

PROJECT MANUAL FOR:

**GENERAL SITE – STEAM AND WATER LINE REPLACEMENT,
STEPHENS AND LEFEVRE HALLS
PROJECT NUMBER CP253171**

AT
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

FOR:
THE CURATORS OF THE UNIVERSITY OF MISSOURI



PREPARED BY:

PRVN Consultants, Inc.
1617 Second Ave., Suite 110
Rock Island, IL 61201
Telephone: (319) 359-7808
Project No. 25103

Crockett Engineering Consultants
1000 W. Nifong Blvd., Bldg. 1
Columbia, MO 65203
(573) 447-0292

DATE: 12/22/2025

ISSUED FOR BIDDING

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SECTION 00 00 01
SEALS AND SIGNATURES

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Specification Sections:
33 63 00
33 63 19



ENGINEER OF RECORD
JAMES J NONNENMANN
LICENSE NO. PE-5053025612
PRVN CONSULTANTS, INC.
1617 SECOND AVE., SUITE 110
ROCK ISLAND, IL 61201
TELEPHONE: 563.263.5160
CORPORATE CERTIFICATE OF AUTHORITY
NO. 2023017605
ENGINEER OF RECORD

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Specification Sections:
Division 26

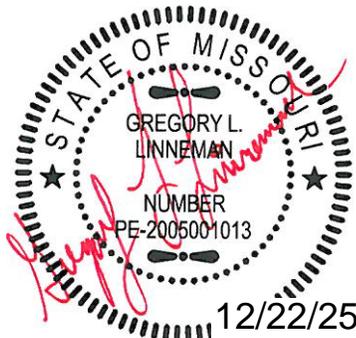


ENGINEER OF RECORD
JEFFERY GAMBRALL
LICENSE NO. PE-2000173300
PRVN CONSULTANTS, INC.
1617 SECOND AVE., SUITE 110
ROCK ISLAND, IL 61201
TELEPHONE: 563.263.5160
CORPORATE CERTIFICATE OF AUTHORITY
NO. 2023017605

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Specification Sections:

- Division 03
- 33 63 41
- 33 63 50
- 33 63 51
- 33 63 54



GREGORY L. LINNEMAN - PE
MO LICENSE - 2005001013

ENGINEER OF RECORD
GREGORY L. LINNEMAN
LICENSE NO. 2005001013
CROCKETT ENGINEERING CONSULTANTS
1000 W. NIFONG BOULEVARD, BUILDING 1
COLUMBIA, MO 65203
TELEPHONE: 573.447.0292
CORPORATE CERTIFICATE OF AUTHORITY
NO. 2000151301

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Specification Sections:

- Division 31
- Division 32
- 33 11 13
- 33 11 14
- 33 41 00



ENGINEER OF RECORD
ANDREW T. GREENE
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CORPORATE CERTIFICATE OF AUTHORITY
NO. 2000151301

PROJECT MANUAL FOR:

**GENERAL SITE – STEAM AND WATER LINE REPLACEMENT AT STEPHENS AND
LEFEVRE HALLS
PROJECT NUMBER CP253171**

**AT
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI**

**FOR:
THE CURATORS OF THE UNIVERSITY OF MISSOURI**

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END OF SECTION

Division 01

General Requirements

University of Missouri – General Site

Steam and Water Line Replacement, Stephens and Lefevre Halls

Division 01

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900 E. Stadium, Ste. 130
Columbia, Missouri 65211
Telephone: (573) 882-6800

ADVERTISEMENT FOR BIDS

Sealed bids for:

General Site –
Steam and Water Lines Replacement, Stephens and Lefevre Halls

UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

PROJECT NUMBER: CP253171

CONSTRUCTION ESTIMATE: \$1,928,284 - \$2,142,538

will be received by the Curators of the University of Missouri, Owner, at Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.S.T., February 5, 2026 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at <http://operations-webapps.missouri.edu/pdc/adsite/ad.html>. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed.

Questions regarding the scope of work should be directed to Jason Hunter with PRVN Consultants, Inc. at (319)430-2496 or jhunter@prvninc.com. Questions regarding commercial conditions should be directed to Greg Hayes at (573) 884-7788 or ghayes@missouri.edu.

A prebid meeting will be held at 10:00 a.m., C.S.T., January 30, 2026 in the General Services Bldg., Room 194A, followed by a site walk-through.

This project has participations goals for Minority Business Enterprises (MBE), Women Business Enterprises (WBE) and Service-Disabled Veteran Business Enterprises (SDVE) as follows: 10% MBE, 10% WBE and 3% SDVE. Please see the Information for Bidders and General Conditions for additional information about the MBE/WBE/SDVE Participation Goals.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-6800.

Advertisement Date: January 21, 2026

SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date: _____

BID OF _____
(hereinafter called "Bidder") a corporation * organized and existing under laws of the State of

_____ ,
A partnership * consisting of _____ ,

An individual* trading as _____ ,

A joint venture* consisting of _____ .

*Insert Corporations(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Associate Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri
Columbia, Missouri 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by PRVN CONSULTANTS, INC., entitled "GENERAL SITE – STEAM AND WATER LINE REPLACEMENT, STEPHENS AND LEFEVRE HALLS" project number CP253171, dated December 22, 2025, having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposed to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of the following addenda:

Addendum No. _____ Dated _____

2. In the following Bid(s), amount (s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. **BID PRICING**

a. Base Bid:

The Bidder agrees to furnish all labor, materials, tools, and equipment required to provide civil, structural, mechanical, and electrical work for new water mains, steam, and condensate piping, steam manhole construction, chase and steam manhole refurbishment, waterproofing, utility relocations, site lighting, and site restoration; all as indicated on the Drawings and described in these Specifications for sum of:

_____ DOLLARS (\$ _____).

b. Additive Alternate Bids:

Above Base Bid may be changed in accordance with the following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of the Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) None

c. Unit Prices:

(1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instruction of the Owner's Representative, the following Unit Prices shall prevail in accordance with the General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliance, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given, and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner's Representative.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by the Owner's Representative.

FILL IN ONLY ONE PRICE PER LINE:

- (6) Repair of concrete cracks, per linear foot as detailed on Drawing S112.
Base Bid quantity = 100 linear feet. \$ _____ / ln. ft.
- (7) Surface spall repair #1 as detailed on Drawing S112,
Base Bid quantity = 200 sq. ft. \$ _____ / sq. ft.
- (8) Surface spall repair #2 as detailed on Drawing S112,
Base Bid quantity = 150 sq. ft. \$ _____ / sq. ft.
- (9) Surface spall repair #3 as detailed on Drawing S112,
Base Bid quantity = 200 sq. ft. \$ _____ / sq. ft.
- (10) Full depth repair as detailed on Drawing S112,
Base Bid quantity = 60 lineal feet \$ _____ / ln. ft.

4. PROJECT COMPLETION

- a. Contract Period – Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and “Instructions for Execution of Contract, Bonds, and Insurance Certificates.” Bidder agrees to complete project within 180 calendar days from the start of onsite construction. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned document from Bidder.
- b. Commencement – Contractor agrees to commence work on this project after the “Notice to Proceed” is issued by the Owner. “Notice to Proceed” will be issued within seven (7) calendar days after the Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.
- c. Special Scheduling Requirements:
 - 1. The sequencing and scheduling of all work shall be dependent on and subject to campus utility system operations.
 - 2. The nature of this project requires a high level of coordination by Contractor with Owner.
 - 3. Owner expects steam manhole / chase work and the new water line at the west end work to be performed concurrently.
 - 4. Onsite construction shall not start prior to May 18, 2026 and shall be completed in 180 calendar days. See Special Conditions Section 1.E for additional scheduling information and critical dates.
 - 5. Demolition and new construction shall be phased as required to maintain the operation of campus utility systems.
 - 6. All work shall be scheduled with the Owner’s Representative and be subject to the Owner’s approval prior to proceeding.
 - 7. Contractor shall coordinate construction activities in the Memorial Union

area and the timing of those activities with the Owner's Representative prior to starting work.

8. The project requires outages to campus utility systems. Contractor shall complete all related work to the maximum extent possible prior to the start of outages. Contractor shall have all required materials on site prior to start of outages.
9. Site utility outages shall be coordinated with the Owner's Representative and are weather dependent. Contractor shall notify Owner's Representative two (2) weeks in advance of desired outage time. Owner's Representative will give Contractor 72 hours advance notice of actual time for outages.
10. Tie-ins to University utility systems shall be made on weekends or nights and work shall be performed around the clock until the tie-in is completed, unless otherwise requested by the individual facility.
11. Detailed sequencing of all work shall be coordinated with the Owner's Representative.
12. Contractor shall coordinate site access requirements with subcontractors, and other contractors in the area. Pedestrian access must be maintained as shown on the drawings.

