifications.

5. Shall notify the Project Representative in a timely manner when and where testing is to take place to provide sufficient time for the Project Representative to be in attendance.

C. Testing & Inspection Agency Responsibilities

1. Perform all testing and inspection of the work in accordance with these specifications.

2. Furnish qualified personnel and sufficient equipment in a timely manner when required by the Contractor and/or Project Representative to perform all testing and inspection in accordance with these specifications.

3. Provide written reports (2 copies) in a timely manner of the work tested and inspected. The reports shall include complete material test results and for in-place material, a sketch showing the exact location where the test was taken on the project site.

4. The inspection and testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirements of the Contract Documents, nor to approve or accept any portion of the work.

5. Work will be checked by representatives of the testing agencies as it progresses, but failure to detect any defective work or product will not in any way prevent later rejection when such defect is discovered, nor will it obligate the Owner to final acceptance. When it appears that the work or product furnished is in non-conformance with the Contract Documents, the representative of the testing agency will direct the attention of the Project Representative and Contractor to such non-conformance.

6. Quality control testing items shall include the following:

    c. Concrete testing

D. Authority of the Project Representative

1. May order additional tests and inspection beyond those required, if in their opinion, the subject work may not meet specification. The costs for these tests and inspections shall be borne by the Contractor.

2. May terminate the testing and inspection agency. The Contractor shall then furnish to the Project Representative the name of an additional agency for approval.

3. May perform quality control tests and inspections.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1- GENERAL

1.1 TEMPORARY UTILITIES

A. General

1. The Contractor for the general construction work shall be responsible for all items specified in Section 015000. The Contractor shall install and maintain all items until project is finished and shall remove same and restore areas to their original conditions.

B. Temporary Electricity

1. The Contractor may use any permanent electrical outlets in the construction area.

2. Construction lighting shall be turned off during unoccupied periods, with the exception of lighting required for safety reasons such as path of egress.

3. Temporary service for heavy loads, or where no other service is available, will be provided by the general Contractor at the Contractor's expense. Power for temporary service connected to public utility company lines, (before an MSU service meter) will be paid for by the Contractor. Power for temporary service connected to the MSU power system, or after an MSU service meter, will be furnished by the Owner at no charge.

4. The contractor shall install temporary lighting within the construction area consistent with MIOSHA requirements.

C. Temporary Heat

1. All equipment and labor for temporary heat shall be furnished by the Contractor. Use of University utilities for temporary heat will be at the discretion of the Owner. The cost of natural gas or steam for heating new structures or other applications requiring temporary heat will be paid by the Contractor.

D. Temporary Telephone Service

1. If there is no University phone at the immediate work site, the Contractor shall provide a temporary job site telephone and/or provide the Job Superintendent with a phone activated paging device or cell phone.

E. Temporary Water

1. Each Contractor may use water for construction purposes from the nearest University source.

F. Temporary Sanitary Facilities

1. A toilet in the work area may be used by the Contractor's employees.

2. Where there is no toilet in the work area, an approved chemical type portable toilet will be provided by the Contractor.

1.2 VEHICULAR ACCESS AND PARKING

A. Parking Regulations

1. Unless otherwise directed, all non-University personnel working on the Campus of Michigan State University are required to park as Visitors. Between 7:00 a.m. and 6:00 p.m., Monday through Friday, Visitors may park only in metered parking spaces or gate controlled parking lots.

2. Commercial permits are available from the Department of Police and Public Safety (355-8440), which will allow parking in specific areas. The cost of a commercial permit is the responsibility of the Contractor.

3. Permits for one day parking in areas reserved for university employees are available to Contractors or their personnel from the Department of Police and Public Safety at the current rate, with a signed note from the Project Representative.

4. Parking permits are not required for vehicles south of Mount Hope Road.

5. The Contractor will be responsible for developing and maintaining an adequate employee parking area within the construction fence. The minimum surface of such an area shall be gravel paving. MSU parking permits will not be required in the Contractor maintained lots. At the completion of the project, all temporary parking provisions will be removed and the site restored.

6. Remote parking for Contractor personnel is available in parking lot _____ at a cost of _____ per vehicle. Due to the limited number of faculty/staff parking spaces in the vicinity of the construction site, no general commercial permits will be issued.

1.3 TEMPORARY BARRIERS AND ENCLOSURES

A. General

1. The Contractor shall provide, install, and maintain necessary temporary barriers, warning signs, and other safety measures to protect the public, property, and plant growth.

2. The Contractor will be required to work within limitations imposed by the University Police and Public Safety Department with respect to vehicular and pedestrian traffic. When approved by the Owner, if it becomes necessary to occupy a traffic lane for **ANY** length of time, proper directional signs, flashers and barricades shall be provided at the Contractor's expense in accordance with the most recent edition of the Michigan Manual of Uniform Traffic Control Devices. The Contractor will replace if damaged or stolen, all barricades, flares, and night protection at Contractor's expense, all being considered as incidental to the work.

B. Dust Control

1. Temporary Partitions

a. The Contractor shall construct necessary temporary partitions to isolate the new work from the existing building.

b. Unless noted otherwise, construct partitions of 2" x 4" wood studs, 16" on center and heavy mil, fire retardant plastic sheeting securely attached so as to keep dust, dirt, and debris from spreading beyond the work area.

2. Return Air Openings

a. The Contractor shall block all return air openings in the work area so that dust will not carry into other areas of the building.

3. Site Dust

a. The General Contractor shall be responsible for eliminating airborne dust in the work area and staging area by application of appropriate mitigation measures, as approved by the Owner.

C. Security Measures

1. Temporary & Access Keying

a. The MSU Infrastructure Planning and Facilities Key Shop will furnish construction keys, and furnish and install construction cores for use during construction as deemed necessary by the Project Representative. The Contractor may pick up the construction keys at the Key Shop with the form, "Authorization for Construction Cores and Keys," completed and authorized by the Project Representative.

b. All construction keys and facility keys issued to a Contractor for a particular project will be returned to the Project Representative before final payment will be processed. If keys are not returned, the Contractor may be held responsible to pay for re-keying any and all affected facilities.

2. Campus Security and Access Control System

   a. When deemed necessary by the Project Representative, temporary security access cards will be issued to the Contractor for building exterior doors, rooms, and/or spaces that are secured by the Campus Security and Access Control System.

   b. On construction projects where the security system is active and armed during construction the Contractor will be assessed a false alarm fee for any unauthorized entry of a secure space and/or setting off an alarm by propping open secured doors/windows, cutting into the security wiring, removing security devices, or any other action causing an alarm.

   c. The false alarm fees shall be as follows:

First occurrence	No assessed fee
Second occurrence	$500
Third and subsequent occurrences	$1,000 each

   d. The breaches of security and associated fees shall be assessed by project to the Contractor, not by sub-contractor, vendor, supplier, etc.

D. Campus Woody Plant Protection

1. Coordinate all plant protection and site work limits with the Project Representative. SITE WORK CANNOT COMMENCE WITHOUT A PRE-CONSTRUCTION WALK-THROUGH.

   All Contractor employees engaged on the project site shall attend, or are expected to have attended, the Contractor Woody Plant Protection Seminar, hosted by MSU's Landscape Services (formerly Grounds Maintenance) Division. This seminar will be presented on an annual basis at a minimum. Coordinate with the Project Representative for times and locations of the seminar(s).

2. Work by Owner

   a. Tie-back of existing plantings. Pruning, thinning, and sealing of existing plantings. Root pruning and root protection of exposed roots. Watering of existing trees under stress. Salvaging of existing small trees, shrubs, and other plant growth that the Owner wishes to retain.

   b. Tree protection barricades will be provided by the Owner. Plant damage occurring within installed barricades does not absolve the Contractor from damage assessment.

   c. Work shall be performed by MSU Landscape Services Department unless otherwise arranged, as needed to provide either preventative or remedial care to plants on a construction site. Contractor shall immediately contact the Project

Representative should "protected plants" be compromised in violation of agreed upon fencing locations and work limits. Failure to communicate promptly could result in 100% damage assessment of fines.

3. Protection of Plantings

a. Protect existing trees and other vegetation indicated to remain in place. Prohibited practices include breaking of branches, scraping of bark, or unauthorized cutting; nailing or bolting into trees or plants; use of trees or plants as temporary support (i.e. for cables); unauthorized filling, excavating, trenching or auguring within the root zone; compaction/driving over the root zone; (see definitions below), storage of any materials or vehicles within the root zone; dumping of construction waste or materials (including liquids); unauthorized removal or relocation of woody plants; removal of tree protection barricades or construction fencing prior to completion of project.

b. Compaction within the root zone is the increasing of the soil density caused by heavy equipment or concentrated foot traffic which significantly alters the soil conditions from that which was present prior to construction.

c. The root zone of a tree is one and a half the distance of plant crown drip line outward from the stem, along undisturbed grade. Should placement of concrete be specified or authorized by the Owner within the root zone, a sulfur application will be applied by the Owner. The Contractor shall notify the Owner at least 48 hours prior to pouring concrete. Trees to receive sulfur shall be identified by Owner.

4. Damage

a. Damage to campus woody plants shall include any of the items indicated in paragraph 2.a above as determined solely by the Owner. The Owner shall evaluate damage and establish proportional fines up to 100% of the value shown below, regardless of the current disposition of the plant.

b. 100% Value Schedule for Campus Trees

1" - 3" caliper	$200/inch
3" - 6" DBH	$290/inch
6" - 9" DBH	$380/inch
9" - 12" DBH	$480/inch
12" - 15" DBH	$670/inch
15" DBH or greater	$960/inch

c. DBH is the tree trunk diameter at breast height.

d. Replacement value for shrubs, vines, and perennials shall be assessed at three times the current market cost of the plant.

e. Alternatives to the above protective measures, or any variations, must be approved by the staff Landscape Architect and the Project Representative. (Measures may include: thinning and root pruning, fertilization, aeration, boring & jacking, hand excavation, supervision by campus arborist, seasonal schedule recommendations.) Alternatives would be based on the specific requirements of the plant species in question, as determined by the staff Landscape Architect.

1.2 TEMPORARY CONTROLS

A. Soil Erosion and Sediment Control (SESC)

1. The Contractor shall comply with all Contract Documents, approved SESC plans, permit conditions and with Parts 31 and 91 of Public Act 451 of 1994. The Owner shall obtain a Soil Erosion and Sedimentation Control (SESC) permit from the appropriate Municipal (MEA) or County (CEA) Enforcing Agency. Permit Fees and MEA/CEA routine inspections will be paid for by the Owner.

2. Prior to beginning any earth change, the Contractor shall retain a DEQ Certified Storm Water Operator (CSWO) to provide the required SESC reports (which include the weekly and storm event reports as well as all follow up reports for both violations and storm event corrections) on the standard DEQ form. The Contractor shall provide the reports to the Owner on a weekly basis, and retain those reports for 3 years.

3. Prior to beginning any earth change, and during the life of the contract, the Contractor shall install and maintain all temporary SESC measures as shown on the Contract Documents, SESC plans, and as directed by the Owner, CSWO, DEQ, or MEA/CEA, until MSU officially takes over responsibility for the site.

4. Immediately prior to MSU taking responsibility for the site, the Contractor:
   a. Will be required to clean all catch basins affected by the construction, both within the Contract Limits and all surrounding roads and lawn areas when soil may have spread as the result of construction activities.
   b. Shall put all temporary SESC measures in satisfactory condition as determined by the CSWO.

5. All temporary SESC measures will remain in place and will become the property of the Owner when responsibility for maintaining the SESC measures becomes the Owner's responsibility.

6. The Contractor shall conduct all excavation, filling, grading and clean-up operations in a manner such that sediment generated by wind or water is not discharged off site or into any storm sewer, drainage ditch, river, lake, air or underground utility system. Stage the work per plan to minimize the area of exposed soil, thereby reducing the opportunity for soil erosion.

7. Water from trenches and other excavation shall be passed through an approved filtration bag to remove sediments from the water before it is released into the storm water drainage system.

8. If sediment extends beyond the project limits, the Contractor shall be responsible for cleanup and restoration of all surfaces and utility systems to the condition that existed prior to the Contract award.

9. All SESC measures shall be maintained daily.

10. Should violations (irrespective of a fine being assessed) be identified by the Owner, CSWO, MEA/CEA or DEQ, they shall be corrected within 24 hours of notification. The correction(s) shall be approved by the Owner, CSWO, MEA/CEA or DEQ. All subsequent inspections performed by the Owner, CSWO, MEA/CEA or DEQ as a result of the violation (and any other associated costs) will be paid by the Contractor. If identified violations are not corrected within 24 hours of written notice, the Owner shall have the right to make necessary repairs at the Contractor's expense, without being required to provide further notice to Contractor.

11. Fines assessed as a result of the violation for non-compliance of the SESC provisions, will be paid by the Contractor. If a "Stop Work" order for non-compliance is issued, a time extension request for that time period will **not** be granted. (Fines could be assessed up to and including $25,000/DAY for each violation.)

12. Only one Seven Day Notice will be issued for violations of the SESC provisions. Should subsequent violations be identified, the contractor will be expected to make the satisfactory correction within 24 hours of notification. Should the corrections not be made, the Owner, without further notice to the Contractor, will correct the violation. The cost of the corrective action will be charged to the Contractor.

1.5 CONSTRUCTION DEBRIS CONTROL

A. The Contractor shall provide and administer a system for disposal of construction debris, and shall be responsible for seeing that the site and the new building are at all times free of accumulated debris caused by the construction. For purposes of this paragraph, debris shall include ALL materials used in construction including construction roads and pads. Special attention should be given to materials that could leach into the ground, including but not limited to lime based materials, all chemicals, and any liquids except clean water.

B. The Contractor shall comply with LEED Materials & Resources Credit 2, including documentation of the Construction Waste materials recycled, reused and sent to the landfill, using the Construction Waste Management form and process provided by the Owner in Unifier. This form shall be submitted monthly, and will be generated from completed payment applications. Negative reports are required.

C. This shall include, but not be limited to, rubbish containers conveniently located throughout the site for the daily disposal of debris directly into them from each work location. Debris

shall not be allowed to accumulate on the ground through-out the site overnight.

D. All combustible debris shall be removed to a solid waste disposal site properly licensed under Act 87 of the Public Acts of 1965 of the State of Michigan.

E. No burning of debris will be permitted on the Project site or elsewhere on the Owner's property.

F. Should the Contractor not execute the work required in this section, the Owner reserves the right to perform the work by other forces and deduct the cost from the contract price.

1.6 CONFINED SPACES

A. The workplace may contain permit confined spaces and entry is allowed only through compliance with a confined space program as defined by 29 CFR 1910.146. The contractor is responsible for assessing real or potential atmospheric hazards and other serious safety and health hazards in the confined space. MSU will make available records of known confined space hazards. The contractor shall provide all necessary equipment for confined space entry. If MSU personnel will be working in or near confined spaces occupied by the contractor, the contractor is required to coordinate activities with the Project Representative. The contractor will inform the Project Representative of procedures followed and hazards confronted or created during entry operations.

1.7 LOCK-OUT/TAG-OUT PROCEDURE

A. The Contractor shall conform to Michigan State University Infrastructure Planning and Facilities lock-out/tag-out procedure. Copies are available from Planning, Design and Construction, Infrastructure Planning and Facilities Building, Michigan State University.

1.8 FM RED TAG PERMIT MONITORING SYSTEM

A. When working on fire protection sprinkler systems the Contractor shall conform to the Factory Mutual Red Tag Permit Monitoring System modified by notifying the Project Representative in lieu of the Emergency Organization, Public Fire Department, and Factory Mutual. Documentation is available from Factory Mutual, (781) 255-4359.

1.9 FM HOT WORK PERMIT SYSTEM

A. For all hot work operations, the Contractor shall conform to the Factory Mutual Hot Work Permit System modified by notifying the Project Representative in lieu of the Fire Safety Supervisor and Factory Mutual. Documentation is available from Factory Mutual, (781) 255-4359.

1.10 HAZARDOUS SUBSTANCE SPILLS

A. Releases of hazardous substances that pose a significant threat to health and safety, or that, by

their very nature, require more than a routine response, are emergency situations. If a release of an emergency nature occurs, call 911 immediately. Provide all applicable information and stay on the phone until told to hang up. If a non-emergency release of a hazardous substance occurs, contact the MSU Infrastructure Planning and Facilities Project Representative immediately.

1.11 ROOF PROTECTION

A. In the event a roof has to be used as a storage, work and/or walkway area, the following protective measures shall be employed.

1. The size and location of the storage, work or walkway areas shall be approved by the MSU Infrastructure Planning and Facilities Project Representative.

2. The storage, work or walkway area protection shall consist of a 1-inch layer of water resistant insulation such as EPS, and a layer of ½ inch plywood. Stagger the seams of the insulation and plywood; use plywood clips to prevent cupping.

3. The perimeter of the area shall be lined with barricades and warning tape to ensure that all traffic will stay on the protected areas.

1.12 CRANE HOISTING

A. Crane hoisting of equipment or materials over occupied spaces shall be performed at the convenience of the Owner, with arrangements made by the Project Representative.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Storage and Protection

1. The Contractor shall be responsible for work, material, and equipment until finally inspected, tested, and accepted. The project shall be protected against theft, injury, and damage. Material and equipment received on the site shall be carefully stored until installation.

B. Staging Area

1. Should the Contractor require exterior staging or on-site storage of materials - the location of this area must be agreed upon prior to actual use of the space by the Project Representative and the Contractor. The area will not be within the drip-line of any tree or in plant beds, as per Section 015000.1.3.D.3.

2. If this exterior area is outside the fenced project site, the area shall be enclosed with a minimum 4' high welded wire fence, with metal fence T-posts not exceeding 8' on center. Fence fabric shall be supported by either a top bar or a tension cable.

3. The Contractor shall be responsible for the cost of placing and removing the fence.

4. Each designated area shall have only one access route from the road or drive.

5. The area is not to be used for employee parking, but may be utilized by the Contractors' vehicles and equipment necessary to service the project.

6. Any areas damaged as a result of the staging operation shall be repaired by the Contractor, at no additional cost to the Owner.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 017000 - EXECUTION REQUIREMENTS

PART 1- GENERAL

1.1 EXAMINATION

A. Pre-Bid Site Inspection

1. Each Bidder shall be held to have visited the site of the proposed work before submitting their proposal and to have familiarized themselves with all existing conditions affecting the execution of the work in this project. No allowance or extra consideration on behalf of the Contractor or Subcontractor will subsequently be made by reason of failure to observe the site conditions.

1.2 PREPARATION

A. Protection of Work and Property

1. Contractor shall protect existing and new work as required by this construction or as requested by the Project Representative.

2. Interior Protection

a. This will include, but not be limited to the wall, floor, and ceiling finishes to remain at the construction site, along the access route to the site, existing elevators, and other areas such as roofs and mechanical rooms where related work is specified or required.

3. Exterior Protection

a. The Contractor shall be responsible for any damage to existing facilities, including but not limited to the following: buildings, trees and shrubs, walks, roads, utility systems, terraces and steps, lights, and unreasonable turf damage as determined by the Project Representative. Damage shall be repaired by the Contractor in accordance with MSU's Construction Standards at no cost to the Owner.

b. No crawler cranes, bulldozers, or other equipment, fitted and running on steel treads, shall be permitted to traverse any walk, road, street, or other thoroughfare on the Campus of Michigan State University. Where it is necessary to unload such equipment on these thoroughfares, and when approved by the Project Representative, planking shall be provided to protect same. If this is not done, and damage is observed, the cost of replacing shall be the burden of the Contractor causing such damage.

c. Staging zones for materials and equipment shall be coordinated with Project Representative. They are to be placed on paved areas where possible. Set-up and storage areas shall be fenced with minimum 6-foot high pedestal-type chain link

fencing. Locations shall be reviewed with the Department of Police and Public Safety and approved by the Project Representative.

d. Crane hoist dates shall be coordinated with Project Representative for sufficient notice to building users. Project Representative shall direct the notice to the building users and coordinate with DPPS.

e. Owner may provide temporary access-ways in turf or root zone areas, as determined in pre-construction walk-through. For heavy equipment on turf areas, Alturna mats or approved equal, must be utilized for travel and set-up zones.

f. All electric, telephone, and steam vaults and water valves shall be protected and remain accessible at all times. Heavy equipment shall not be run over the top of vaults or valve boxes, nor shall materials be stored over them.

g. Contractor shall provide lighted barricades if building entrances or pedestrian walks are closed after work hours or on the weekends.

h. Tree pruning, plant tie-back, and vine removal shall be done by the Owner, as coordinated with the Project Representative, and as noted in Section 015000.1.3.D.2.a. Trees or other plant material shall not be used as anchor points for any lines or equipment.

i. Plant protection as directed by the Project representative:

   a. Minor work: Plants adjacent to, or below work zones are to be washed off daily. In no case shall masonry dust or other construction debris remain on plants for more than 24 hours.
   b. Major work: Plants adjacent to, or below work zones are to be covered with breathable woven mesh tarp. Tarp shall be removed at the end of each day and debris disposed of. Debris and dust shall not be absorbed into soil

1.3 EXECUTION

A. Cutting and Patching – Concrete and Masonry

1. The Contractor shall be responsible for any cutting, fitting, and patching that may be required to complete this project, except for core drilling required for mechanical and electrical installations, which shall be the responsibility of the Mechanical or Electrical Contractor.

2. The Contractor shall not endanger any work of any other Contractors by cutting, excavating, or otherwise altering any other work and shall not cut or alter the work of any other Contractor except with the written consent of the Architect/Engineer.

3. No cutting of structural members of the building, likely to impair its strength, shall be done without written approval from the Architect/Engineer.

4. To avoid damage to hidden utilities and structural re-enforcement any cutting or core drilling over one inch in diameter, through concrete floors and slabs will be x-rayed/scanned by the contractor prior to cutting.

    a. A qualified engineer will conduct an on-site assessment before any cutting or drilling of a pre-tensioned or post-tensioned component or other structural component of a building or structure commences. The assessment will be documented and provided to the person contracted to carry out the work.

    b. If any load bearing member is cut, cored or removed all the requirements of 29 CFR 1926 Subpart T (LARA Part 20) shall apply. This will require notifications to the DEQ 10 working days before cutting begins. Emergency notifications are possible under specific conditions.

    c. The responsible person for the project shall ensure substantial compliance with the requirements for exposure to Silica Dust. Substantial compliance will also be required for all other construction safety standards and published by the State of Michigan or Federal OSHA.

    d. Work shall be conducted outside of the regular hours to avoid disturbing the building occupants. An exception to this rule will be granted only by the project manager and shall be in writing.

    e. The MSU project representative or employee shall be responsible for locating all utilities in the area to be cut. This part of the job is mandatory and shall be given appropriate attention. Minimally the responsible person shall review all available prints and consider structural scanning. The MSU representative or employee shall take necessary steps to isolate and lock out any energy sources that may be jeopardized by the cut to protect worker safety and avoid equipment damage. In some cases, utilities will need to be cut and relocated to conduct the work. The responsible person shall take steps to notify repair persons in advance of the anticipated timing and scope of the repair project or the need for temporary services.

    f. Responsible person shall inspect the area to ensure that no damage has occurred and that the area is cleaned to an acceptable level.

5. Cutting and Patching for Mechanical Work

    a. The Mechanical Contractor shall be responsible for any core drilling required to complete their work.

    b. The Mechanical Contractor shall be responsible for the accurate location of all openings necessary for the installation of the mechanical work. Any additional openings required to move their work due to an error in the initial layout and the repair of inaccurate openings, shall be made at the expense of the Mechanical Contractor.

6. Cutting and Patching for Electrical Work

   a. The Electrical Contractor shall be responsible for any core drilling required to complete their work.

   b. The Electrical Contractor shall be responsible for the accurate location of all openings necessary for the installation of the electrical work. Any additional openings required to move their work due to an error in the initial layout and the repair of inaccurate openings, shall be done at the expense of the Electrical Contractor.

B. Salvaging of Materials

1. Materials or equipment shown on drawing or specified herein to be removed, which are not to be reused or salvaged, shall become the property of the Contractor and will be removed from University property and disposed of legally.

2. Salvage the following items to the locations as directed:

   a. Face brick
   h. Limestone cap

3. Deliver all fire alarm equipment removed from the job to the IPF Storage Building 210, 1457 Recycling Drive, East Lansing, MI.

4. Deliver all Best key cylinders to be removed from the job to the Key Shop in the Infrastructure Planning and Facilities Building, 1147 Chestnut Road, East Lansing, MI.

5. Salvage of Brick and Stone

   a. Salvage brick and stone for patching areas shown on the drawings. All materials shall be carefully palletized and stored at the site. The Contractor shall take special care in handling stone to avoid chipping corners and scarring faces.

1.4 CLEANING UP

A. Cleaning up shall be in accordance with the General Conditions of the Contract.

B. No rubble, dust, or debris shall be allowed to accumulate or be transported throughout the building.

C. A thorough final cleaning of all of the adjacent streets, as specified by the Project Representative, will be required before final payment is made.

D. If the Contractor fails to clean up, the Owner may do so and the cost thereof shall be charged to the Contractor.

1.5 STARTING AND ADJUSTING

A. Refer to each Division for requirements.

1.6 CLOSEOUT PROCEDURES

A. In general, one or more walk-throughs will be performed with the Contractor and punch lists developed of items to be completed before the project can be closed out.

1.7 CLOSEOUT SUBMITTALS AND PROJECT DELIVERABLES

A. Operation and Maintenance Data

1. The Contractor shall provide operation and maintenance data as required in this specification, and submit the required information through use of the Unifier and PlanGrid systems.

2. Submittals for equipment and systems shall contain the manufacturer's information on installation, balancing, operating, maintenance, lubrication, and repair instructions and parts list for each component.

3. Please refer to MSU Document Submittal Standards and PlanGrid Standardization Guide.

B. As-Built Drawings

1. Submission of all As-built Drawings called for in this specification shall precede request for final payment.

2. The Contractor shall submit As-built Drawings in electronic (.pdf) format, that is not password protected, indicating any deviations from the Contract Drawings, including contract Change Orders. Upon request of the Owner, printed copies of the As-Built drawings shall be provided as well.

3. Provide any Building Information Model (BIM) data developed for this Project to the Project Representative.
4. Please refer to MSU Document Submittal Standards

C. Facility Asset Data Exchange (FADE) Log

1. The Constructor shall furnish all information as indicated on the FADE log spreadsheet. The University's FADE procedure and requirements for asset tracking and populating the log can be found at the following web addresses:

FADE process during design phase:
https://us.promapp.com/msu/Process/Minimode/Permalink/BrVwOrmhTRjBaJ5QaaOZKI

FADE process during construction:
https://us.promapp.com/msu/Process/Minimode/Permalink/BDKsT36upoGpxJeNiakDkW

Should the Owner change the FADE process change in form or content, the Constructor is not relieved of fully executing the work required to compile the information and complete the Log.

E. Certificates of Inspection

1. The Contractor shall provide a copy of all Certificates of Inspection called for in this specification. Refer to Section 013000 Part 1.4.B.