5. **SUBCONTRACTOR LIST:**

Bidder hereby certifies that the following subcontractors will be used in performance of Work:

NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

Work to be performed	Subcontractor Name, City, and State
Excavation / Site Utilities	_____
Mechanical	_____
Waterproofing	_____

6. MBE/WBE/SDVE PARTICIPATION

- a. SDVE Bonus Preference: A three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Business Enterprise (SDVE) doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business, as stated in the Information for Bidders. By indicating “Yes” below, the Bidder certifies that the Bidder is certified as an SDVE by the State of Missouri, Office of Administration.

Yes _____ No _____

- b. MBE/WBE/SDVE Participation Goals: The Bidder shall have a goal of providing participation in the contract of Minority Business Enterprises (MBE) of ten percent (10%) with Women Business Enterprises (WBE) of ten percent (10%), and with Service-Disabled Veteran Business Enterprises (SDVE) of three percent (3%) of the awarded contract price for work to be performed.
- c. Good Faith Effort Waiver: Requests for waiver of these goals due to good faith effort shall be submitted on the attached Application For Waiver form. A determination by the UM Executive Director of Facilities Planning and Development that a good faith effort has not been made by Bidder to achieve above stated goals may result in rejection of the bid.
- d. The undersigned Bidder proposes to perform work with the MBE/WBE/SDVE participation level set forth below. An MBE/WBE/SDVE Compliance Evaluation form shall be submitted with this bid for each MBE/WBE/SDVE subcontractor to be used on this project.

MBE PERCENTAGE PARTICIPATION: ___ percent (_____%)

WBE PERCENTAGE PARTICIPATION: __ percent (_____%)

SDVE PERCENTAGE PARTICIPATION: __ percent (_____%)

7. BIDDER’S ACKNOWLEDGEMENTS

- a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.
- b. Bidder agrees that bid shall not be withdrawn for a period of ninety (90) days after

scheduled closing time for receipt of bids.

- c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.
- d. Accompanying the bid is a bid bond, or a certified check, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.
- e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.
- f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

- a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules or any group, association or corporation.
- b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.
- c. He has not solicited or induced any person, firm or corporation to refrain from bidding.
- d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.
- e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.
- f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By

virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

END OF BIDDER'S CERTIFICATE

9. BIDDER’S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one: Individual Partnership Corporation Joint Venture	
If a corporation, incorporated under the laws of the State of _____	
Licensed to do business in the State of Missouri? ___yes ___no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION

**UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name _____

Phone# _____ Fax #: _____

Address _____

2. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

3. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

4. General character of work performed by your company personnel.

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

6. Other experience qualifying you for the work now bid.

7. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made _____
(b) Description of defaulted contracts and reason therefor _____

8. Are you or your company certified by the State of Missouri, Office of Administration as a Minority Business Enterprise (MBE), Women Business Enterprise (WBE), or Service-Disabled Veteran Business Enterprise (SDVE)?

Yes _____ No _____

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?

Yes _____ No ____ (If the answer is "yes", give details.)

10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?

Yes _____ No ____ (If the answer is "yes", give details.)

11. Workers Compensation Experience Modification Rates (last 3 yrs): ____ / ____ / ____

Incidence Rates (last 3 years): ____ / ____ / ____

12. List banking references.

13. (a) Do you have a current confidential financial statement on file with Owner?

Yes _____ No ____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

(b) If not, upon request will you file a detailed confidential financial statement within three (3) days?

Yes _____ No ____

Dated at _____ this _____ day of _____ 20____

Name of Organization

Signature

Printed Name

Title of Person Signing

END OF SECTION

**UNIVERSITY OF MISSOURI
 BIDDER'S STATEMENT OF QUALIFICATIONS
 FOR ASBESTOS ABATEMENT**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name _____ Phone# _____

Address _____

2. State of Missouri Registration number _____

3. Number of years in business _____ If not under present firm name, list previous firm names and types of organization.

4. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

5. General character of work performed by your company personnel.

6. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
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7. Other experience qualifying you for the work now bid.

8. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made _____

(b) Description of defaulted contracts and reason therefor _____

9. Are you or your company certified by the State of Missouri, Office of Administration as a Minority Business Enterprise (MBE), Women Business Enterprise (WBE), or Service-Disabled Veteran Business Enterprise (SDVE)?
Yes _____ No _____

10. Have you or your company been suspended or debarred from working at any University of Missouri campus?
Yes _____ No _____ (If the answer is "yes", give details.)

11. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
Yes _____ No _____ (If the answer is "yes", give details.)

12. Workers Compensation Experience Modification Rates (last 3 yrs): _____ / _____ / _____
Incidence Rates (last 3 years): _____ / _____ / _____

13. List banking references.

14. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No _____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

(b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No _____

Dated at _____ this _____ day of _____ 20_____

Name of Organization

Signature

Printed Name

Title of Person Signing

MBE/WBE/SDVE COMPLIANCE EVALUATION FORM

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each MBE/WBE/SDVE firm that will perform work under the contract. The undersigned submits the following data with respect to this firm's assurance to meet the goal for MBE/WBE/SDVE Participation.

1. Project: _____
2. Name of General Contractor: _____
3. Name of MBE/WBE/SDVE Firm: _____
Address: _____
Phone No.: _____ Fax No.: _____
Status (check one) MBE _____ WBE _____ Service-Disabled Veteran _____
4. Describe the work to be performed. (List Base Bid work and any Alternate work separately):
Base Bid:

5. Dollar amount of contract to be subcontracted to the MBE/WBE/SDVE firm:
Base Bid:
Alternate(s), (Identify separately):

6. Is the proposed firm certified as an MBE/WBE/SDVE by the State of Missouri, Office of Administration?
Yes _____ No _____

Signature: _____

Name: _____

Title: _____

Date: _____

APPLICATION FOR WAIVER

This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to meet the MBE/WBE/SDVE Participation Goals for that project. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the Bidder's efforts to meet the MBE/WBE/SDVE Participation Goals.

- 1. List pre-bid conferences your firm attended where MBE/WBE/SDVE Participation Goals were discussed.

- 2. Identify advertising efforts undertaken by your firm which were intended to recruit potential MBE/WBE/SDVE subcontractors or suppliers for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

- 3. Note specific efforts to contact in writing those MBE/WBE/SDVE firms capable of and likely to participate as subcontractors or suppliers for this project.

- 4. Describe steps taken by your firm to divide work into areas in which MBE/WBE/SDVE firms would be capable of performing.

- 5. What efforts were taken to negotiate with prospective MBE/WBE/SDVE? Include the names, addresses, and telephone numbers of MBE/WBE/SDVE firms contacted, a description of the information given to MBE/WBE/SDVE firms regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with MBE/WBE/SDVE firms.

6. List reasons for rejecting an MBE/WBE/SDVE firm which has been contacted.

7. Describe the follow-up contacts with MBE/WBE/SDVE firms made by your firm after the initial solicitation.

8. Describe the efforts made by your firm to provide interested MBE/WBE/SDVE firms with sufficiently detailed information about the plans, specifications and requirements of the contract.

9. Describe your firm's efforts to locate MBE/WBE/SDVE firms.

Based on the above stated good faith efforts made to meet the MBE/WBE/SDVE Participation Goals, the Bidder hereby requests that the original goal be waived and that the percentage goal for this project be set at _____ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature: _____

Name: _____

Title: _____

Company: _____

Date: _____

AFFIDAVIT

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of

_____ (name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the UM Executive Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature: _____

Name: _____

Title: _____

Date: _____

Corporate Seal (where appropriate)

Date: _____

State of _____

County of _____

On this _____ day of _____, 20__, before me appeared _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by _____ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public

Commission expires: _____

AFFIDAVIT OF MBE/WBE/SDVE PARTICIPATION

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Minority Business Enterprise (MBE), Women Business Enterprise (WBE), and Service-Disabled Veteran Business Enterprise (SDVE) that will participate in the performance of the contract.

1. Name of MBE/WBE/SDVE Firm: _____
 Contact Name: _____
 Address: _____
 Phone No.: _____
 Status (check one) MBE WBE SDVE

2. Is the proposed MBE/WBE/SDVE firm certified by the State of Missouri, Office of Administration
 Yes No
 Certification Number: _____

3. MBE/WBE/SDVE firm scope work and dollar amount of participation (List Base Bid and Alternate work separately):

	Scope of Work	Bid/Contract Amount	Final Dollar Amount (Complete at Project Closeout)
Base Bid			
Alternate #1			
Alternate #2			
Alternate #3			
Alternate #4			
Alternate #5			
Alternate #6			

Signature Page Follows

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

General Contractor: _____	MBE/WBE/SDVE Firm: _____
Signature: _____	Signature: _____
Name: _____	Name: _____
Title: _____	Title: _____
Date: _____	Date: _____

Sign at Project Close Out

The undersigned certified that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach a written justification for the difference.