F. Construction Waste Management – LEED Documentation

1. The Contractor shall provide written documentation of the Construction Waste Management program, as required for LEED Materials & Resources Credit 2. A form for this purpose is provided within this specification. Refer to Section 024200, Construction Waste Management.

G. Warranty

A. The Contractor shall provide a written guarantee stating that all work performed and material furnished is free from all defects in workmanship, and material for a period of one year, unless noted otherwise, after the equipment has been accepted by the Owner. Final payment or Certificate of Substantial Completion, whichever is issued first, shall constitute Owner acceptance.

B. Additional warranties are required for site concrete pavement (Section 321313), curb/gutter (Section 321613), bituminous pavement (Section 321216), and specific mechanical equipment (Division 23)

H. Final payment

A. The contractor shall provide a sworn statement with final payment. The statement shall detail all subcontractors paid on the project and other information detailed in the link below:

https://api.gis.msu.edu/edms/file/{C500C6DD-E852-11ED-0000-76DDD13A85C5}

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 024113– SITE DEMOLITION

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. Provide labor, materials and equipment as necessary to complete work as indicated on the Drawings and specified herein.

B. This section includes the removal of existing structures, fences, pavements, and other items indicated on the Drawings or specified, or both.

C. Related sections include the following:

1. Division 01 Section “General Requirements – Temporary Facilities and Controls.”

1.3 PROJECT CONDITIONS

A. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Project Representative. Provide alternate routes around closed or obstructed traffic ways if required.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 DEMOLITION OPERATIONS

A. At the direction of the Project Representative, certain items within the Project limits may be salvaged by the Contractor to the Owner. Salvaged materials or equipment will be indicated on the Drawings or specified. Salvaged items not indicated or noted to be reinstalled shall be delivered to designated location(s) on campus as directed by Project Representative.

B. Materials to be recycled shall be hauled from the project to Beaumont Landscape Supply, 4080 Beaumont Road, East Lansing MI 48824. Call (517) 884-4880 to coordinate drop-off time and location.

1. Items to be salvaged include, but are not limited to:
   a. Face brick
   b. Limestone cap

2. Materials to be recycled include, but are not limited to:
   a. Concrete material (pavement, curb and gutter, walls and footings)
   b. Topsoil
   c. Clean pavement base aggregate

C. The use of explosives is not permitted.

D. Conduct demolition operations and the removal of debris to ensure minimum interference with adjacent roads, streets, walks, and other facilities, operations and people.

E. Conduct operations to prevent damage by falling debris or other cause to adjacent buildings, structures, vegetation to be retained, and other facilities as well as persons.

F. Promptly repair damages caused to adjacent facilities by demolition operations, as directed by the Project Representative. Repairs shall be made at no cost to the Owner.

3.2 REMOVAL OF PAVEMENTS

A. Saw cut concrete curb and gutter and flatwork on nearest existing joint beyond area required to be removed as shown on the Drawings.

3.3 CLEANUP

A. Contractor shall be responsible for disposing debris from demolition and salvage operations. Disposal of debris shall be done legally off the Owner's property, except that specifically requested for salvage by the Project Representative. Burning of debris is not permitted.

B. During demolition operations, keep dust to a minimum using appropriate methods.

C. During demolition operations, access roads and adjacent concrete pathways shall be maintained broom clean. Roads shall be cleaned by using a pick-up type sweeper. A front-end tractor mounted sweeper is not permitted.

D. The site shall be graded to provide surface drainage and shall be left in a clean condition.

END OF SECTION 024113

SECTION 024200– CONSTRUCTION WASTE MANAGEMENT

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 administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

B. Related sections include the following:

   1. Division 01 Section “General Requirements – Temporary Facilities and Controls.”

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations and clearing debris including soil, vegetation, and rocks are not to be included.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Collect, reprocess and reuse of materials diverted or recovered from solid waste stream.

E. Salvage: Recovery of demolition or construction materials from existing buildings or construction sites and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction materials from existing buildings or construction sites and subsequent incorporation into the Work.

1.4 PERFORMANCE GOALS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 50 (75) percent by weight of total waste generated by the Work.

1.5 SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 14 days of date established for commencement of the Work

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit 2 copies of report. Include separate reports for demolition and construction waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons or cubic yards.
5. Quantity of waste recycled, both estimated and actual in tons or cubic yards.
6. Total quantity of waste recovered (salvaged plus recycled) in tons or cubic yards.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit 2 copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licenses to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number for each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Plan for and describe the means for securing waste containers from unauthorized users.

E. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
2. Observe and follow site measures that prevent cross-contamination of waste.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project. The Construction Superintendent may perform the role of the Waste Management Coordinator.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at the Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities upon execution of their contracts. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area off-site designated by Owner.
5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closes, leave door hardware attached to doors.

3.3 RECYCLING DEMOLITION AND CONTRUCTION WASTE, GENERAL

A. General:

1. Recycle paper and beverage containers used by on-site workers.
2. Concrete, masonry, or asphalt crushed and reused are to be identified and include in calculations.
3. Exclude hazardous waste from calculations.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Separate wood pieces and lumber and comply with requirements for recycling wood.

C. Metals: Separate metal by type or to meet requirements of recycling receiver or processor.

3.5 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow excessive on-site accumulation of waste materials.
1. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
2. Coordinate with each product manufacturer for take-back programs. Set aside scrap to be returned to manufacturer for recycling into new product.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner’s property and legally dispose of them.

END OF SECTION 024200

SECTION 033015 – CAST-IN-PLACE CONCRETE FOR BUILDING CONSTRUCTION

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 furnishing and placement of cast-in-place concrete and the furnishing an installation of post-installed anchors.

B. ACI Standard 347, “Guide to Formwork for Concrete”, shall establish minimum requirements when not otherwise specified in this section.

C. Nothing in this standard should be considered to apply to streets, pedestrian walkways, curbs, steam tunnels, or other concrete that is not part of a building. See Division 32 Sections “Curbs and Gutters” and “Concrete Pavement.”

D. A vapor barrier shall be installed under a slab on grade if required by the flooring manufacturer’s warranty and will comply with that requirement.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this section shall comply with the following:

1. ASTM Standard Specifications:

    a. A36 – Carbon Structural Steel.
    b. E488 – Strength of Anchors in Concrete and Masonry Elements.
    c. E1512 – Testing Bond Performance of Bonded Anchors.
    d. F436 – Hardened Steel Washers.
    e. F594 – Stainless Steel Nuts.

2. ACI:

    a. 318, Chapter 17 – Anchoring to Concrete.
    b. 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete.

3. International Code Congress Evaluation Service – ICC-ES:

    a. AC-308 – Post-Installed Adhesive Anchors in Concrete.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, acceptable to MSU and any other authority having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
2. ACI 301, "Specification for Structural Concrete."

D. Installation Personnel Qualifications:

1. Knowledgeable of the specific Manufacturer’s requirements for proper installation of post-installed anchors.
2. Anchor installers shall be properly trained by the anchor Manufacturer on Site.
   a. Anchor Manufacturer’s representative shall not be a distributor or third party.
   b. The installers to be trained shall be the actual person or persons installing the anchors, not the foreman, superintendent or similar supervisory personnel.
   c. The on Site training shall include training for installation of each anchor in each substrate on the Project for each trade.
   d. Each person installing the anchor shall be trained.
   e. Anchor installation training shall take place prior to the installation of the anchors. The installer shall have training verification available for review at any time.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

1.6 SUBMITTALS

A. Product Data: For each anchor type to be furnished for each base material to which it will be fastened, including:
   1. Anchor specific type, physical properties and installation procedures.
      a. General catalog sheets of anchors without specific reference are not acceptable.
   2. Strength developed by anchor in each base material to which each is being fastened.
   3. Anchor embedment depth in base material.
   4. Anchor material.
   5. ICC-ES Report for each specific anchor indicating compliance to applicable building code.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Wood, plastic, fiberglass or metal, complete with shores, bracing etc. as required, conform to the shapes, lines, and dimensions of the members indicated on the Drawings.

B. Forms for exposed concrete shall be constructed of metal or smooth plywood, or other material to provide a smooth surface finish.

C. Form-Release Agent: Use commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Use a form-release agent formulated with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

A. Bar reinforcement: ASTM A615, Grade 60.

B. Epoxy coated bar reinforcement: ASTM A775, Grade 60

C. Welded wire fabric: ASTM A185. Provide in flat sheets only.

D. Galvanized welded wire fabric: ASTM A1064

E. Wire, bar and chain type reinforcement supports shall be corrosive resistant, hot dipped galvanized, epoxy, or plastic coated in accordance with CRSI recommendations.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I shall be used unless otherwise indicated in the reviewed mix design.

B. Normal-Weight Aggregates: ASTM C 33.

1. Coarse aggregate shall be well graded gravel and crushed stone of hard, durable, uncoated particles, or limestone if specifically required. Other materials such as fly ash and ground blast furnace slag may be included subject to Owner's approval. Gradation and physical requirements to conform to MDOT Specification 6AA (ASTM C 33 one inch maximum size) or as included in the reviewed mix design.

2. Fine Aggregate: Shall conform to the MDOT Specifications for Sand 2NS (ASTM C33).

C. Water: ASTM C 94 and potable.

2.4 ADMIXTURES

A. Admixtures will be allowed as indicated in this section or as included in the mix designs reviewed by the Engineer responsible for the structural integrity of the Project.

B. Air-Entraining Admixture: ASTM C 260.

C. Bonding Admixtures. Specify latex or acrylic bonding agents when placing new concrete against existing concrete. Mix bonding agents in concrete mix in accordance with manufacturer's recommendations when patches require thin and/or feathered sections.

D. Shrinkage Reducing and Compensating Admixture: ASTM C494

1. Approved Product: SikaControl NS

2.5 CURING MATERIALS

A. Damp curing is preferred over using curing compounds to avoid incompatibility with the many finish materials, hardeners, and sealers. Curing compounds shall be used where required by weather, approved construction schedules, and construction that is not adaptable to damp curing.

B. The sodium silicate base curing compounds that follow are compatible with the MSU preferred sealer, most resilient floor covering adhesives, and many paint finishes.

1. "Gardseal"; Lambert Corporation
2. "Sonosil"; Sonnebore Building Products Div. (BASF Building Systems)

C. Utilize other curing compounds as approved by the manufacturer of the finish materials to be installed. Curing compounds should contain a fugitive dye, or, when hot weather conditions dictate, a fugitive heat reflecting pigment.

D. The use of hardeners should be considered for special areas, but the incidental hardening of most curing compounds and sealers has been adequate. Magnesium zinc fluoresilicate hardener is generally compatible with the sodium silicate curing compounds listed above, but is not recommended for finished areas because the surface is often rough and mottled.

2.6 CONCRETE MIXTURES, GENERAL

A. The concrete mix design criteria shall be specified by the Architect or Engineer to meet the project design conditions and minimum loading conditions indicated in these standards. The mix design shall be submitted to the Architect or Engineer for review.

B. Unless specified otherwise by the Engineer, a maximum allowable slump before the addition of water reducer (if any) shall be 4-1/2 inches, air entrainment shall be 5% to 7%, and compressive strength shall be 4,000 psi with a minimum of six sacks of cementitious products per cubic yard of concrete. Use non-air entrained concrete for interior concrete slabs.

C. Add shrinkage reducing and compensating admixture to topping slab concrete mix design in accordance with the manufacturer recommendation.

D. The Contractor shall provide the Project Representative with delivery tickets which shall list slump, sack mix, percent of air entraining agent, time the truck left the plant, time of arrival on the job site, and time of departure from the job site.

E. When requested, the Contractor shall provide documentation from the concrete supplier certifying the concrete meets the specifications of this section.

F. Retempering of concrete will not be allowed.

G. Where conditions make consolidation or finishing of concrete difficult, or where reinforcement is congested, separate concrete mix designs shall be specified, submitted, and reviewed prior to placement. For example, specify concrete with smaller coarse aggregate for concrete fill of metal pan stairs.

2.7 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

B. Welding of reinforcing steel is not permitted.

2.8 VAPOR RETARDER

A. Minimum thickness 10 mil: ASTM E1745

B. Approved Manufacturers: Stego Industries; Reef Industries

2.9 PREMOLDED JOINT FILLER

A. Approved Manufacturers: W. R. Meadows, Inc.; J & P Petroleum Products, Inc.; Celotex Corporation; or equal. ASTM D1751

2.10 PVC WATER STOP

A. Multi-ribbed type with hollow center bulb, 4”, polyvinylchloride.

B. Acceptable Manufacturer: W. R. Meadows, Inc., Elgin, Illinois; Vinylex Corporation, Knoxville, Tennessee; Greenstreak, St. Louis, Missouri; or equal.

2.11 POST-INSTALLED ANCHOR MATERIALS

A. Adhesive Anchors

1. Basis of Design: Hilti

2. Anchors that Resist Loads Through an Injectable Chemical Adhesive:
   a. In Concrete: Hilti HIT HY 200 Safe Set.
   b. In Solid Grouted Masonry: Hilti HIT-HY 270.
   c. In Hollow Brick or Hollow Masonry: Hilti HIT-HY 270 with screen tubes.
   d. Anchored Material: Carbon steel or stainless steel threaded rods or deformed reinforcing bars as specified herein or as indicated on the Drawings.
   e. Bonding Strength: Tested in accordance with ASTM E1512.
   f. If installation temperatures of base materials fall below 41 degrees F, review cold weather applications with Manufacturer.

PART 3 - EXECUTION

3.1 FORMWORK

A. Formwork design shall be the responsibility of the Contractor.

B. Design, erect, shore, brace, and maintain formwork according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied until structure can support such loads.

C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, ice, snow, dirt, and other debris just before placing concrete. The Project Representative shall inspect forms prior to placing the concrete.