General Contractor: _____	MBE/WBE/SDVE Firm: _____
Signature: _____	Signature: _____
Name: _____	Name: _____
Title: _____	Title: _____
Date: _____	Date: _____

University of Missouri INFORMATION FOR BIDDERS

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1. Contract Documents and Definitions

1.1 The “Drawings,” “Specifications,” and “Contract Documents” are defined in the “General Conditions of the Contract for Construction.”

1.2 The Drawings, Specifications, and other Contract Documents may be obtained as indicated in the Advertisement for Bids.

1.3 As used herein, “Bid” refers to an offer or proposal submitted to the Owner to enter into a contract for the work identified in the Drawings, Specifications and other Contract Documents.

1.4 As used herein, “Bidder” means an individual or business entity that submits a Bid to the Owner as a prime bidder or general contractor.

1.5 All other terms used herein shall have the meanings defined herein or in the General Conditions of the Contract for Construction or other Contract Documents.

2. Bidder Obligations

2.1 Before submitting a Bid, each Bidder shall carefully examine the Drawings and Specifications and related Contract Documents, visit the site of the work, and fully inform themselves as to all existing conditions, facilities, restrictions, and other matters that could affect the work or the cost thereof.

2.2 Each Bidder shall include in their Bid the cost of all work and materials required to complete the contract in a first-class manner, as specified in the Drawings, Specifications, and other Contract Documents. All work shall be done as defined in the Specifications and as indicated on the Drawings.

2.3 Failure or omission of any Bidder to receive or to examine any form, instrument, addendum, or other document, or to visit the site of the work and acquaint themselves with existing conditions, shall in no way relieve the Bidder from any obligation with respect to their Bid or any awarded contract. No extra compensation will be allowed concerning any matter about which the Bidder should have fully informed themselves prior to submitting a Bid.

2.4 Submission of a Bid shall be deemed acceptance by the Bidder of the above obligations and every obligation required by the Contract Documents in the event the Bid is accepted by the Owner.

3. Interpretation of Documents

3.1 If any prospective Bidder is in doubt about the meaning of any part of the Drawings, Specifications, or other Contract Documents, the Bidder shall submit a written request to the Architect for an interpretation.

3.2 Any request for interpretation shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

3.3 A Bid shall be based only on an interpretation issued in the form of an addendum mailed to each person or business

entity that is on the Architect’s record as having received a set of the Contract Documents.

3.4 Bidders shall not be entitled to rely on oral interpretations or written statements not issued in an addendum from either the Architect or a representative, agent, or employee of the Owner.

4. Bids

4.1 Bids shall be submitted on a single “Bid for Lump Sum Contract” form (“Bid Form”) as furnished by the Owner or Architect. Bids shall be received separately or in combination as required by Bid Form

4.2 In addition to the Bid Form, the Bid shall include any documents or information required to be submitted by this Information for Bidders or the Contract Documents.

4.3 Bids shall include amounts for alternate bids, unit prices, and cost accounting data where required by the Bid Form.

4.4 Bidders shall apportion each base Bid between various phases of the work, where stipulated in the Bid Form.

4.5 Bids shall be presented in sealed envelopes, which shall be plainly marked “Bids for (indicate name of project from cover sheet)” and mailed or delivered to the building and room number specified in the Advertisement for Bids.

4.6 Each Bidder shall be responsible for actual delivery of their bid during business hours, and it shall not be sufficient to show that a Bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a Bid was somewhere in a university facility.

4.7 The Bidder’s price shall include all federal sales, excise, and similar taxes that may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City and State taxes shall not be included as stated in the General Conditions of the Contract for Construction.

4.8 No Bidder shall stipulate in their Bid any conditions not contained in the Bid Form or Contract Documents. Inclusion of any additional conditions or taking exception to any terms may result in rejection of the Bid.

4.9 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

5. Modification and Withdrawal of Bids

5.1 A Bidder may withdraw their Bid at any time before the scheduled closing time for receipt of bids. No Bidder may withdraw their Bid after the scheduled closing time for receipt of bids.

5.2 Only a written request for modification or correction of a previously submitted Bid, contained in a sealed envelope that is plainly marked “Modification of Bid on (name of project on cover sheet),” which is addressed in the same manner as a Bid and

received by Owner before the scheduled closing time for receipt of bids, will be accepted and the Bid modified in accordance with such written request.

6. Signing of Bids

6.1 All bids shall be signed manually, by an individual authorized to sign on behalf of the Bidder. The title or office held by the person signing for the Bidder shall appear below the signature.

6.2 A Bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the Bid form should appear as shown in the Secretary of State's records.

6.3 A Bid from a partnership or joint venture shall be signed in the name of the partnership or joint venture by at least one partner or joint venturer or by an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid executed by all partners or joint venturers.

6.4 A Bid from a corporation shall be signed by an officer of the corporation.

6.5 A Bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

6.6 A Bid from an individual or sole proprietor shall be signed in the name of the individual by the individual or an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid executed by the individual.

7. Bid Security

7.1 Each Bid shall be accompanied by a Bid Bond, certified check, or cashier's check, acceptable to and payable without condition to "The Curators of the University of Missouri" in an amount at least equal to five percent (5%) of the Bidder's Bid including additive alternates ("Bid Security").

7.2 Bid security is required as a guarantee that the Bidder will enter into a written contract and furnish a Performance Bond within the time and in form as specified herein or in the Contract Documents; and, if successful Bidder fails to do so, the Bid Security will be realized upon or retained by the Owner. The apparent low Bidder shall notify the Owner in writing within forty-eight (48) hours of the Bid opening of any circumstance that may affect the Bid Security including, but not limited to, an error in the Bid. This notification will not guarantee release of the Bidder's security and/or the Bidder from the Bidder's obligations.

7.3 If a Bid Bond is given as a Bid Security, the amount of the Bid Bond may be stated as an amount equal to at least five percent (5%) of the Bid, including additive alternates, described in the Bid. The Bid Bond shall be executed by the Bidder and a responsible surety licensed in the State of Missouri with a Best's rating of no less than A-/XI.

7.4 It is specifically understood that the Bid Security is a guarantee and shall not be considered as liquidated damages for failure of Bidder to execute and deliver the contract and Performance Bond, nor limit or fix the Bidder's liability to the Owner for any damages sustained because of failure to execute and deliver the required contract and Performance Bond.

7.5 The Bid Security of the two (2) lowest, responsive, responsible bidders will be retained by the Owner until a contract has been executed and an acceptable Performance Bond has been furnished, as required hereby, when such Bid Security will be returned. The Bid Bonds of all other Bidders will be destroyed and all other alternative forms of Bid Security will be returned to them within ten (10) days after the Owner has determined the two (2) lowest, responsive, responsible bids.

8. Bidder's Statement of Qualifications

8.1 Each Bidder shall present evidence of their experience, qualifications, financial responsibility, and ability to carry out the terms of the contract by completing and submitting with their Bid the "Bidder's Statement of Qualifications" form included with the Bid documents.

8.2 Financial information required to be included with the Statement of Qualifications may be submitted by the Bidder in a separately sealed envelope, which will not be opened by the Owner during the public Bid opening.

8.3 The Bidder's Statement of Qualifications will be treated as confidential information by the Owner to the extent permitted by the Missouri Sunshine Law, Section 610.010, RSMo et seq.

8.4 Bids not accompanied by the Bidder's Statement of Qualifications may be rejected.

9. Award of Contract

9.1 The Owner reserves the right to let other contracts in connection with the work, including, but not limited to, contracts for furnishing and installation of furniture, equipment, machines, appliances, and other apparatus.

9.2 In awarding the contract, the Owner may take into consideration the ability of the Bidder, and their subcontractors, to handle promptly the additional work; the skill, facilities, capacity, experience, ability, responsibility, previous work, and financial standing of Bidder; the Bidder's ability to provide the required bonds and insurance; the quality, efficiency and construction of equipment proposed to be furnished; the period of time within which equipment is proposed to be furnished and delivered; success in achieving the specified MBE/WBE/SDVE Participation Goals or demonstrating a good faith effort to do so as described in Article 15 of this document; and the Bidder's status as suspended or debarred. Inability of any Bidder to meet the requirements mentioned above may be cause for rejection of their Bid.

10. Contract Execution

10.1 The awarded Bidder shall submit within fifteen (15) days from receipt of notice of award, the documents required in Article 9 of the General Conditions of the Contract for

Construction.

10.2 No bids will be considered binding upon the Owner until all such required documents have been furnished. Failure of Contractor to execute and submit such documents within the time specified will be treated, at the option of the Owner, as a breach of the Bidder's Bid Security and the Owner shall be under no further obligation to the Bidder.

11. Contract Security

11.1 When the Contract Sum exceeds \$50,000, the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of the Contract, including but not limited to the Contractor's obligation to correct any defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under the Contract and furnishing materials in connection with the Contract in accordance with Section 107.170, RSMo. These bonds shall be in effect through the duration of the Contract plus any Guaranty Period required by the Contract Documents.

11.2 The bonds required hereunder shall meet all requirements of Article 11 of the General Conditions of the Contract for Construction.