I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

K. Forms shall be cleaned and treated each time they are used.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

A. The latest publication of the following standards shall establish the minimum requirements when not otherwise specified in this section:

1. “Placing Reinforcing Bars”: CRSI.

2. “Manual of Standard Practice”: CRSI.

3. “Manual of Structural and Placing Drawings for Reinforced Concrete Structures”: ACI 315R.

B. Fasten the reinforcement securely to supports unless required otherwise by the joint design. At control joints the reinforcement shall be held 1-1/2-inch short of the joint. Reinforcement cover shall conform to ACI 318 requirements.

C. When reinforcing a slab on grade use one of the following methods:

1. Place half the thickness of concrete followed by the laying of the flat reinforcement, followed by the second half thickness and vibrate it into the first.

2. Provide supports for the flat reinforcement to prevent it sinking in the pour.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Placing the concrete shall not commence until the subgrade, reinforcing, and forms have been approved. A sufficient quantity of forms shall be in place to accommodate all of the concrete that is scheduled to be placed at any one time. Concrete shall be deposited with a minimum of rehandling and shall be consolidated, particularly adjacent to forms and joints. In the case of isolation joints, concrete shall be placed simultaneously against both sides of the joint.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

E. Slope surfaces uniformly to drains where required.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg.F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.5 FINISHING FLOORS AND SLABS

A. General: When not otherwise specified below, comply with ACI 302.1R recommendations for screeding, restraightening and finishing operations for concrete surfaces. Do not wet concrete surfaces while finishing.

B. Concrete shall be carefully compacted and screeded off to the correct elevation. Bull-float shortly after placing. Move stone pockets to sandier area of slab and tamp or vibrate.

C. When floors are sufficiently hard, machine float surface to remove irregularities and secure a uniformly dense floor. Provide necessary jointing and edging.

D. Mechanical steel troweling and a minimum of one hand troweling shall be used to bring slabs to a true hard surface such as will ring with the touch of a trowel.

E. Exterior slabs shall have a finished steel flat surface, followed up by a broom finish.

F. Floor finish tolerance (Random Traffic Floor):

1. F-Number system in accordance with ASTM E1155 shall be used to specify flatness and levelness.

2. If requested by MSU, conformance to flatness and levelness tolerances will be evaluated by a testing agency. If conformance with flatness and levelness tolerances is confirmed, MSU will pay for the cost of the test. If conformation with flatness and levelness tolerances is not met, Contractor shall remove and replace the concrete and will pay for all testing required to achieve conformance with required flatness and levelness tolerances.

3. For slabs on grade, the minimum flatness and levelness to be specified shall be overall value of flatness, (F(F)35; and of levelness, F(L)25; with minimum local values of flatness, F(F)24; and of levelness, F(L)17, unless a lesser or greater value is appropriate for the specific situation and approved in advance by MSU.

4. For suspended slabs, the minimum flatness and levelness to be specified shall be overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15, unless a lesser or greater value is appropriate for the specific situation and approved in advance by MSU.

3.6 CONCRETE PROTECTING AND CURING

A. General: Concrete shall be cured in accordance with ACI 301 procedures and as described herein. Water loss from new concrete will be limited to a rate of 1 lb./sq.ft. per 72 hours. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

3.7 CONTROL JOINTS IN SLABS ON GRADE

A. Joint Type: Sawcut or formed. Joint depth shall be between 1/4 and 1/3 the thickness of the slab.

B. For a 4-inch slab on grade, reinforced with welded wire fabric, joints should be spaced from ten to twenty feet on center, creating slab panels that have aspect ratios of 1.5 or less.

3.8 FLOOR SEALING

A. Interior floors and stairs not receiving additional finishes shall receive a sealer to provide a smooth non-dusting surface for ease of maintenance. Air plenum chamber floors and areas to receive carpet shall also be sealed.

B. The sealer will generally be sodium silicate, applied by the MSU Custodial Department as described below. (During the design stage, coordinate the schedule, level of cleaning, and who will perform the tasks.)

1. Clean floor by power scrubbing with a good detergent or vegetable oil soap.

2. First coat: Mix one part sodium silicate (water glass) with four parts water. Apply a heavy coat using a mop and work into the floor for ten minutes or until the solution becomes tacky. Mop up puddles and runs immediately. Mop floor dry and allow to dry for a minimum of eight hours.

3. Second and third coats: Mix one part sodium silicate (water glass) with three parts water. Apply each coat using the same method as the first coat, allowing each coat to dry a minimum of eight hours.

3.9 POST-INSTALLED ANCHOR INSTALLATION

A. Install post-installed anchors:
1. In strict accordance with the installation instructions supplied by the Manufacturer.
2. In rotary hammer drilled holes, unless otherwise approved by Engineer.
3. In drilled out holes of the proper depth and diameter cleaned of dust and debris according to the Manufacturer’s specific installation instructions.

B. Provide sizes, spacings, edge distances and embedment as indicated on the Drawings.

C. Anchors that Resist Loads Through an Injectable Chemical Adhesive:
1. Do not apply load until adhesive has properly cured and developed specified strength where cure time shall be as called out in the Manufacturer’s literature based on prevailing environmental conditions at the time of installation.

3.10 CLEANING

A. Prior to acceptance of the work of this section, thoroughly clean structural steel and related areas in accordance with Division 01 requirements.

END OF SECTION 033015

SECTION 036000 – GROUTING

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 furnishing and placement of cementitious grout for drilled-in anchor bolts, drilled-in reinforcing dowels, and the like.

1.3 REFERENCES

A. Except as herein specified or as indicated on Drawings, the work of this section shall comply with the following:

1. ASTM:

a. C939 - Flow of Grout for Preplaced Concrete (Flow Cone Method).

b. C1107 - Packaged Dry Hydraulic-Cement Grout (Nonshrink).

c. C1181 - Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

d. C1339 - Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts.

2. Corps of Engineers: CRD C621.

1.4 SUBMITTALS

A. Product Data or manufacturer's descriptive literature, including surface preparation and installation instructions.

B. Shop Drawings to include drawing setting locations, templates, and directions for installing anchor bolts and other anchorages.

1.5 QUALITY ASSURANCE

A. Use only experienced tradesmen for the work of this section.

B. Test for flow consistency of 25 to 30 seconds in accordance with ASTM C939 at 30 minutes extended working time at temperature extremes between 45 and 90 degrees F.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Non-metallic shrinkage-resistant grout: Premixed, non-metallic, non-corrosive, non-staining, product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents complying with CRD C621 and ASTM C 1107, Grade B, with minimum compressive strength of 6,000 psi at 28 days:

1. Subject to compliance with requirements, provide one of the following:

a. "Supreme Grout", Cormix Inc.
b. "Sure Grip Grout", Dayton Superior.
c. "Euco N.S. ", Euclid Chemical Co.
d. "Crystex", L&M Construction Chemicals, Inc.
e. "Masterflow 713", Master Builders.
f. "Sealtight 588 Grout", W.R. Meadows.
g. "Set Non-Shrink", Set Products, Inc.
h. "Five Star Grout", U.S. Grout Corp.

PART 3 - EXECUTION

3.1 MIXING GROUT

A. Add only potable water and use mechanical mixer for minimum of 3 minutes.

B. Maintain proper curing temperature between 45 and 90 degrees F.

C. Comply with manufacturer’s instructions.

3.2 INSTALLATION

A. Blow or vacuum out loose particles and dust.

B. Dampen walls of the hole with a swab to ensure good bonding dust free surface.

C. Pour or place small amount of grout in hole and work bolt or dowel in and out to eliminate air pockets.

D. Fill balance of hole.

E. Allow to cure.

END OF SECTION 036000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Face brick.

B. See Division 7 Section SHEET METAL FLASHINGS AND TRIM for furnishing manufactured reglets installed in masonry joints for metal flashing.

C. See Division 7 Section AIR BARRIERS for air barriers installed prior to unit masonry.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for each type and color of exposed masonry units.

C. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.

1. For masonry units include material test reports substantiating compliance with requirements.

D. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1.3 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects and assembly of all materials and details.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high. Sample panel may remain as part of work.

1.4 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 BRICK

A. General:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216, Grade SW, Type FBS.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 8000 psi .
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
5. MSU Brick Committee Selected Brick: Glen-Gery, SIS18-1814.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91.

D. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable.

2.3 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.

1. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
2. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
3. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Multiwythe Masonry:

a. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.
b. Tab type, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
c. Adjustable (two-piece) type, with one side rod at each face shell of backing wythe and with ties that extend into facing wythe. Ties engage eyes or slots in reinforcement and extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.4 TIES AND ANCHORS

A. Materials:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch- diameter, hot-dip galvanized steel wire.
3. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch- thick, steel sheet, galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.5 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Division 7 Section SHEET METAL FLASHING AND TRIM.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section SHEET METAL FLASHING AND TRIM.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.6 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar for exterior masonry to portland cement and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270 Property Specification.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.

2.7 ACCESSORIES

A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings form clogging weeps and cavity vents and allow proper cavity drainage.

B. Weeps: White, polyester mesh.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3.2 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.3 MORTAR BEDDING AND JOINTING

A. Lay face brick units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.4 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

3.5 MASONRY JOINT REINFORCEMENT

A. General: Install in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.

2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and at locations as indicated on drawings.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.7 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect adjacent surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.8 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
2. Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off owner's property.

END OF SECTION 042000

SECTION 051200 – STRUCTURAL STEEL 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 furnishing, fabrication and erection of structural steel, including the major items listed below:

1. Shelf angles.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this section shall comply with the following:

1. ASTM Standard Specifications:

a. A36 - Carbon Structural Steel.
b. F436 - Hardened Steel Washers.
c. F1554 - Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.

2. AISC:

a. Code of Standard Practice for Steel Buildings and Bridges.
b. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
c. Detailing for Steel Construction.
d. Manual of Steel Construction.
e. Specification for Structural Joints Using ASTM A325 or A490 Bolts.

3. AWS - American Welding Society publications:

a. ANSI/AWS D1.1 - Structural Welding Code - Steel.
b. American Hot-Dip Galvanizers Association.

1.4 DEFINITIONS

A. Fabricator: An individual, firm or corporation that assembles raw structural steel items into structural steel building members.

1.5 SUBMITTALS

A. Shop Drawings: For all members to be furnished to include:

1. Detail Drawings of Members and Connections:
   a. In accordance with AISC - Detailing for Steel Construction.
   b. Size, number and type of bolts.
   c. Dimensions.
   d. Connection angles and plates.
   e. Camber.
   f. Holes.

2. Erection Drawings:

   a. Locate and identify members.
   b. Clearly identify bolt installation requirements.

3. Welding: In accordance with AWS welding symbols.
4. Type of paint.
5. Steel sections which are not available, and suggested steel sections that are available.

B. Certification:

1. Proof of acceptable quality control program.
2. Bolts, Nuts and Washers: Manufacturer's certification that products supplied for this Project comply with this specification.
3. Weld Filler Materials: Manufacturer's certification that products supplied for this Project comply with this specification.

C. Mill Certification Tests: Submit in compliance with Michigan Building Code.

D. Provide setting Drawings, templates and directions for the installation of anchor rods and other devices.

1.6 QUALITY ASSURANCE

A. Fabrication and Erection Personnel Qualifications:

1. Trained and experienced in the type of work being performed.
2. Knowledgeable of the design and the reviewed Shop Drawings.

B. Welders, Welding Operators and Tackers Qualifications:

1. Qualified by tests in accordance with Section 5 of AWS D1.1.
2. Qualification Papers:

   a. Given by an independent testing laboratory.
   b. Dated no earlier than 6 months prior to beginning of Project.

3. Engineer, at Engineer's discretion, may accept evidence of previous qualifications.

C. Steel Fabricators Qualifications:

1. Certified under the AISC Quality Certification Program for Category I - Conventional Steel or II - Complex Steel Building Structures, as applicable, or under other quality control program acceptable to building official in accordance with building code, prior to fabrication.
2. The quality control program shall permit work on fabricator's premises without special inspection.

D. Testing of Welds, Bolts and Shear Studs: In accordance with Division 01 Section "General Requirements – Quality Requirements," and the Michigan Building Code.

E. Inspection of Steel Fabrication and Erection: In accordance with Division 01 Section "General Requirements – Quality Requirements" and Michigan Building Code.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, unload, handle and store structural steel items in such manner as to not distort or otherwise damage the materials, and protect from corrosion and deterioration.

B. Reject damaged, deteriorated or distorted material and immediately remove from the site. Replace rejected materials with new material at no additional cost to Owner.

C. Embedded Items

1. Includes anchor rods and other anchorage devices which are to be embedded in cast-in-place concrete and masonry.
2. Deliver to the Project site before the start of cast-in-place concrete and masonry operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: All materials shall be subject to Engineer's review.

B. Structural Steel:

1. All Structural Steel Shapes:

a. New, unused and perfect stock.
b. Free from millscale, rust, flake, pitting and imperfections.
c. Without bends, kinks and distortions.

2. Identified Steel Sizes:

a. Review availability of specified steel sizes for delivery within the Project schedule.
b. Submit to Engineer proposed alternative sizes, if specified sizes are unavailable.
c. Be responsible for additional costs, if any, of steel size revisions required because of availability or Project schedule.

3. Shop splicing of members will be permitted only if the member exceeds maximum mill length or if approved by Engineer and so indicated on the Shop Drawings.
4. Yield Stresses and Types of Steel:

    a. HP-Shapes, M-Shapes, S-Shapes, Channels, Angles, Bars, Plates and Rods: ASTM A36, with yield stress of 36,000 psi.