11.3 If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If the Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

12. Time of Completion

12.1 The awarded Contractor shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions of the Contract for Construction.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract, Performance Bond, and Payment Bond.

13.2 The Owner will furnish the Contractor the number of copies of complete sets of Drawings and Specifications for the work, as well as clarification and change order Drawings pertaining to change orders required during construction as set forth in the Special Conditions.

14. Missouri Products and Missouri Firms

14.1 The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies, and articles mined, grown, produced, and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations, or individuals. Each Bidder submitting a Bid agrees to comply with and be bound by the foregoing policy.

14.2 MBE/WBE/SDVE Participation Award of Contract

14.2.1 Pursuant to Sections 37.020 and 34.074, RSM (and the implementing regulations adopted by the State of Missouri, Office of Administration), the University of Missouri System sets goals for the participation of Minority Business Enterprise, Women Business Enterprise and Service Disabled Veteran Business Enterprise (MBE/WBE/SDVE) Firms (as defined in Article 1 of the General Conditions of the Contract for Construction) in its construction projects. The applicable goals for each project shall be as stated in the Bid Form. The standard goals for University projects by location are identified in the document entitled MBE/WBE/SDVE Participation Goals; however, the Executive Director of Facilities Planning and Development may set higher or lower MBE or WBE goals for a specific project by reviewing the type of project, elements of work to be performed, time for contract performance, and geographical location, history of MBE/WBE and non-MBE/WBE utilization, and availability of ready, willing, and able certified MBE/WBEs.

14.2.2 The Bidder shall have a minimum goal of providing participation of Minority Business Enterprise, Women Business Enterprise and/or Service Disabled Veteran Business Enterprise (MBE/WBE/SDVE) Firms in the project, through self-performance, if a MBE/WBE/SDVE Firm, or by subcontracting with MBE/WBE/SDVE Firms as subcontractors, suppliers, or manufacturers, in the amount of the percent of contract price stated in the Bid Form ("MBE/WBE/SDVE Participation Goals"). The Owner will take into consideration the Bidder's success in achieving the MBE/WBE/SDVE Participation Goals in awarding the contract. Inability of any Bidder to meet one or more of the MBE/WBE/SDVE Participation Goals shall be cause for rejection of their Bid, unless the Bidder has demonstrated that they made a good faith effort to comply as set forth below.

14.2.3 In addition to the MBE/WBE/SDVE Participation Goals set forth in the Bid Form, a three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Enterprises (SDVE) business doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business. The bonus preference will **not** be given to a Bidder for the use of SDVE subcontractors, suppliers, or manufacturers. The bonus preference shall be calculated and applied by reducing the Bid amount of the SDVE Bidder by three

(3) percent of the apparent low, responsive Bidder's Bid. Based on this calculation, if the SDVE Bidder's resulting total Bid valuation is less than the Bid of the apparent low, responsive Bidder, the SDVE Bid becomes the apparent low, responsive Bid. This reduction is for evaluation purposes only and will have no impact on the actual amount(s) of the SDVE Bidder's Bid or the amount(s) of any contract awarded.

14.3 List of MBE/WBE/SDVE Firms

14.3.1 The Bidder shall submit, within forty-eight (48) hours of the receipt of bids to the University Contracting Officer, a list of MBE/WBE/SDVE Firms that will be performing as contractor, subcontractor, supplier, or manufacturer on the project. The list shall separately identify each MBE/WBE/SDVE Firm by name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, supplier, or manufacturer, the Bidder shall provide information for each affected category.

14.3.2 Failure to include a complete list of MBE/WBE/SDVE Firms that will be used to meet the MBE/WBE/SDVE Participation Goals may be grounds for rejection of the Bid.

14.3.3 The list of MBE/WBE/SDVE Firms shall be submitted in addition to any other listing of subcontractors required in the Bid Form or elsewhere in this document.

14.4 MBE/WBE/SDVE Participation Computation

14.4.1 The Bidder may count toward the Supplier Diversity Goal only expenditures to MBE/WBE/SDVE Firms that perform a commercially useful function in the work of a contract. An MBE/WBE/SDVE Firm is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work or contract and is carrying out its responsibilities by actually performing managing and supervising the work.

14.4.2 The Bidder may count toward its MBE/WBE/SDVE Participation Goals work granted to a second or subsequent tier subcontractor that is an MBE/WBE/SDVE Firm provided the MBE/WBE/SDVE Firm assumes the actual and contractual responsibility for performing work on the project. The Bidder may count toward its MBE/WBE/SDVE Participation Goals expenditures for materials and/or supplies obtained from an MBE/WBE/SDVE Firm, provided the MBE/WBE/SDVE Firm assumes the actual and contractual responsibility for the provision of the materials and/or supplies. To perform a commercially useful function, a supplier or manufacturer that is an MBE/WBE/SDVE Firm must be responsible for negotiating price, determining quality and quantity, ordering the material, installing (where applicable) and paying for the material itself.

14.4.3 An MBE/WBE/SDVE Firm does not perform a commercially useful function if its role is solely that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of participation. In determining whether a firm is such an extra participant, the Owner will examine similar transactions, particularly those in which MBE/WBE/SDVE Firms do not participate.

14.4.4 A Bidder that is a certified MBE/WBE/SDVE may count one hundred percent 100% of the contract amount towards the applicable MBE/WBE/SDVE Participation Goal, less any amount awarded to another MBE/WBE/SDVE Firm. For projects with separate MBE/WBE/SDVE Participation Goals, the Bidder will be required to obtain participation in the other categories for which it is not certified through participation by subcontractors, suppliers, or manufacturers. Therefore, an MBE Bidder is expected to obtain the required WBE and SDVE participation; a WBE Bidder is expected to obtain the required MBE and SDVE participation; and a SDVE Bidder is expected to obtain the required MBE and WBE participation.

14.4.5 If the Bidder is a joint venture and the joint venture itself is certified as a MBE/WBE/SDVE Firm, the joint venture may count toward the MBE/WBE/SDVE Participation Goals that portion of the total dollar value of the work equal to the percentage of the ownership and control of the MBE/WBE/SDVE Firm that is a participant in the joint venture. When a MBE/WBE/SDVE Firm performs work as a participant in a joint venture where the joint venture is **not** separately certified as an MBE/WBE/SDVE Firm, only the portion of the Contract Sum equal to the distinct, clearly defined portion of the work that the MBE/WBE/SDVE Firm performs with its own forces shall count toward the MBE/WBE/SDVE Participation Goals.

14.4.6 If an MBE/WBE/SDVE Firm is certified in more than one category, that MBE/WBE/SDVE Firm may be used to satisfy more than one MBE/WBE/SDVE Participation Goal, provided that the MBE/WBE/SDVE Firm is awarded a sufficient percentage of the contract work to meet or exceed all applicable MBE/WBE/SDVE Participation Goals.

14.5 Certification of MBE/WBE/SDVE Firms

14.5.1 The Bidder shall submit, within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer, the information requested in the "MBE/WBE/SDVE Compliance Evaluation Form" for every MBE/WBE/SDVE Firm the Bidder intends to award work to under the contract to meet the MBE/WBE/SDVE Participation Goals.

14.5.2 The Bidder is responsible for obtaining information regarding the certification status of an MBE/WBE/SDVE Firm. Firms must be certified as an MBE, WBE or SDVE, as applicable, by the State of Missouri, Office of Administration as of the date of bid opening.

14.6 MBE/WBE/SDVE Participation Waiver

14.6.1 The Bidder is required to make a good faith effort to locate and contract with MBE/WBE/SDVE Firms. If a Bidder has made a good faith effort to secure the required MBE/WBE/SDVE Participation and has failed, the Bidder shall submit within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer the information requested in "Application for MBE/WBE/SDVE Participation Waiver." The Contracting Officer will review the Bidder's actions as set forth in the Bidder's "Application for Waiver" and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the MBE/WBE/SDVE Participation

Goal(s). If the Bidder is judged not to have made a good faith effort, the Bid may be rejected. Bidders who demonstrate that they have made a good faith effort to meet the MBE/WBE/SDVE Participation Goal(s) may be awarded the contract regardless of the actual percent of MBE/WBE/SDVE Participation, provided that the Bid is otherwise acceptable and is determined to be the lowest, responsive, responsible Bid.