C. Anchor Rods

1. ASTM F1554, Grade 36, or greater if indicated on the Drawings.
2. Remove oil, grease and dirt from anchor rods prior to shipping to the site.
3. Anchor Rod Washers:

    a. 5/16-inch ASTM A36 plate.
    b. With hole 1/16-inch larger than anchor rod diameter.

2.2 FABRICATION

A. Shop Assembly:

1. Assemble steel work in shop by bolting and welding, as indicated on Drawings and as herein specified.
2. Assemble components prior to shipping as much as is practical.
3. Camber steel beams to amounts indicated on the Drawings.
4. Fabricate and ship steel in sequence which minimizes rehandling of steel and expedites erection.
5. Accurately mill ends of columns and other members to be in direct bearing.

B. Fabrication:

1. Conform to Applicable Portions of AISC:

    a. Specification for the Design, Fabrication, and Erection of Structural Steel for Building.
    b. Code of Standard Practice.

C. Holes:

1. Provide required holes for attachment of the work of other trades.
2. Where conditions require, holes shall be slotted.
3. Do not flame cut holes or enlarge holes by burning.

D. Galvanizing:

1. Hot-dipped galvanize with 2 oz/ft^2 minimum after fabrication in accordance with ASTM A123, unless noted otherwise.
2. Hot-dip galvanize bolts, nuts, washers and anchor rods in accordance with ASTM A153, Class C.
3. Do not hot-dip galvanized cold bent items.
4. Galvanize the items so indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey:

1. Check elevations of bearing surfaces and locations of anchor rods and embedded connections.
2. Report discrepancies to Engineer.
3. Do not proceed with erection until Engineer has reviewed discrepancies and adjustments have been agreed upon.

3.2 ERECTION

A. Assembly:

1. Erect steel accurately to lines and elevations indicated.
2. Align and adjust framing as erection proceeds and before final fastening.
3. Splice members only where so indicated on the reviewed Shop Drawings.
4. Remove erection bolts and connections where required for exposed construction; plug weld holes and grind exposed surfaces smooth.
5. Remove mud, tags, and other foreign material from members prior to erection.

B. Plumbing:

1. Make allowances for thermal changes of length of members when plumbing columns and struts.
2. Generally:

    a. Set columns at the center of building plumb.
    b. Cant exterior columns in or out depending upon temperature at time of erection.

C. Temporary Bracing:

1. Provide temporary bracing and accessories required for complete erection.
2. Safety and adequacy of temporary bracing is the responsibility of Contractor.
3. Structure will not be stable until all beams, floors, roofs, shear walls and bracing are complete.

D. Burning of holes is prohibited.

E. Cutting:

1. Gas cutting is prohibited on major members.
2. On minor members not stressed: Obtain Engineer's prior approval.

F. Do cutting, fitting, drilling and tapping of materials as required for proper and complete installation of work of this section.

G. Tightening:

1. Tighten bolts snug-tight as defined by AISC, unless otherwise noted on the Drawings.
2. Tighten bolts in long and short slotted holes using AISC Turn-of-the-Nut Method, unless indicated otherwise on the Drawings; or approved by Engineer.
3. Where specifically indicated on the Drawings, finger-tighten nuts in connections where movement must be permitted, and tighten jam nut over finger-tightened nut, or peen bolt threads, to prevent nut backoff.

H. Welding: Field welding shall be performed to the same standards and requirements as shop welding.

I. Touch Up:

1. After erection is complete, touch up shop priming coats damaged during transportation and erection.
2. Prime field welds, bolt heads, nuts and abrasions using the priming paint specified for shop priming.
3. Touch up damaged galvanized areas with a zinc rich paint meeting ASTM A780.

J. Erection Tolerances:

1. Structural Steel: In accordance with AISC Code of Standard Practice.
2. Architecturally Exposed Structural Steel: In accordance with AISC Code of Standard Practice.

3.3 CLEANING

A. Prior to acceptance of the work of this section, thoroughly clean structural steel and related areas in accordance with Division 01 requirements.

END OF SECTION 051200

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. The latest publication of "Pipe Railing Systems Manual" by the National Association of Architectural Metal Manufacturers (NAAMM) shall establish the minimum requirements when not otherwise specified in this section.

1.2 Related Sections include the following:

1. Division 03 Section CONCRETE FOR BUILDING CONSTRUCTION for installing anchor bolts, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 04 Section UNIT MASONRY for installing anchor bolts, and other items indicated to be built into unit masonry.

1.3 SUMMARY

A. This Section includes the following:

1. Aluminum pipe and tube railings.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 lbf/ ft. applied simultaneously both vertically and horizontally.
b. Concentrated load of 300 lbf applied at any point.
c. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required.

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.3 FASTENERS

A. General: Provide the following:

1. Aluminum Railings: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Anchors: Provide anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior applications. For exterior applications use Sikadur® 31, Hi-Mod Gel epoxy and Pecora Dynatrol II caulk.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.5 FABRICATION

A. Except for expansion and contraction joints, handrails will be fabricated in the largest pieces practical and consistent with shipping and handling.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails, with the end turned into the wall and cut parallel to the wall leaving ¼" clearance. A plate equal to the pipe gauge will be welded over the open end and ground smooth.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodized Finish: AA-M12C22A44 (Electrolytically deposited colored anodic coating not less than 0.7 mils thick) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions. Holes for handrails set with expanding grout will have 1/2” radial clearance, and with epoxy will have 1/4” radial clearance. Bolted flange floor mounting is not acceptable.

B. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch buildup, sloped away from post.

3.5 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. Slabs on grade should be protected by either a membrane, mud mat, or by plastic sheets, depending on conditions.

B. All above-grade construction, including slabs above grade in potentially wet areas, shall receive waterproofing in accordance with SECTION 071416 – COLD FLUID-APPLIED WATERPROOFING. Sleeves and openings in the slab shall be properly flashed. This protection is required over occupied spaces and under load-all situations, docks or penthouse floor slabs.

1. NOTE: PENTHOUSE FLOORS, ESPECIALLY UNDER LARGE AIR HANDLERS AND INTERIOR COOLING TOWERS HAVE BEEN TROUBLESOME. THESE AREAS NEED SPECIAL ATTENTION.

C. All horizontal areas should be tested by flooding, after the waterproof membrane system has been applied. A five-year warranty is required for all waterproofing work.

1.2 SUMMARY

A. This Section includes the following:

1. Rubberized-asphalt sheet waterproofing.

1.3 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and flashing sheet.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

F. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

G. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is acceptable to waterproofing manufacturer to install manufacturer's products.

B. Source Limitations: Obtain waterproofing materials through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.

1. Warranty Period: Five years after date of Substantial Completion.

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, the following:

B. Products: Subject to compliance with requirements, provide one of the following products:

1. Rubberized-Asphalt Sheet Waterproofing:

a. W. R. Grace & Co.; Bituthene 3000.
b. Polyguard Products, Inc.; Polyguard 650.

2.2 RUBBERIZED-ASPHALT SHEET WATERPROOFING

A. Rubberized-Asphalt Sheet: 60-mil- thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil- thick, polyethylene film with release liner on adhesive side.

1. Physical Properties: As follows, measured per standard test methods referenced:

a. Tensile Strength: 250 psi minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
f. Hydrostatic-Head Resistance: 150 feet minimum; ASTM D 5385.
g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
h. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of sheet waterproofing material.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as sheet waterproofing.

E. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

F. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

I. Protection Course: Location and type as recommended by membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Verify that compacted subgrade is dry, smooth, and sound; ready to receive HDPE sheet.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

F. Bridge and cover isolation joints, expansion joints **and** discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.
b. At plaza deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 RUBBERIZED-ASPHALT SHEET APPLICATION

A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, rubberized-asphalt sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Horizontal Application: Apply sheets from low point to high point of decks to ensure that side laps shed water.

E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.

G. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches beyond repaired areas in all directions.

I. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 PROTECTION AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326

SECTION 072400 – DIRECT-APPLIED EXTERIOR FINISH SYSTEMS (DEFS)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Composite soffit cladding of reinforced finish coating applied to gypsum substrate.

B. Water-resistive barriers behind reinforced finish coating.

1.2 RELATED REQUIREMENTS

A. Section 09 21 13 - Gypsum Board Assemblies

1.3 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.

B. ASTM C297/C297M - Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions 2016.

C. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage 2013 (Reapproved 2019).

D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive 2022.

E. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity 2015 (Reapproved 2020).

F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.

G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2023).

H. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies 2018.

I. ASTM E2486/E2486M - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS) 2022.

J. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013 (Reapproved 2021).

K. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials 2021.

L. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems 2009, with Editorial Revision (2022).

M. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies 2015, with Editorial Revision (2022).

N. NFPA 259 - Standard Test Method for Potential Heat of Building Materials 2023, with Errata.

O. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source 2022.

P. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components 2023.

1.4 SUBMITTALS

A. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

B. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.

C. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.

D. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.5 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.

B. DEFS Manufacturer Qualifications: Provide DEFS products from the same manufacturer with qualifications as follows:
   1. Member in good standing of EIMA (Finish System Industry Members Association).

C. Insulation Manufacturer Qualifications: Approved by manufacturer of DEFS and approved and labeled under third party quality program as required by applicable building code.

D. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Store materials as directed by manufacturer's written instructions.
   1. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.
   2. Protect insulation materials from exposure to sunlight.

1.7 FIELD CONDITIONS

A. Do not prepare materials or apply DEFS under conditions other than those described in the manufacturer's written instructions.

B. Do not prepare materials or apply DEFS during inclement weather unless areas of installation are protected. Protect installed DEFS areas from inclement weather until dry.

C. Do not install coatings or sealants when ambient temperature is below 40 degrees F.

D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.8 WARRANTY

A. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

B. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:
   1. Sto Corp; StoQuik.

B. Subject to compliance with requirements, products that are equivalent to the basis of design product provided by one of the following manufacturers may be incorporated into the Work:
   1. Parex USA, Inc..
   2. Dryvit Systems, Inc..

2.2 DIRECT-APPLIED EXTERIOR FINISH SYSTEM

A. Direct-Applied Exterior Finish System: Reinforced finish coating over gypsum substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Fire Resistance: Complies with fire resistance requirements indicated on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   4. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot.

C. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi, when tested in accordance with ASTM C297/C297M.

D. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

E. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

F. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.

G. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

H. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.

I. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.

J. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

K. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

L. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
   1. Medium: 50 to 89 in-lb, for areas with limited access to public.

2.3 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   1. Texture: As selected by Owner and Architect from manufacturer's full range..
   2. Color: As selected by Owner and Architect from manufacturer's full range.

B. Base Coat: Fiber-reinforced, acrylic or polymer-based product compatible with gypsum substrate and reinforcing mesh.

C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.

D. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.

E. Fluid-Applied Flashing: Flexible water based polymer material suitable for use with reinforcing mesh and, if used with water-resistive barrier sheet, certified compatible with sheet material.

F. Flashing Tape: Self-adhering rubberized asphalt tape with polyethylene backing or other material and surface conditioner furnished or approved by EIFS manufacturer.

2.4 ACCESSORIES

A. Trim: DEFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

B. Primer: Compatible with DEFS materials and as recommended by DEFS manufacturer.

C. Sealant Materials: Compatible with DEFS materials and as recommended by DEFS manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with DEFS installation and is of a type and construction that is acceptable to DEFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.

3.2 PREPARATION

A. Apply primer to substrate as recommended by DEFS manufacturer for project conditions.

3.3 INSTALLATION - GENERAL

A. Install in accordance with DEFS manufacturer's instructions and ASTM C1397.
   1. Where different requirements appear in either document, comply with the most stringent.
   2. Neither of these documents supersedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.4 INSTALLATION - WATER-RESISTIVE BARRIER

A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.

B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.

C. At soffit penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, using method recommended by manufacturer.

D. Lap flexible flashing or flashing tape at least 2 inches on each side of joint or transition.

3.5 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Fill gaps greater than 1/16 inch in gypsum substrate with strips or shims cut from the same substrate material.

C. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of DEFS. Install reinforcing fabric as recommended by DEFS manufacturer.
   1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
   2. Allow base coat to dry a minimum of 24 hours before next coating application.

D. As required by impact resistance requirements, install second layer of reinforcing mesh embedded in second coat of base coating, tightly butting ends and edges of mesh.

E. Apply primer by brush or roller to entire base coat surface after base coat has dried not less than 24 hours.

F. Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.

G. Finish Coat Thickness: As recommended by manufacturer.

H. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.6 CLEANING

A. Clean DEFS surfaces and adjacent work areas of foreign materials resulting from EIFS operations.

3.7 PROTECTION

A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION 072400

SECTION 072700 - AIR BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air barriers.

1.2 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.3 SUBMITTALS

A. Product Data: Provide data on material characteristics, performance criteria, and limitations.

B. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.4 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Air Barrier Assemblies; www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.5 MOCK-UPS

A. Construct air barrier mock-up, 5 feet long by 4 feet wide, in conjunction with unit masonry mock-up.

B. Mock-up may remain as part of work.

1.6 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.1 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Air Barrier Coating:
      a. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
      b. Water Vapor Permeance: 11 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
      c. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure.
      d. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
      e. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
      f. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
      g. Products:
         1) Dow Chemical Company; DOWSIL DefendAir 200C.
         2) GCP Applied Technologies; Perm-A-Barrier VPL 50RS UV Stable.
         3) Sto Corp; Sto Gold Coat.

2.2 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
   1. Products containing rubberized asphalt, butyl, or other components that are not compatible with silicone are not permitted.

B. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrate and air barrier materials.
   1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch, nominal thickness.
   2. Color: Green.

C. Primer: Liquid applied polymer as required by air and water barrier manufacturer.
   1. Color: Green.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.