14.6.2 To determine the good faith effort of the Bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

14.6.2.1 The bidder's attendance at pre-bid conferences for the solicitation;

14.6.2.2 The bidder's efforts and methods to provide M/WBEs and SDVEs with full sets of plans, specifications, or appropriate information in a timely manner to assist the M/WBE or SDVE in responding to the bidder's solicitation. This could include conducting market research to identify M/WBEs and SDVEs, and providing emails or written notices to all certified M/WBEs listed in OA's directory and listed SDVEs that specialize in the areas of work desired and which are located in the applicable area or surrounding areas as early in the acquisition process as practicable. Pro forma mailings to M/WBEs or SDVEs requesting bids are not alone sufficient to satisfy good faith efforts;

14.6.2.3 The bidder's efforts to make initial contact with at least three (3) M/WBEs and SDVEs for each category of work to be performed, its follow up with those contacted, and whether the bidder received a proposal for those categories of work;

14.6.2.4 The bidder's efforts to assist interested M/WBEs and SDVEs in obtaining bonding, lines of credit, or insurance or the efforts made to assist in obtaining necessary equipment, supplies, materials, or related assistance or services;

14.6.2.5 The extent to which the bidder divided work into projects suitable for subcontracting to M/WBEs and SDVEs including, where appropriate, breaking out contract work items into economically feasible units, for example, smaller tasks or quantities to facilitate M/WBE or SDVE participation, even when the bidder might otherwise prefer to perform the work with its own forces. Prime contractors are not, however, required to accept higher quotes from M/WBEs or SDVEs if the price difference is excessive or unreasonable, but the fact that there may be some additional costs involved in finding and using M/WBEs or SDVEs is not in itself sufficient reason for a bidder's failure to meet the contract M/WBE or SDVE percentage, as long as such costs are reasonable;

14.6.2.6 The bidder's ability to provide sufficient evidence in the form of documentation that supports the information provided;

14.6.2.7 The reasons provided by the bidder for the inability to reach a contract percentage and the ability of other bidders to meet the percentages, if applicable;

14.6.2.8 Actual past participation of M/WBEs and SDVEs achieved by the bidder; and

14.6.2.9 The rejection of an M/WBE or SDVE solely because its quotation for work was not the lowest received is not a sufficient good faith effort. However, a bidder is not required to accept an excessive or unreasonable quote in order to satisfy contract percentages.

14.7 Submittal of Forms

14.7.1 Within forty-eight (48) hours of the time for receipt of bids, the apparent low Bidder shall submit to the University Contracting Officer all MBE/WBE/SDVE Compliance Evaluation Form(s), and/or Application for Waiver with supporting information, and an "Affidavit of MBE/WBE/SDVE Participation" for every MBE/WBE/SDVE Firm the Bidder intends to award work on the contract. The affidavit will be signed by both the Bidder and the MBE/WBE/SDVE Firm. Failure to submit the documents in the time indicated may result in rejection of the Bid.

Additional Bid/Proposer Information

14.8.1 The Contracting Officer reserves the right to request from the apparent low Bidder additional, clarifying information regarding the Bidder's MBE/WBE/SDVE Participation and supporting documentation. The Bidder shall respond in writing to the Contracting Officer within twenty-four (24) hours of a request.

14.8.2 The Contracting Officer reserves the right to request additional information after the Bidder has responded to prior requests. This information may include follow-up and/or clarification of the information previously submitted.

14.8.3 The Bidder shall provide to the Owner information related to the MBE/WBE/SDVE Participation included in the Bidder's proposal, including, but not limited to, the complete Application for Waiver, evidence of certification of participating MBE/WBE/SDVE Firms, dollar amount of participation of MBE/WBE/SDVE Firms, information supporting a good faith effort as described above, and a list of all MBE/WBE/SDVE Firms that submitted bids to the Bidder with the MBE/WBE/SDVE Firm's price, and the name and the price of the firm awarded the scope of work.

15. List of Subcontractors

15.1 If a list of subcontractors is required on the Bid Form, the Bidder shall list the name, city, and state of the firm(s) that will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of MBE/WBE/SDVE Firms required in Section 15.2 and the complete list of subcontractors required in Section 10.1 of this document. Should the Bidder choose to perform any of the listed portions of the work with its own forces, the Bidder shall enter its own name, city, and state in the space provided. If acceptance or

non-acceptance of alternates will affect the designation of a subcontractor, the Bidder shall provide that information on the Bid Form.

15.2 Failure of the Bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the Bid. The Bidder can petition the Owner to change a listed subcontractor within forty-eight (48) hours of the Bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical errors in the Bid, a listed subcontractor's inability to perform the work, etc. Any request to change a listed subcontractor shall include at a minimum, a Bid sheet showing tabulation of the Bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

15.3 Upon award of the contract, the requirements of Article 10 herein and Article 5 of the General Conditions of the Contract for Construction will apply.

University of Missouri

General Conditions

of the

Contract

for

Construction

June 2025 Edition

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**ARTICLE 1
GENERAL PROVISIONS**

1.1 Basic Definitions

As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1.1.1 Owner

The Owner is The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof. The Owner may also be referred to herein as "University".

1.1.2 Contracting Officer

The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

1.1.3 Owner's Representative

The Owner's Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

1.1.4 Architect

When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

1.1.5 Owner's Authorized Agent

When the term "Owner's Authorized Agent" is used herein, it shall refer to an employee or agency acting on the behalf of the Owner's Representative to perform duties related to code inspections, testing, operational systems check, certification or accreditation inspections, or other specialized work.

1.1.6 Contractor

The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term "Contractor" means the Contractor or the Contractor's authorized representative.

1.1.7 Subcontractor and Lower-tier Subcontractor

A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether

performed at the Owner's site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

1.1.8 Minority Business Enterprises (MBE)

Minority Business Enterprise (MBE) shall have the meaning set forth in Section 37.020, RSMo and the implementing regulations promulgated by the State of Missouri, Office of Administration.

1.1.9 Women Business Enterprise (WBE)

Women Business Enterprise (WBE) shall have the meaning set forth in Section 37.020, RSMo and the implementing regulations promulgated by the State of Missouri Office of Administration.

1.1.10 Service-Disabled Veteran Enterprise (SDVE)

Service-Disabled Veteran Enterprise (SDVE) shall have the same meaning as "Service-Disabled Veteran Business" set forth in Section 34.074, RSMo and the implementing regulations promulgated by the State of Missouri, Office of Administration.

1.1.11 MBE/WBE/SDVE Firm

MBE/WBE/SDVE Firm shall mean a business entity that is certified as an MBE, WBE, and/or SDVE by the State of Missouri, Office of Administration.

1.1.12 Work

Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by the Contractor therefrom as necessary to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.

1.1.13 Approved

The terms "approved", "equal to", "directed", "required", "ordered", "designated", "acceptable", "compliant", "satisfactory", and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner's Representative.

1.1.14 Contract Documents

The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor's bid addressed to Owner, including Contractor's completed Qualification Statement, (8) Contractor's Performance Bond and Contractor's Payment Bond, (9) Notice to Proceed, (10)

and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

1.1.15 Contract

The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

1.1.16 Change Order

The Contract may be amended or modified without invalidating the Contract only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the Work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract Sum, time and schedule.

1.1.17 Substantial Completion

The terms "Substantial Completion" or "substantially complete" as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner's Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

1.1.18 Final Completion

The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

1.1.19 Supplemental and Special Conditions

The terms "Supplemental Conditions" or "Special Conditions" shall mean the part of the Contract Documents which amend, supplement, delete from, or add to these General Conditions.

1.1.20 Day

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

1.1.21 Knowledge

The terms "knowledge," "recognize" and "discover" their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes, or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the Work. Analogously, the expression "reasonably inferable" and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the Work.

1.1.22 Punch List

"Punch List" means the list of items, prepared in connection with the inspection(s) of the Project by the Owner's Representative or the Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner's Representative or the Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

1.1.23 Force Majeure

An event or circumstance that could not have been reasonably anticipated and is out of the control of both the Owner and the Contractor.

1.2 Specifications and Drawings

1.2.1 The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

1.2.2 The Drawings herein referred to, consist of drawings prepared by the Architect, and are enumerated in the Contract Documents.

1.2.3 Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor's written request to the Owner's Representative.

1.2.4 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract

Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.5 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner's Representative's interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large-scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner's Representative and the Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such departure for the approval by the Owner's Representative and the Architect before making the change.

1.2.6 Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and the Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

1.2.7 Only Work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.

1.2.8 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. The Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

- .1 conditions bearing upon transportation, disposal, handling, and storage of materials;
- .2 the availability of labor, materials, equipment, water, electrical power, utilities and roads;
- .3 uncertainties of weather, river stages, flooding and similar characteristics of the site;
- .4 conditions bearing upon security and protection of material, equipment, and Work in progress;
- .5 the form and nature of the Work site, including the surface and sub-surface conditions;

- .6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and
- .7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.
- .8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the Contract Documents.

The Owner assumes no responsibility or liability for the physical condition or safety of the Work site, or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.

1.2.9 Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner's property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

1.3 Required Provisions Deemed Inserted

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein; and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the written application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

ARTICLE 2 OWNER

2.1 Information and Services Required of Owner

2.1.1 Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the Contract Documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

2.1.2 When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

2.2 Owner's Right to Stop the Work

2.2.1 If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract

Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner's Representative may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. The Owner's lifting of Stop Work Order shall not prejudice the Owner's right to enforce any provision of this Contract.