B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Fluid-Applied Coatings or Membranes:
   1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
   2. Where exterior masonry veneer is being installed, install masonry anchors before installing air barrier over masonry; provide airtight seal around anchors.
   3. Apply a second coat of air barrier around penetrations, including masonry ties.
   4. Use flashing to seal to adjacent construction and to bridge joints in coating substrate.

E. Openings and Penetrations in Exterior Air Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
   3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
   4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

3.4 FIELD QUALITY CONTROL

A. Do not cover installed air barriers until required inspections have been completed.

B. Obtain approval of installation procedures from air barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

C. Take digital photographs of each portion of installation prior to covering up air barriers.

3.5 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 072700

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. All sheet metal work should normally be copper. Use lead coated copper for locations that can be seen from normal viewing.

B. All through-wall flashings should be copper, extending completely through the wall and forming a hemmed drip edge on each side.

C. Flashing should normally be applied to all steel lintels and shelf angles carrying exterior masonry facings.

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:
1. Formed wall flashing and trim.

B. Related Sections include the following:

1. Division 07 Section JOINT SEALANTS for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: On request, for each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.

2. Trim: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1. Copper Standard: Comply with CDA's "Copper in Architecture Handbook."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   a. York Flashings.
   b. Advanced Building Products.

2.2 SHEET METALS

A. Copper Sheet: ASTM B 370, Temper H00 or H01, cold-rolled copper sheet.

B. Lead-Coated Copper Sheet: ASTM B 101, Temper H00 and H01, cold-rolled copper sheet, of weight indicated below, coated both sides with lead weighing not less than 12 lb/100 sq. ft. nor more than 15 lb/100 sq. ft. of copper sheet (total weight of lead applied equally to both sides).

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Nails for Copper Sheet: Copper, hardware bronze, or Series 300 stainless steel, 0.109 inch minimum and not less than 7/8 inch long, barbed with large head.

C. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Solder for Lead-Coated Copper: ASTM B 32, Grade Sn60, 60 percent tin and 40 percent lead.

E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

F. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.5 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high end dams. Fabricate from the following material:

1. Copper: 16-oz./sq. ft.

B. Wall Expansion-Joint Cover: Fabricate from the following material:

1. Copper: 16-oz./sq. ft.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

1. Copper: Use copper, hardware bronze, or stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.

1. Pretinning is not required for lead-coated copper and lead.
2. Copper Soldering: Tin uncoated copper surfaces at edges of sheets using solder recommended for copper work.
3. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
4. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
5. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 MSU ISSUES

A. It the intent of MSU that all joint sealants used on its projects will comply with LEED™ NC 3 Credit Requirements EQ Credit 4.1: Low-Emitting Materials: Adhesives and Sealants.

1.2 SUMMARY

A. This Section includes joint sealants for the applications listed in 3.6 JOINT SEALANT SCHEDULE below.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. VOC Statement and Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- 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. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

E. Qualification Data: For Installer and testing agency.

F. Preconstruction Field Test Reports: When requested by owner, indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

G. 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.

H. Field Test Report Log: For each elastomeric sealant application.

I. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

J. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 or manufacturer’s standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than six pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.

2. Conduct field tests for each application indicated below:

    a. Each type of elastomeric sealant and joint substrate indicated.
    b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify M.S.U. Project Manager seven days in advance of dates and times when test joints will be erected.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

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 joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Warranty

1. Provide installation warranty for a period of 5 years against defective materials and workmanship.
2. During the warranty period restore defective work to the standard of the contract documents without additional compensation, including all materials, labor, refinishing and other costs incidental to the work. Within 24 hours after receipt of notice from the owner, inspect the work and immediately repair leaks. Restore work found to be defective as defined in the contract documents, within 10 days after receipt of notice from the owner.

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.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Single-Component Neutral-Curing Silicone Sealant; **SEALANT A**

1. Available Products:

   a. Dow; DOWSIL 790 Silicone Building Sealant.
   b. GE Silicones; SilPruf SCS2000.
   c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant.
   d. Dow; DOWSIL 795 Silicone Building Sealant.
   e. Pecora Corporation; 895.
   f. Dow; DOWSIL 756 SMS Building Sealant.
   g. Or as approved

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

E. Multicomponent Immersible Urethane Sealant **SEALANT B**

1. Available Products:

   a. LymTal International, Inc., Iso-Flex 881 (NS – nonsag)
   b. LymTal International, Inc., Iso-Flex 880 (P – pourable).
   c. Or as approved

2. Type and Grade: M (multicomponent) and NS (nonsag) or P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic), NT (nontraffic) and I (immersible).

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) or B (bicellular material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material 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.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

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.

B. 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 and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.

B. Joint Priming: Prime joint substrates**,** 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.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

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. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings 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 sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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 in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. 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 sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing 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 so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. **SEALANT A**: Control joints in exterior (non-traffic) masonry. Joints in exterior precast architectural concrete. Joints between masonry non-bearing walls or partitions and under side of floors, beams and slabs. Joints around pipes, conduits, and ducts that penetrate walls and partitions. Exterior joints at perimeter of metal frames, including door and window frames. Exterior joints at ends of aluminum windowsills. Horizontal (non-traffic) and vertical expansion joints in exterior brick masonry.

B. **SEALANT B**: Isolation and control joints in exposed interior concrete floors. Expansion joints in interior tile. Expansion and control joints in exterior curbs and walks, and in paving other than concrete road paving, subject to pedestrian and vehicular traffic.

END OF SECTION 079200

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal channel ceiling framing.

C. Gypsum sheathing.

D. Joint treatment and accessories.

1.2 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing 2020.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing 2015, with Errata (2020).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.

E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.

F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).

G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2022.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.

K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

M. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.

O. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

P. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

1.3 SUBMITTALS

A. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
   1. ICC-ES Evaluation Report No. for an exterior grid suspension system.

2.2 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of ceiling framing of L/240 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
   4. Minimum stud gauge as 20 gauge. Use heavier gauge if required to meet the performance requirements of this Section.

C. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

D. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. CertainTeed Corporation.
      b. USG Corporation; Drywall Suspension System.
      c. Chicago Metallic; Drywall Grid.

2.3 BOARD MATERIALS

A. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
   4. Regular Type Thickness: 5/8 inch.
   5. Edges: Tapered.

2.4 GYPSUM BOARD ACCESSORIES

A. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic or galvanized steel, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. L-Trim with Tear-Away Strip: Sized to fit 5/8 inch thick gypsum wallboard.
   3. Wall Mounted Deflection Beads: Flexible gasket and bead with 1-1/8 inch flange.
   4. Expansion Joints:
      a. Type: V-shaped PVC with tear away fins.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Joint Compound: Setting type, field-mixed. For use with fiberglass tape.

C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Members Less than 0.033 inches in Thickness: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

D. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

E. Anchorage to Substrate: Tie wire, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

B. Start of Work indicates acceptance of conditions.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.
   3. Install bracing as required at exterior locations to resist wind uplift.

C. Blocking: Install mechanically fastened steel channel blocking for support of:
   1. Light fixtures.
   2. Ceiling mounted devices and fixtures.

3.3 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.5 JOINT TREATMENT

A. Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 3: Soffits to receive direct-applied exterior finish.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.6 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092116

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Grout.
5. Plumbing demolition.
6. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

C. Certificate of Acceptance: Provide certificate as described in this section.

1.5 QUALITY ASSURANCE

A. Permits and Inspections

1. The Plumbing Contractor shall obtain and pay for all permits required by the State of Michigan Department of Licensing and Regulatory Affairs, Plumbing Division.

2. The Plumbing Contractor shall submit, to precede request for final payment, a copy of the Certificate of Acceptance of the plumbing systems.

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 plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with MSU Project Manager/MSU Project Representative. Activation and shut down of existing systems shall be conducted by MSU personnel only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASTM A-354 Grade BD and SAE J-429 Grade 8 for steam and condensate application, and ASTM A-354 and SAE J-429 Grade 5 for other low service temperature applications, unless otherwise indicated.

D. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

   a. Link-Seal.
   b. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, plain ends.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.

H. Install piping to allow application of insulation.

I. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.

J. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.

K. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.

L. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.

M. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.

N. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

O. Select system components with pressure rating equal to or greater than system operating pressure.

P. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size. Eccentric couplings shall make the pipe flush on the top for water lines.

Q. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

    a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    d. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
    e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

R. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.

3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
4. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
5. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.

S. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

U. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

V. Verify final equipment locations for roughing-in.

W. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

3.4 PIPING CONNECTIONS

A. Make connections according to 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

B. Unions shall be used in preference to couplings where their use will facilitate dismantling the pipe for maintenance.

C. Install transition couplings at joints of dissimilar piping.

D. No Uni-flange pipe adapters will be allowed.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

END OF SECTION 220500

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Pipe positioning systems.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Clevis.
2. Fee and Mason.
3. Anvil.
4. PHD Manufacturing, Inc.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 THERMAL-HANGER SHIELD INSERTS

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

1. PHS Industries, Inc.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal 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.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. 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 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

H. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.

I. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.

J. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with suitable vibration isolation units to eliminate noise transmission between the piping and the building structure.

K. Hanger components shall not be used for purposes other than for which they were designed.

L. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.

M. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roller carriages shall be used.

N. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4".

O. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

P. Anchors, Guides and Restraints: Anchors, guides and restraints shall be provided wherever necessary to support risers, to maintain pipe in position, and to properly distribute expansion.

Q. Supplemental Framing: Supplemental framing, angles, channels or beams, shall be provided where the anchor locations do not align with the building structure or where the intended loads exceed the structural framing maximum load carrying capacity.

R. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

S. 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.

T. 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. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) 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 (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

U. Plastic Pipe Hanger Installation:

1. Rigid plastic piping shall normally be supported by the same type of hangers used with steel pipe. In pressure application, hangers shall be provided with pads or cushions on the bearing surfaces.
2. Flexible plastic tubing shall be supported continuously by metal angles or channels with special hangers.

3.2 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 (40 mm).

3.3 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 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 finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.

I. 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 (DN 15 to DN 750).
2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

K. 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. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles. Use only when it is not possible to use center loading beam clamps. Subject to prior approval by the A/E.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
6. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
7. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

L. 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.

M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or 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 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe labels.
2. Stencils.

1.3 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.

1.4 COORDINATION

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Emed.
2. Marking Services Inc.
3. Seton Name Plate Co.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

B. 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. Near each branch connection. Where flow pattern is not obvious, mark each pipe at branch.
2. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

C. Pipe Label Legends:

1. General Services

a. Storm - Primary

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
   c. Polyolefin.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail application of field-applied jackets.

C. 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.

D. 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000 Pipe Insulation.
c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armacell LLC; Tubolit.
b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Zeston.

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.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Finish and thickness are indicated in field-applied jacket schedules.
b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-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.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. 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.

B. Coordinate insulation installation with the trade 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 equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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, soften, or otherwise attack insulation or jacket in either wet or dry state.

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. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

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 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.
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.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer 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 more than 75 percent of its nominal thickness.

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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar 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. Manholes.

5. Handholes.
6. 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 (50 mm) 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 (50 mm).
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.

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.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be 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 or sectional pipe insulation of same material and thickness as 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 or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
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.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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 indicated. Installation shall conform 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 adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two 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 (50 mm) 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 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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 (50-mm) 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 (300 mm) o.c. and at end joints.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 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. Vertical portions of the storm drains.

C. Insulate cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps.

1. Horizontal portions of the storm drain.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Stormwater:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
c. Polyolefin: 1 inch (25 mm) thick.

3.10 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. Piping, Concealed:

1. None.

C. Piping exposed in mechanical equipment rooms or in finished spaces below 10' above finished floor:

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.

END OF SECTION 220700

SECTION 221413 – FACILITY STORM DRAINAGE PIPING

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 storm drainage piping inside the building.

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

C. Adhesive Primer: ASTM F 656.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

C. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

D. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

E. Install PVC piping according to ASTM D 2665.

F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.2 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

3.4 CONNECTIONS

A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

B. Connect storm drainage piping to area drains.

1. Comply with requirements for cleanouts and drains specified in Division 22 Section "Storm Drainage Piping Specialties."

3.5 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

A. Drainage system shall be inspected and tested in accordance with State of Michigan Plumbing Code.

B. 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.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. Test storm drainage piping according to 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. 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 storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains 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.

3.8 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping shall be any of the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Area drains.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 AREA DRAINS

A. Refer to schedule on Drawings for approved manufacturers and requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section shall apply to all Division 26 sections.

1.2 SUMMARY

A. Work Included

1. The work shall be executed in conformity with the drawings, the approved shop drawings, and these specifications.

2. In general, this work shall consist of, but not necessarily be limited to the following:

3. Demolition

4. New Work

B. Work Not Included

C. The Contractor shall refer to Alternates listed in Division 01 and Proposals and shall submit price quotations for the alternates that apply to the electrical work.

1.3 SUBMITTALS

A. Shop Drawings and Samples

1. The Contractor shall submit shop drawings for all major equipment including, but not limited to the following items and/or the items listed in Division 26 sections.

2. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

B. As-Built Drawings

1. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

2. The Contractor shall submit as-built drawings indicating the location of all outlets, junction boxes, and conduit runs; including conduit size, circuit numbers, and number of wires in each run.

C. Certificate of Electrical Inspection: Provide certificate as described in this section.

1.4 QUALITY ASSURANCE

A. Codes and Regulations

1. See Division 01 General Requirements for Codes and Regulations that apply.

2. The latest National Electrical Code shall be observed and shall govern the character of work, style, quantity and the size of all material used.

3. All materials shall conform with the standards of the Underwriter's Laboratories in every case where such standards have been established for the particular type of material in question.

4. All material and equipment shall be UL listed and bear the UL label where such listing and labeling exists.

5. The complete electrical installation shall comply with all the requirements of the MI.O.S.H.A.

6. Codes shall be used as minimum requirements, and where the Specifications or Plans call for an installation that exceeds and does not violate the Code requirements, the Specifications and Plans shall be followed.

B. Character of Work

1. The installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

2. Contractors working in the T.B. Simon Power Plant shall have a minimum of five years of experience working on like systems in power plants that involved in this project.

C. Permits and Inspections

1. The Electrical Contractor shall obtain and pay for all permits required by the State of Michigan Labor Department, Electrical Division.

2. The Electrical Contractor shall submit, to precede request for final payment, a copy of the Certificate of Electrical Inspection as required by the State of Michigan.

1.5 GUARANTEE

A. Refer to Division 01 - General Requirements.

B. Refer to individual Division 26 sections for any additional guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to individual Division 26 sections for product specifications.

B. Material to be Returned to the Owner

1. Refer to Division 01 - General Requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Division 01 - General Requirements for items such as examination of premises, coordination with other trades, cutting and patching, connection to present equipment, etc.

B. Laying Out Work

1. All exterior light locations shall be staked out by the Contractor and approved by the Engineer prior to installation.

C. Equipment Supports

1. Enclosures for panelboards, motor starters, motor control centers, and other similar equipment shall be mounted on ½" spacers when mounted in a room on a below grade exterior wall.

D. Feeders and/or branch circuit wiring shall not pass through electrical equipment such as switchboards, panelboards, disconnect switches, and motor starter enclosures where the power source for that wiring originates in another location.

END OF SECTION 260500

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. This Section specifies the conductors and cabling for buildings and structures electrical systems under 600 volts. Wiring for fire alarm and communication systems is specified in their respective sections.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Tray cable.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

C. Furnish wire and cable that has been manufactured and factory tested in accordance with ASTM, ANSI, IPCEA, and NEMA.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. All wiring, branch circuits and feeders, 600 volts and below, shall be stranded copper, type THW, THWN, or THHN sized as indicated on the drawing. Aluminum conductors can be used for feeders above 150 amps.

B. Feeder phase identification from left to right or front to back facing front of equipment shall be one of the following:

Phase A	Phase B	Phase C	Neutral	System
X	Y	Z	N	Any voltage
BLACK	RED	BLUE	WHITE	120/208 volt feeders
BROWN	ORANGE	YELLOW	GRAY	277/480 volt feeders

C. In general, all branch circuit wiring shall be 600 volt type THHN or THWN, minimum wire size number 12 AWG, except where noted otherwise. Branch circuits 100 feet or longer shall be minimum size number 10 wire AWG.

D. 120 volt control circuits may be number 14 AWG wire.

E. Neutral conductor insulation color for emergency and “X” panel circuits shall be as noted above with a red tracer.

F. Cable types MC, MI, NM, NMC, or NMS shall not be used unless specifically noted on the drawings or in the specifications.

2.2 TRAY CABLE

A. Tray cable shall be three conductor with ground, size as shown on the drawings, UL listed TC for cable tray installation, and comprised of the following:

1. Class B stranded, tinned, annealed copper conductors, each insulated with flame-retardant ethylene propylene rubber (EPR) rated for 90 deg C operation. Each insulated conductor shall be individually identified by color coding to differentiate one phase from the other.

2. The three insulated conductors shall be cabled together with non-hygroscopic, flame-retardant fillers, a bare copper ground conductor with an overall binder tape applied.

3. A flame-retardant chlorinated polyethylene (CPE) jacket shall be applied over the cable assembly.

B. All new single conductor tray cable shall be covered with 3M Scotch 77 arc and fire proofing tape 2 inches wide. Apply two layers of tape, half lapped and wound in opposite directions

C. Cable shall be manufactured by General Cable, Kerite, or Okonite.

2.3 WIRING CONNECTIONS

A. Taps and splices in all feeder and branch circuit conductors larger than no. 8 AWG shall be made with approved solderless, pressure type bolted connectors. Splices in conductors no. 8 AWG and smaller may be made with preinsulated Scotchlock or Ideal Wing-Nut spring tension connectors.

B. Termination of motor leads to branch circuit conductors shall be made with Burndy Clear UNITAP inspectable insulated multiple tap connectors sized for the conductors being terminated.

PART 3 - EXECUTION

3.1 CONDUCTORS

A. All wiring shall be installed in rigid galvanized conduit, intermediate metal conduit (I.M.C.), flexible conduit, electrical metallic tubing (E.M.T.) or other approved raceway.

B. Pulling compounds shall be compatible with the cable being installed in accordance cable manufacturers recommendations.

C. A shared neutral between branch circuits shall not be used for single phase, phase-to-neutral loads at either 120 volts or 277 volts.

D. Neutral conductors in junction boxes, pull boxes, outlet boxes, etc. shall be identified with the associated phase conductor circuit number.

3.2 TRAY CABLE

A. In other than horizontal runs where side rails do not provide adequate containment of the cables, cable shall be fastened securely to transverse members of the tray.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the grounding and bonding of electrical systems for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 – Electrical.

1.3 SUBMITTALS

A. Grounding test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code.”

C. Comply with applicable requirements of U.L. Standards 467 pertaining to electrical grounding and bonding. Provide grounding products that are U.L. listed and labeled.

PART 2 - PRODUCTS

2.1 GROUND RODS

A. Ground bus shall be solid 98% conductivity, electrical grade copper.

2.2 CONDUCTORS USED FOR GROUNDING

A. Conductors used for grounding shall be stranded copper, THWN/THHN, the same as the feeder conductors and/or branch circuit conductors. Conductors buried in concrete shall have RHW or THW insulation.

B. Grounding conductors shall have green insulation the entire length. Isolated grounding conductors shall have green insulation with a yellow tracer the entire length.

PART 3 - EXECUTION

3.1 OTHER BUILDING SPACES

A. Install a 1/4 x 2 inch solid copper ground bus with predrilled holes where shown on the drawing. Length shall be 12” or longer as noted on the drawings. Connect each ground bus with a No. 4 AWG THWN/THHN grounding conductor in conduit to the ground grid in the main electrical room.

3.2 ISOLATED GROUNDING CONDUCTORS

A. Isolated grounding conductors shall be identified with its associated circuit at both ends and at all accessible points in the conduit/raceway system.

3.3 GROUNDING CONDUCTORS IN CONDUIT

A. A grounding conductor shall be installed in all conduits and raceways containing lighting and/or power circuits. Size the grounding conductor per the NEC for the associated circuit unless noted otherwise on the drawings.

END OF SECTION 260526

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the raceway, conduit, boxes, fittings, multioutlet assemblies, etc. for buildings and structures electrical systems.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Shop Drawings

1. Surface raceway.

2. Multioutlet assemblies.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

A. All boxes, brackets, bolts, clamps, etc., shall be galvanized, electro-galvanized, metalized, or sherardized.

B. All hardware used outdoors and in steam vaults shall be hot dipped galvanized.

C. Pull boxes, junctions boxes, and outlet boxes installed outdoors and in steam vaults shall be heavy duty die cast aluminum construction powder coat finished with gasketed cover plate.

2.2 CONDUIT

A. Rigid galvanized conduit shall be installed in poured concrete slabs, walls and partitions. Rigid or I.M.C. shall be installed in damp locations and inaccessible places.

B. All rigid conduit, I.M.C. and E.M.T. shall be hot dipped galvanized, sherardized, metalized or electro-galvanized.

C. In locations where rigid or IMC conduit cannot be turned and a fitting is required, three piece malleable iron/steel rain-tight fittings shall be used.

D. E.M.T. may only be installed exposed, above suspended ceilings, or in partitions.

E. Flexible metal conduit may be used for short runs, up to a length of six feet, to individual pieces of equipment.

F. Flexible metal conduit and flexible metallic tubing may be used for light fixture whips up to a length of six feet.

G. Liquidtight flexible metal conduit shall be used for short runs, up to a length of six feet, to individual pieces of equipment in mechanical rooms, penthouses, on roofs, water softener areas and other similar locations.

H. MC (metal clad) 2 conductor with ground cable can be used for lighting fixture whips.

I. MC (metal clad) whips with 2#12 conductors & #12 ground conductor and 2#16 conductors can be used for lighting fixture whips for LED lighting fixtures with low voltage dimming. Lighting fixture whips shall be AFC LW4H3S62E46-00 or approved equal.

J. All conduit 2-1/2 inches and larger shall be rigid or I.M.C.

K. No E.M.T. or aluminum conduit shall be used in concrete or direct burial, nor in water softener areas or similar corrosive locations.

L. Aluminum conduit may only be used in sizes 1-1/2 inch and larger. No aluminum conduit will be permitted in concrete. When aluminum conduit is used, all bends shall be galvanized steel.

M. Size and type of conduit shall comply with the National Electric Code. Where conduits are indicated on the drawing to be larger than required by Code, the larger conduit shall be used.

N. All conduit used for life safety systems such as emergency lighting, shall have a green topcoat to identify as life safety.

O. Minimum conduit size shall be 3/4 inch for all feeder and branch circuit conduits to all panels, junction boxes, pull boxes, and outlets.

P. Short runs of exposed conduit to individual pieces of equipment may be one-half inch.

Q. Minimum conduit size shall be one-half inch for low-voltage control wiring.

R. Where metal conduit is buried underground outside the building walls, to signs, exterior lights, etc., it shall be not less than 1 inch regardless of wire size.

2.3 PULL AND JUNCTION BOXES

A. All pull boxes shall be galvanized sheet steel, sized as required, with thickness not less than no. 14 gauge.

B. All pull and junction boxes used for fire alarm system wiring shall have a red cover plate.

2.4 OUTLET BOXES

A. All outlets, except as otherwise specified, shall consist of approved galvanized steel boxes of pattern adapted to the special requirements of each outlet, securely fastened in place in an approved manner.

PART 3 - EXECUTION

3.1 CONDUIT

A. Conduit shall be concealed in all new walls and run above suspended ceilings.

B. Channel existing plaster walls and/or ceilings to conceal conduit in finished areas.

C. In lieu of channeling existing plaster walls and where lay-in ceilings are used, flexible metal conduit of minimum size 3/4" may be installed from a switch or receptacle outlet up to a junction box located above the lay-in ceiling. In this instance, the conduit length may exceed six feet.

D. Use Wiremold where necessary to run exposed on existing walls and/or ceilings in finished areas as shown on the drawings.

E. Use Wiremold where necessary to run exposed on existing walls and/or ceilings in finished areas.

F. Provide one spare 1 inch conduit up and one down, to ceiling space, from each new flush panel.

G. All conduits shall be fastened or suspended from structural members, slabs, or walls only. It shall not be run on or fastened to tee bars of suspended lay-in ceilings.

H. All conduits shall be supported by approved hangers.

I. Conduit shall be terminated with locknuts and bushings in all outlet boxes and panels. Insulated bushings shall be used on all rigid conduits 1-1/4 inch and larger. Use insulated bushings and connectors on all E.M.T. All conduit connectors and couplings shall be galvanized steel; cast connectors and couplings are not acceptable.

J. Threaded couplings, connectors, and conduit bodies shall be used on rigid galvanized conduit and intermediate metal conduit; set screw or threadless types are not acceptable.

K. All exposed conduits shall be run parallel to the structural members of the building in a neat manner, securely fastened in place. Approved conduit type fittings or outlet boxes shall be used at all bends in a vertical plane or where breaking around beams or columns. Bends on ceilings in a horizontal plane shall be made with long sweep ells. Paint all exposed conduit in finished areas to match existing finishes.

L. All conduits penetrating underground walls into basements, crawlspaces, vaults, etc. shall be sealed between the conduits and walls with Link-Seal Model “C” modular sealing system.

M. When metal conduit extends below the bottom of a slab on the ground, the slab shall be thickened in the area of the conduit so as to encase the conduit in concrete by at least 2 inches on all sides. The responsibility for and expense of this work shall be borne by the Contractor.

N. Where high voltage conduit or fiber duct is laid beneath the floor slab of a building, there shall be a minimum of 6 inches of sand fill between the outside of the concrete envelope around the conduit and the underside of the floor slab.

3.2 PULL AND JUNCTION BOXES

A. Pull boxes shall not be installed in inaccessible locations.

B. In general, pull or junction boxes shall be used in conduit runs when the number of bends in the conduit run exceeds 360 degrees. When conduits are installed in a bank, conduit bodies may be utilized due to space limitations.

3.3 MOUNTING UNDER ROOF DECKS

A. Conduit and raceways systems shall not be mounted directly to the underside of roof decks or installed through the webbing, flutes, or ribs of the roof deck support system.

B. Conduit and raceway systems shall be attached to the bottom of the structural elements supporting the roof deck.

END OF SECTION 260533

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the identification for electrical equipment in buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 NAMEPLATES

A. Nameplates shall be provided on all major equipment, including the following:

Primary Switches	Contactors
Substations	Remote Controlled Switches
Drawout Circuit Breakers	Dimmers
Disconnect Switches	Control Devices
Switchboards	Transformers
Panelboards, electrical cabinets, enclosures	Adjustable Frequency Drives
Motor Starters	Power Generating Units
Motor Control Centers	Fire Alarm Control Panel
Push Button Stations	Etc.

B. Nameplates shall be plastic laminate, white face with black engraved letters, numbers, etc.

C. All junction box and pull box covers shall be labeled with the circuit numbers of the circuits contained in the boxes using laminated labeling such as TZ Tape.