2.3 Owner's Right to Carry Out the Work

2.3.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default or neglect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

2.3.2 In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its surety. In such case, the Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

2.4 Extent of Owner Rights

2.4.1 The rights stated in Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (1) granted in the Contract Documents, (2) at law or (3) in equity.

2.4.2 In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

ARTICLE 3 CONTRACTOR

3.1 Contractor's Warranty

3.1.1 The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breach of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

3.1.2 Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

3.1.3 The above warranties are not intended as a limitation but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

3.1.4 Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed all actions necessary to bring the Work into conformance with the Contract Documents at the Contractor's expense.

3.1.5 The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their officers, agents, employees, and volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breach of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the

University, agrees to pay to or reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

3.2 Compliance with Laws, Regulations, Permits, Codes, and Inspections

3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, permit requirements, codes, statutes, and regulations (which may be collectively referred to as "laws").

3.2.2 Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.

3.2.3 All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are included in the Contract Sum and shall be the Contractor's responsibility.

3.2.4 If the Contractor has knowledge that any Contract Documents are at variance with any laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations, or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner's Representative, in writing, and any necessary changes will be adjusted as provided in the Contract Documents. However, it is not the Contractor's primary responsibility to ascertain that the Contract Documents are in accordance with applicable laws, unless such laws bear upon performance of the Work.

3.3 Anti-Kickback

3.3.1 No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

3.3.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

3.4 Supervision and Construction Procedures

3.4.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

3.4.2 The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership, corporation, or joint venture or other business entity, the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

3.4.3 The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.18 this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

3.4.4 The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever Contract Work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the Contractor without approval from the Owner's Representative.

3.4.5 The Contractor shall establish and maintain a permanent benchmark to which access may be had during progress of the Work, and Contractor shall establish all lines

and levels, and shall be responsible for the correctness of such. The Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

3.4.6 The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

3.4.7 The Contractor's scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner's Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of the Contractor to comply with the provisions of this Paragraph shall cause the Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by the Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

- .1** All shutting of valves, switches, etc., shall be by the Owner's personnel.
- .2** The Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.
- .3** The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.
- .4** The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

3.4.8 The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems, and equipment of the Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a workday or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

3.4.9 The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

3.4.10 The Contractor shall be responsible for all shoring required to protect the Work or adjacent property and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice.

Shoring shall be removed only after completion of permanent supports.

3.4.11 The Contractor shall maintain at the Contractor's own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for students, faculty, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

3.4.12 During the performance of the Work, the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences, and other devices appropriately located on site which shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor's work area.

3.4.13 The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by the Contractor.

3.4.14 The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

3.4.15 When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination or inspection of Work in progress or completed.

3.4.16 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors of any tier and their agents and employees, and any other entity or persons performing portions of the Work.

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

3.4.18 The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are compliant and in proper condition to receive subsequent Work.

3.5 Use of Site

3.5.1 The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to exiting utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

3.5.2 Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.5.3 No project signs shall be erected without the written approval of the Owner's Representative.

3.5.4 The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, the Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, the Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. The Contractor shall assume full responsibility for any damage to the property comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

3.5.5 The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of the Owner's operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner's Representative for determination.

3.5.6 The Contractor and the Subcontractor of any tier shall have its' name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

3.6 Review of Contract Documents and Field Conditions by Contractor

3.6.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and the Owner and shall at once report in writing to the Architect and the Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency, or omission in the Contract Documents without such written notice to the Architect and the Owner's Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.6.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Architect and the Owner's Representative within twenty-four (24) hours. During the progress of the Work, the Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. The Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with the Owner's Representative and the Architect. The Contractor shall be responsible for the proper fitting of the Work in place.

3.6.3 The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractor's own expense, but only as directed by the Architect, through the Owner's Representative.

3.6.4 Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and the Owner's Representative what is to be used and to supply it at the Contractor's expense, or else thereafter replace it to the Owner's Representative's satisfaction. At a minimum, the

Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

3.7 Cleaning and Removal

3.7.1 The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than six (6) inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards and code at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the Work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner's Representative. If the Contractor fails to comply with the provisions of this Paragraph, the Owner may do so, and the cost thereof shall be charged to the Contractor.

3.8 Cutting and Patching

3.8.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

3.8.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.8.3 If the Work involves renovation and/or alteration of existing improvements, the Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. The Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, the Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the

Work to the reasonable satisfaction of both the Owner's Representative and the Architect.

3.9 Indemnification

3.9.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, the Architect's consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the "Indemnitees") from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor's obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this Paragraph or other provisions of the Contract Documents and if the Contractor refuses to assume or perform, or delays in assuming or performing the Contractor's obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys' fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon the Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which the Contractor is obligated to indemnify the Indemnitees from under this Paragraph, the Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of the Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner's interests. The Owner shall in its sole discretion determine if such assurances are reasonable. The Owner reserves the right to control the defense and settlement of any claim, action or proceeding which the Contractor has an obligation to indemnify the Indemnitees against.

3.9.3 In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9

shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, the Architect's agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

3.10 Patents

3.10.1 The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

3.10.2 If the Contractor uses any design, device, or material covered by letters patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum include, and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material or any trademark or copyright in connection with Work agreed to be performed under this Contract and shall indemnify the Owner for any cost, expense, or damage it may be obligated to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

3.11 Delegated Design

3.11.1 If the Contract Documents specify the Contractor is responsible for the design of any Work as part of the project, then the Contractor shall procure all design services and certifications necessary to complete the Work as specified, from a design professional licensed in the State of Missouri. The signature and seal of that design professional shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals related to the Work. The design professional shall maintain insurance as required per Article 11.

3.12 Materials, Labor, and Workmanship

3.12.1 Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor and shall be of the most suitable grade of their respective kinds for their respective uses and shall be fit

and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

3.12.2 Materials and fixtures shall be new and of latest design unless otherwise specified and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

3.12.3 The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

3.12.4 The Contractor shall base its bid only on the Contract Documents.

3.12.5 Materials and workmanship shall be subject to inspection, examination, and testing by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

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

3.12.7 Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.12.8 Substitutions

3.12.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of what has been specified or shown in the Contract Documents, which is not an "or equal" as set forth in Section 3.13.

3.12.8.2 The Contractor may make a proposal to the Architect and the Owner's Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner's Representative's decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

- .1** Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution.
- .2** Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

- .3 The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.
- .4 The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.
- .5 An affidavit stating that (a) the proposed substitution conforms to and meets all of the Contract Document requirements and is code compliant, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and the Owner's Representative in sufficient time to allow the Architect and the Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

3.12.8.3 Substitutions may be rejected without explanation at the Owner's sole discretion and will be considered only under one or more of the following conditions:

- .1 Required for compliance with interpretation of code requirements or insurance regulations then existing;
- .2 Unavailability of specified products, through no fault of the Contractor;
- .3 Material delivered fails to comply with the Contract Documents;
- .4 Subsequent information discloses inability of specified products to perform properly or to fit in designated space;
- .5 Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or
- .6 When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

3.12.8.4 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitution.

3.13 Approved Equal

3.13.1 Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner's Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved manufacturers

in any Contract Document shall be for informational purposes only and it shall be the Contractor's sole responsibility to ensure that any proposed "or equal" complies with the requirements of the Contract Documents and is code compliant.

3.13.2 The Contractor shall submit to the Architect and the Owner's Representative a written and full description of the proposed "or equal" including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed "or equal" strictly complies with the Contract Documents. The Architect or the Owner's Representative shall take appropriate action with respect to the submission of a proposed "or equal" item. If Contractor fails to submit proposed "or equals" as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed "or equals" as provided for herein. All documents submitted in connection with preparing an "or equal" shall be clearly and obviously marked as a proposed "or equal" submission.

3.13.3 No approvals or action taken by the Architect or Owner's Representative shall relieve the Contractor from its obligation to ensure that an "or equal" article, appliance, device, or material strictly complies with the requirements of the Contract Documents. The Contractor shall not propose "or equal" items in connection with Shop Drawings or other Submittals, and the Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner's Representative with respect to Shop Drawings or other Submittals shall constitute approval of any "or equal" item or relieve the Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any "or equal" item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No "or equal" items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed "or equal" items prior to receipt of bids, unless otherwise noted in the Special Conditions.

3.14 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models

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

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

3.14.3 Samples are physical samples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.14.4 Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on Shop Drawings or product data. Coordination Drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the Contractor and are submitted for informational purposes. The Special Conditions will state whether Coordination Drawings are required. BIM models may be used for coordination in lieu of Coordination Drawings at the Contractor's discretion, unless required in the Special Conditions. The final Coordination Drawings/BIM Model will not change the Contract Documents, unless approved by a fully executed Change Order describing the specific modifications that are being made to the Contract Documents.