END OF SECTION 260553

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

C. Start up of equipment and systems such as medium voltage switches, transformers, unit substations, emergency power and lighting systems, etc. shall be done by or with a trained manufacturer's representative who can check and report on all items such as installation, operation, and see that the equipment or system starts and operates properly.

D. Testing shall be performed at the convenience of the Owner and with the Owner’s representatives present and the manufacturer’s representative of the equipment and/or system present.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing and adjusting of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.

5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing and adjusting reports.

1.9 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS

2.1 EXTERIOR BUILDING LIGHT FIXTURES

A. See Drawings.

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing and adjusting procedures have been completed and that testing and adjusting reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING VERIFICATION

A. Prior to performance of testing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing Work, and provide access for the CxA to witness testing Work.

C. Provide technicians, instrumentation, and tools to verify testing of electrical systems at the direction of the CxA.

1. The CxA will notify testing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.

2. The testing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing and adjusting report.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of electrical testing shall include all components, equipment, and systems as outlined in outlined later in this section.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response to input signals.

D. The CxA along with the Electrical Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.4 LIGHTING DIMMING AND CONTROL SYSTEMS

A. All dimming systems shall be operated throughout its entire range with all functions operated to verify proper operation.

END OF SECTION 260800

SECTION 265600 - EXTERIOR LIGHTING

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. This Section specifies the exterior lighting fixtures for buildings, structures, and exterior areas.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

3. The Contractor shall furnish and install all fixtures, as shown on the drawing. Fixtures shall conform to the types and manufacturers as hereinafter specified.

4. The Contractor shall furnish all lamps and necessary hangers, supports, wiring, etc., for installation of fixtures.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings that are not specified in this section.

2. Applicable sections of Division 26 – Electrical.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. HID: High-intensity discharge.

C. LED: Light Emitting Diode.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

E. Pole: Luminaire support structure, including tower used for large area illumination.

F. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

A. Shop Drawings: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, for the following:

1. Lighting fixtures.
2. Poles.
3. Street light conductors.
4. Pull boxes/handholes.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code.”

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store aluminum and concrete poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on poles until right before pole installation. Handle poles with web fabric straps.

PART 2 - PRODUCTS

2.1 STREET LIGHTS

A. 25 Foot Street Light Luminaires – LED:

1. Luminaires shall be of a size and type as manufactured by one of the following:

a. Lumark LD-RC-T2-E03-E with 4000K color temperature.
b. Autobahn ATB2-40BLEDE70-MVOLT-R2-NR-DF with 4000K color temperature.

B. 25 Foot Street Light Standards:

1. Standards shall be aluminum poles, type as manufactured by one of the following:

2. Hapco catalog no. RTA25D7B4M16-01, 25 foot single arm aluminum pole 7 inch by 4-1/2 inch shaft diameter with plain base and 4 inch by 6 inch hand hole, 6 foot upsweep pipe arm and 2 inch slip fitter.

3. Hapco catalog no. RTA25D7B4M26-01, 25 foot double arm aluminum pole, 7 inch by 4-1/2 inch shaft diameter with plain base and 4 inch by 6 inch hand hole, 6 foot upsweep pipe arms and 2 inch slip fitter.

4. Street light standard anchor bolts shall be galvanized steel, size as noted on the drawing.

2.2 AREA LIGHTS

A. See Drawings.

B. New area light poles shall be concrete, overall length 21'-3", 17'-0" above ground, with a 3" O.D. Provide two cable entrances on opposite sides of the pole, and a nominal 1-7/8" X 12" hand hole. Poles shall be one of the following:

1. Lonestar Prestress Mfg., Inc. catalog number 211206 with 2” conduit and MSU Sample Brown polished finish; drawing number 1064-2B, March 11, 2005.

2. StressCrete Limited catalog number E213-APT-G-S72 C/W 140-30/40 with S72 Spartan Sand polished finish; drawing number MSU213APT, December 8, 2004, Rev A.

2.3 LANTERNS

A. See Drawings.

2.4 SPECIALITY LIGHT FIXTURES UNDER BRIDGE

A. See Drawings.

2.5 EXTERIOR BUILDING LIGHT FIXTURES

A. See Drawings.

2.6 STREET LIGHT CONDUCTORS

A. Street light cable shall be three 600 volt insulated conductors with an overall jacket for direct burial installation. Cable shall be suitable for use in wet or dry locations; indoors or outdoors; in free air, cable trays, ducts, conduits, or direct burial in earth. This streetlighting cable shall be used for all street lighting and concourse lighting on campus, and there shall be no single conductors used in any lighting projects in green spaces or hard spaces.

B. Conductors shall be #4 AWG Class B concentric strand (7 strand) copper conductor.

C. Conductors shall be insulated with a minimum of 45 mils of ethylene-propylene rubber (FR-EPR) Type III insulation.

D. The cable shall consist of three conductors. One insulated 600 volt conductor shall be color black (phase), one 600 volt conductor shall be color white (neutral), and one 600 volt conductor shall be color green (ground) consistent with ICEA Method 3.

E. The cable shall be assembled with the three conductors using flame retardant non-hygroscopic fillers in the cable interstices to preserve the round cable geometry and to limit water ingress and transmission.

F. The cable jacket shall be lead-free flame retardant; water, sunlight, and oil resistant; thermoplastic Chlorinated Polyethylene (CPE). The cable jacket shall pass the -40 degree C. cold bend test. The jacket shall be a minimum thickness of 80 mils.

G. The cable jacket shall be surface printed with the manufacturer's name, year of manufacture, gauge size, number of conductors, voltage rating, and pertinent U.L. information at 24 inch intervals.

H. Conductors shall be manufactured and tested in accordance with this specification and the latest version of U.L. Standard 44 UL1277 Type TC-ER; ICEA S-95-658/NEMA WC70; and IEEE 1202, ICEA T-29-520, U.L. 1685, U.L VW-1.

I. Conductor ends shall be sealed to prevent the ingress of water.

J. Conductors shall be as manufactured by Draka, Catalog No. 400699.

2.7 STREET LIGHT AND AREA LIGHT PULL BOXES

A. Street light pull boxes shall be 11" x 18" x 18" deep, Hubbell CDR catalog no. B12111818A box and C12111802A041 cover with penta-socket bolts and "STREET LIGHTING" logo.

2.8 STREET LIGHT AND AREA LIGHT FUSING

A. Fuses for street lights and area lights shall be Bussmann Tron in-line fuse holder and fuse, Type HEB-AA, 30A, 600V with KTK-5 fuse. Install one fuse in each phase conductor. Fuses shall be sized for the fixtures being protected. Fuses shall be installed in the fixture.

2.9 STREET LIGHT AND AREA LIGHT VOLTAGE

A. The operating voltage for street lights and area lights shall be 277 V.

PART 3 - EXECUTION

3.1 LAYING OUT WORK

A. All exterior light locations shall be staked out by the Contractor and approved by the Engineer prior to installation.

3.2 STREET LIGHTS

A. 25 Foot Street Light Bases:

1. Bases for 25 foot street light poles and parking area lights shall be constructed as shown on the drawing. Bases shall be 18" diameter.

2. Bases shall be made of 3,000 psi strength, 6-AA limestone concrete mixture.

3. Install LFNC-B marked for concrete embedment and direct burial conduits to be left in base. Size and quantity as shown on drawings. LFNC-B shall be manufactured by Southwire Ultratight Type NM, Thomas and Betts XTRA Flex, or equal.

4. Chamfer top edge of the base with a one inch chamfer.
5. After the base has cured the form shall be removed.

B. Install the street light standard with on nut above and one nut below the standard base. The nut below shall be used as a leveling nut.

C. After the standard is plumb, grout the opening between the concrete base and standard base full from the conduit to the edge of the standard base.

3.3 GROUNDING

A. Each street and walk light shall be grounded with a 5/8 inch x 8 foot copperweld ground rod driven adjacent to the base, covered by a minimum of 6 inches of earth and connected to the standard or post with a no. 6 bare copper wire.

B. Provide Burndy GRC58 or equal ground rod connector.

C. Install a No. 10 USE ground wire from the luminaire grounding lug to the hand hole and connect to the grounding rod conductor.

3.4 TRENCHING

A. The Contractor shall use a trenching machine or back hoe in digging trench for conductors. Trench shall have a minimum width of 6 inches and a maximum width of 12 inches. Depth of trench shall be a minimum of 30 inches.

B. Trench shall be free of stones or debris before conductors are installed.

C. When backfilling, fill first 6 inches of trench with sand. Earth removed may only be used in this first 6 inches of fill if it is hand shoveled and kept free of stone, cinders, and other debris.

D. All backfill placed under roadways, sidewalks, parking areas, or other surfaced areas shall be compacted to 95 maximum density. All backfill placed in lawn or field areas shall be compacted to 90 maximum density. Density tests shall conform to A.A.S.H. Test T-180 and field test T-147.

E. Failures of any surface areas caused by settlement shall be repaired at the contractors expense for a period of 3 years after completion of contract.

3.5 STREET LIGHT PULL BOXES

A. Pull Box Location:

1. At all locations where a three-way splice is made within the street light circuit cable, an underground street light pull box shall be located next to a light pole for a tap to the pole, or for a splice.

2. The street light cable shall be daisy chained by looping into and out of the light pole and the tap for the fixture will be made in the handhole.

3. All street light underground pull boxes and sleeves, shall be GPS located for street light mapping purposes. All electronic as-built utility information in the as-built survey must reference the Michigan State Plane Coordinate System, South Zone, **NAD83(86)** horizontal and **NVGD29** vertical utilizing **GEOID 12B** grid #3; the units must be in **US Survey Feet** and tied to the benchmark control network that can be found at https://apps.gis.msu.edu/facilities-information-tool/maps/benchmarks/.

B. Pull Box Installation:

1. Install pull box approximately 1 to 2 feet from the light standard as shown on the details.
2. Install street light conduits to enter the bottom of the street light pull box.

3. Install 6 inches of peastone around the conduits to form a level base for the pull box to set on. Install the pull box on the peastone so that the top of the box even with grade.

4. Install crushed peastone inside the pull box to a depth of 2 inches around the conduits. Leave conduits extended a minimum of 3 inches above the peastone which will allow approximately 8” of room for cable splices.

5. Provide conduit end bells on all conduits that enter the street light pull box.

6. Pull Box shall be Hubbell CDR Cat No. B1211818A box and C12111802A cover, with penta-socket bolts and “Street light” Logo.

3.6 CONDUIT

A. Install minimum 3 inch Sch 40 PVC conduit under all walks, roadways, parking lots, and all other hard surfaces.

B. Install a locator ball at one of the sleeve for sleeves eight feet or less, and at both ends of the sleeve for sleeves over eight feet.

C. Locator balls shall be 3M Dynatel EMS 4” extended range, color red, transmitting at a frequency of 169.8 kHz.

3.7 CONDUCTOR INSTALLATION

A. Care shall be taken not to cross conductors in the trench.

B. Connections Made In Street Light Standard or Area Light Pole.

1. Extend the street light conductors up into pole so that 10 inches of each conductor is accessible out through hand hole.

2. Install 3#10 AWG USE stranded copper conductors from luminaire to hand hole.

3. Street light conductors shall be connected to luminaire conductors in hand holes using Polaris Electrical Connectors catalog number IT-1/0.

C. Connections Made In Street Light Pull Box.

1. Extend the street light conductors up into pull box so that 24 inches of each conductor is accessible from the end of the conduit.

2. Install MSU street light cable from pull box to hand hole.

3. Street light conductors shall be connected to luminaire conductors in hand holes using Homac catalog no. RAB 1/0-3 (UPC 35042) for three conductor connections and Homac catalog no. RAB 1/0-4 (UPC 35043) for four conductor connections.

3.8 CONDUCTOR SPLICING

A. Street light conductors shall be installed in continuous lengths from light to light with connections in the base of lights or street light pull boxes. Where a pipe in an existing base is filled, drill an additional hole in base to insert new conductors.

B. A buried splice may only be made if conductors are to be cut and rerouted, extended where a light is removed, or if broken by another trade during construction. Buried splices shall be made in the following manner:

1. Form conductors and cut to length so that ends of the three conductors to be spliced meet with no tension.

2. Remove 3-1/2” jacket from the ends of each cable.

3. Cut back each conductor’s insulation just far enough so that the conductors will meet in the center of a sleeve and have from 1/8 to 1/4 inch of bare conductor showing on each end of the sleeve.

4. Thoroughly clean the insulation of each conductor and the cable jacket of each cable end prior to applying heat shrink tubing to provide good adhesion.

5. Apply the compression connectors.

6. Apply 3-1/2 inch Raychem WCSM-20/6-1200-S heavy wall heat shrink tubing (or approved equal) over each conductor splice.

7. Apply 12 inch Raychem WCSM-33/8-1200-SS heavy wall heat shrink tubing (or approved equal) over the three spliced conductors and the cable jacket overlapping the cable jacket a minimum of 2 inches beyond the edge of the each cable jacket.

3.9 STREET LIGHT AND AREA LIGHT FUSES

A. Install Bussmann Tron in-line fuse holders and fuses in the luminaire.

3.10 EXTERIOR LIGHTING CONTROL

A. Exterior building lights and site lights shall be controlled by the MSU Central Control system.

B. The exterior building lights shall be served from one lighting panel thru a multi-pole lighting contactor with a Hand-Off-Auto switch. MSU Central Control shall be connected at the Auto position.

C. The site lighting shall be served from one lighting panel thru a multi-pole lighting contactor with a Hand-Off-Auto switch. MSU Central Control shall be connected at the Auto position.

D. The contactor control power shall originate from the same panel serving the lighting load.

E. The lighting panels and contactors shall be located in the building electrical substation.

3.11 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."
b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
d. IESNA LM-64, "Photometric Measurements of Parking Areas."
e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600