3.14.5 Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples, and similar submittals (collectively referred to as "Submittals") are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.14.6 The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this Contract, unless noted otherwise in the Special Conditions or Technical Specifications, all Submittals, Shop Drawings and Samples must be submitted as required to maintain the Contractor's plan for proceeding but must be submitted within ninety (90) days of the Notice to Proceed. If the Contractor believes that this milestone is unreasonable for any submittal, the Contractor shall request an extension of this milestone, within sixty (60) days of Notice to Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the ninety (90)-day milestone is unrealistic and shall specify a date on which the submittal will be provided, for approval by the Owner's Representative. Failure of the Contractor to comply with this Section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

3.14.7 The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of separate contractors and no later than twenty

(20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of the Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that the Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by the Architect and in such event, the Contractor shall immediately remove all such materials from the Work site. When requested by the Architect or the Owner's Representative, Samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

3.14.8 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved Submittals.

3.14.9 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. The Contractor shall also coordinate each Submittal with other Submittals.

3.14.10 The Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

3.14.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and the Contractor has satisfied its obligations under the Contract Documents with respect to the Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of the Contractor who approved the Submittal, together with the Contractor's name, Owner's name, number of the Project, and the item name and specification section number.

3.14.12 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, the Contractor acknowledges that the Architect's approval of Shop Drawings shall not relieve the Contractor for responsibility for errors and omissions in the Shop Drawings since the Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

3.14.13 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous Submittals.

3.14.14 The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable laws, by a licensed engineer or other design professional.

3.15 Record Drawings

3.15.1 The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed Change Orders, (3) deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control valves, drains, openings, and stub-outs; and (7) such other information as either the Owner or the Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by the Architect to the Contractor at the start of construction. Upon Substantial Completion of the Work, the Contractor shall deliver all Record Drawings to the Owner and the Architect for approval. If not approved, the Contractor shall make the revisions requested by the Architect or the Owner's Representative. Final payment and any retainage shall not be due and owing to the Contractor until the final Record Drawings marked by the Contractor as required above are delivered to the Owner.

3.16.1 Operating Instructions and Service Manuals

3.16.1 The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

- .1** Start-up and Shutdown Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available, they may be incorporated into the operating manual for reference.
- .2** Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
- .3** Equipment List: List of all major equipment as installed shall include model number, capacities, flow rate, and name-plate data.
- .4** Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

.4.1 Recommended spare parts including catalog number and name of local suppliers or factory representative.

.4.2 Belt sizes, types, and lengths.

.4.3 Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

3.16.2 Submission

.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner's project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

3.17 Taxes

3.17.1 The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to Section 144.062, RSMo. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of Section 144.062, RSMo.

3.17.2 The Contractor shall furnish this certificate to all Subcontractors, and any person or entity purchasing materials for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this Section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

3.17.3 Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or

use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party's Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

3.17.4 If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, the Owner shall be liable for the tax owed.

3.17.5 The Owner shall not be responsible for any tax liability due to the Contractor's neglect to make timely orders, payments, etc. or the Contractor's misuse of the Project Tax Exemption Certificate. The Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with Section 144.062, RSMo and the terms of the Project Tax Exemption Certificate. The Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys' fees, arising out of the Contractor's use of the Project Tax Exemption Certificate.

3.18 Contractor's Construction Schedules

3.18.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and the Architect's information the Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner's Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

3.18.2 The construction schedule shall be in a detailed format satisfactory to the Owner's Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner's Representative or the Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

3.18.3 As time is of the essence to this Contract, the University expects that the Contractor will take all necessary steps to ensure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this Contract. At a minimum, the Contractor shall comply with the following:

.1 The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner's Representative.

- .2** The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).
- .3** Prior to submittal to the Owner's Representative for review, the Contractor shall obtain full buy-in to the schedule from all major Subcontractors, in writing if so, requested by Owner's Representative.
- .4** Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner's Representative.
- .5** Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.
- .6** The submission of the updated schedule certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this Contract. See Special Conditions for detailed scheduling requirements.

3.18.4 In the event the Owner's Representative or the Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

ARTICLE 4

ADMINISTRATION OF THE CONTRACT

4.1 Rights of the Owner

4.1.1 The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's

Representative with the administration of the Contract as indicated in these Contract Documents.

4.1.2 If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the Work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the Work as may be required to enable others to hasten and properly engage and carry out the Work, all as directed by the Owner's Representative. The additional cost of accelerating the Work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

4.1.3 If the Contractor refuses, for any reason, to proceed with what the Owner believes to be Contract Work, the Owner may issue a Construction Directive, directing the Contractor to proceed. The Contractor shall be obligated to promptly proceed with such work. If the Contractor feels that it is entitled to additional compensation as a result of a Construction Directive, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this Contract.

4.1.4 The Owner's Representative may, by written notice, require the Contractor to remove from involvement with the Work, any of the Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

4.1.5 The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

4.1.6 The Owner does not allow smoking on University property.

4.2 Rights of the Architect

4.2.1 The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity, and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. The Contractor shall provide Owner's Representative a copy of such written request.

4.3 Review of the Work

4.3.1 The Architect, the Owner's Representative, and the Owner's Authorized Agent shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

4.3.2 The Owner's Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner's Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner's Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed, or completed.

4.3.3 The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

4.4 Claims

4.4.1 A Claim is a demand or assertion by the Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of the Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or rescission. Claims must be made by written notice. The Contractor shall have the responsibility to substantiate Claims.

4.4.2 Claims by the Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. The Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. The Contractor shall furnish the Owner and the Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and the Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

4.4.3 Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

4.5 Claims for Concealed or Unknown Conditions

4.5.1 If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to

exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor's cost, or time, required for performance of the Work, an equitable adjustment in the Contract Sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will so notify the Contractor in writing. If the Contractor disputes the finding of the Owner's Representative that no change in the terms of the Contract terms is justified, the Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

4.5.2 It is expressly agreed that no adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition which does not differ materially from those conditions disclosed or which reasonably should have been disclosed by the Contractor's (1) prior inspections, tests, reviews and preconstruction investigations for the Project, or (2) inspections, tests, reviews and preconstruction inspections which the Contractor had the opportunity to make or should have performed in connection with the Project.

4.6 Claim for Additional Cost

4.6.1 If the Contractor makes a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. In addition to all other requirements for notice of a Claim, said notice shall detail and itemize the amount of all Claims and shall contain sufficient data to permit evaluation of same by the Owner.

4.7 Claims for Additional Time

4.7.1 If the Contractor makes a Claim for an increase in the Contract Time, written notice as provided herein shall be given. In addition to other requirements for notice of a Claim, the Contractor shall include an estimate of the probable effect of delay upon the progress of the Work, utilizing a CPM Time Impact Schedule Analysis, (TIA) as defined in the AGC Scheduling Manual. In the case of a continuing delay, only one Claim is necessary.

.1 Time extensions will be considered for excusable delays only. That is, delays that are beyond the control and/or contractual responsibility of the Contractor.

4.7.2 If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the anticipated weather day schedule in the Special Conditions. To be considered a weather day, at least four (4) working hours must be lost due to the weather conditions on a critical path scope item for that day. Weather days and anticipated weather days listed in the Special Conditions shall only apply to Monday through Friday. A weather day claim cannot be made for Saturdays, Sundays, New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving Day and Christmas Day, unless that specific day was approved in writing for work by the Owner's Representative.

.1 The Contractor must have fulfilled its contractual obligations with respect to temporary facilities and protection of its work, and worker protection for hot and cold weather per OSHA guidelines.

.2 If the contractual obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

.2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner's Representative. Each week, the Contractor will notify the Owner's Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the Contract, until such time as the weather days acknowledged by the Owner's Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the Contract Time will be considered.

.2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the Contract requirements. The Owner will provide a Change Order extending the time for contract completion or direct an acceleration of the Work in accordance with the Contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

4.7.3 A Force Majeure event or circumstance shall not be the basis of a claim by the Contractor seeking an adjustment in the Contract amount for costs or expenses of any type. With the exception of weather delays, which are administered under Article 4, and notwithstanding other requirements of the Contract, all Force Majeure events resulting in a delay to the critical path of the project shall be administered as provided in Article 8.

4.7.4 The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment.

4.8 Resolution of Claims and Disputes

4.8.1 The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

4.8.2 If a Claim has not been resolved, the Contractor shall, within ten (10) days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

4.8.3 If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner's Representative's decisions on matters relating to aesthetics will be final.

4.9 Administrative Review

4.9.1 Claims not resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner's Representative's decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this Section. All requests for administrative review shall be made in writing.

4.9.2 Upon written request from the Contractor, the Owner's Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner's Representative within fifteen (15) days of receipt of such written request. The Contractor and Owner's Representative will be allowed to present written documentation with respect to the Claim(s) before or during the meeting. The Contractor and Owner's Representative will be allowed to present the testimony of any knowledgeable person regarding the Claim at the review meeting. The Owner's Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner's Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

4.9.3 If the Contractor is not in agreement with the proposal of the Owner's Review Administrator as to the

resolution of the Claim, the Contractor may file a written appeal with the UM System Contracting Officer, [in care of the Executive Director of Facilities Planning and Development, University of Missouri, 130 General Services Building, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner's Review Administrator's proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner's Representative, and the Owner's Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner's Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections, or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner's Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the Claim at the meeting called by the UM System Contracting Officer.

4.9.4 The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this Section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or Law. The Contractor and the Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. The Contractor agrees not to file any complaint, petition, lawsuit or legal proceeding against the Owner except with such Missouri Circuit Court.

ARTICLE 5 SUBCONTRACTORS

5.1 Award of Subcontracts

5.1.1 Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The Owner's Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

5.1.2 The Contractor may request to change a Subcontractor. Any such request shall be made in writing to the Owner's Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

5.1.3 The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

5.2 Subcontractual Relations

5.2.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound. Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

5.2.2 All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby Subcontractor or supplier waives all rights against the Owner, Contractor, Owner's Representative, the Architect and all other Additional Insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

5.3 Contingent Assignment of Subcontract

5.3.1 No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has

had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. In addition to the usual recitals in assignment Contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the Contract and to claims and to liens for services rendered or materials supplied for the performance of the Work called for in said Contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

ARTICLE 6 SEPARATE CONTRACTS AND COOPERATION

6.1 The Owner reserves the right to let other contracts in connection with the Work.

6.2 It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

6.3 No Contractor shall delay another Contractor by neglecting to perform the Contractor's work at the proper time. Each Contractor shall be required to coordinate the Contractor's work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, non-compliant, or ill-timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

6.4 Each Contractor shall be responsible for damage to the Owner's or another Contractor's property done by the Contractor or the Contractor's employees, through his or their fault or negligence. If any Contractor shall cause damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

6.5 The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete the Contractor's performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

6.6 Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

6.7 If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the

Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

ARTICLE 7 CHANGES IN THE WORK

7.1 CHANGE ORDERS

7.1.1 A Change Order is a written instrument prepared by the Owner and signed by the Owner and the Contractor formalizing their agreement on the following:

- .1** a change in the Work
- .2** the amount of an adjustment, if any, in the Contract amount
- .3** an adjustment, if any, in the Contract Time

7.1.2 The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner's Representative directing the Contractor to proceed pending receipt of the document, the Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

7.1.3 Until such time as the Change Order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

7.1.4 The amount of adjustment in the Contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

- .1** By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.
- .2** By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner's Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the Contractor may be required to submit weekly reports summarizing costs to date on time and material Change Order Requests not yet finalized.
- .3** By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the

Contractor, the applicable unit prices shall be equitably adjusted.

7.1.5 The Contractor shall submit all fully documented Change Order Requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

7.1.6 The Contractor shall submit Change Order Requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

- .1** Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of the Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.
- .2** Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars (\$1,000) in cost shall be supported with supplier invoices at the request of the Owner's Representative. Normal hand tools are not compensable.
- .3** Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

7.2 Construction Change Directive

7.2.1 A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract Time, or both. A Construction

Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a Change Order. If the Construction Change Directive allows an adjustment of the Contract amount or time, such adjustment amount shall be based on one of the following methods:

- .1 A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.
- .2 By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.
- .3 A method agreed to by both the Owner and the Contractor with a mutually agreeable fee for overhead and profit.
- .4 In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the Contract amount, the Owner, with the assistance of the Architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment, and other costs consistent with other provisions of the Contract. The Contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

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

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

7.3 Overhead and Profit

7.3.1 Overhead and Profit on Change Orders shall be applied as follows:

- .1 The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.
- .2 The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the

Work involved but in no case shall exceed the following:

- | | |
|-----|---|
| 15% | To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased |
| 5% | To the Contractor on Work performed by other than the Contractor's forces |
| 5% | To first tier Subcontractor on Work performed by his Subcontractor |

- .3 , extent, and complexity of The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.
- .4 Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier Subcontractors. Overhead and profit shall be shown separately for each Subcontractor of any tier and the Contractor.
- .5 On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.
- .6 The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature the Work involved, but shall not be less than the following:

Overhead and Profit

- | | |
|------|---|
| 7.5% | Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased |
| 2.5% | Credit to the Owner from the Contractor on Work performed by other than his forces |
| 2.5% | Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier |

7.4 Extended General Conditions

7.4.1 The Contractor acknowledges that the percentage mark-up allowed on Change Orders for overhead and profit cover the Contractor's cost of administering and executing the Work, inclusive of Change Orders that increase the Contract Time. The Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

7.4.2 The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist, the Contractor may be reimbursed by unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

7.4.3 If unit prices are subsequently agreed upon, the Contractor's compensation shall be limited as follows:

- .1** For the portion of the direct payroll cost of the Contractor's project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor;
- .2** Cost of the Contractor's temporary office, including temporary office utilities expense;
- .3** Cost of temporary utilities required in the performance of the Work;
- .4** Profit not to exceed 5% of the total extended overhead direct costs;

7.4.4 All costs not falling into one of these categories and costs of the Contractor's staff not employed onsite are not allowed.

7.5 Emergency Work

7.5.1 If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately proceed with the emergency work as directed by the Owner under the applicable provisions of the Contract. In so doing, the Contractor agrees that all provisions of the Contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

ARTICLE 8 TIME

8.1 Progress and Completion

8.1.1 The Contractor acknowledges and agrees that time is of the essence of this Contract.

8.1.2 The Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

8.1.3 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

8.1.4 The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

8.2 Delay in Completion

8.2.1 The Contractor shall be liable for all of the Owner's damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, the Contractor shall be liable for such liquidated damages as set forth in Section 8.3

8.2.2 All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, Force Majeure including but not limited to war, armed conflict, riot, civil commotion or disorder, act of terrorism or sabotage; epidemic, pandemic, outbreaks of infectious disease or any other public health crisis, including quarantine or other employee restrictions, compliance with any law or governmental order, rule, regulation or direction, curfew restriction, act of God or natural disaster such as earthquake, volcanic activity, landslide, tidal wave, tsunami, flood, damage or destruction by lightning, drought; explosion, fire, destruction of machines, equipment, prolonged break-down of transport, telecommunication or electric current; general labor disturbance such as but not limited to boycott, strike and lock-out, occupation of factories and premises, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify delay then, upon submission of the Time Impact Schedule Analysis (TIA) justifying the delay called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent the Contractor from achieving Substantial Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that the Contractor provides the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. If a Force Majeure is approved by the Owner as the basis for a delay claim, an adjustment in the Contract Time to the extent the Force Majeure impacts the schedule is the only remedy. No increase in the Contract Sum for any reason shall be allowed due to a Force Majeure.

8.2.3 The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or

avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents the Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

8.2.4 Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other claims due to or caused by any events beyond the control of both the Owner and the Contractor defined herein as Force Majeure. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of the Contractor or by acts or omissions of the Contractor or its Subcontractors of any tier or delays beyond the control of both the Owner and the Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. The Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions, but in no case shall Force Majeure be the basis of an increase in the Contract Sum. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall only be entitled to its actual direct costs caused thereby and the Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

8.2.5 If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if the Contractor intends or is able to complete the Work prior to

the Contract Time, it shall assert no Claim and the Owner shall not be liable to the Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

8.3 Liquidated Damages

8.3.1 If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

8.3.2 The Owner's Representative shall establish the date of Substantial Completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and the Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

8.3.3 Liquidated Damages or any matter related thereto shall not relieve the Contractor or the Contractor's surety of any responsibility or obligation under this Contract.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 Commencement, Prosecution, and Completion

9.1.1 The Contractor shall commence Work within five (5) days upon the date of a "Notice to Proceed" from the Owner or the date fixed in the Notice to Proceed. The Contractor shall prosecute the Work with faithfulness and diligence, and the Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

9.1.2 The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the Contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

9.1.3 The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

- .1** Contract
- .2** Bond (See Article 11)
- .3** Insurance (See Article 11)
- .4** List of Subcontractors of any tier

9.1.4 In the event the Contractor fails to provide the Owner such documents, the Contractor may not enter upon the site of the Work until such documents are provided. The date the

Contractor is required to commence and complete the Work shall not be affected by the Owner denying the Contractor access to the site as a result of the Contractor's failure to provide such documents and the Contractor shall not be entitled to an adjustment of the Contract Time or Contract Sum as a result of its failure to provide the Owner the required documents

9.1.5 Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the word "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of the Contractor represent and warrant that the person signing the Contract has the legal authority to bind the Contractor to the Contract.

9.1.6 Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

9.1.7 Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner's Representative.

- .1 Reproducible progress and payment schedule
- .2 Contractor's Schedule of Values
- .3 List of material suppliers
- .4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by the Owner.
- .5 Itemized breakdown of anticipated equipment rates (breakout operator rate). Overhead and profit shall

not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/ pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. The Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

9.1.8 The Contractor shall be paid electronically using the Owner's web-based payment program with a direct electronic transfer from the Owner's account into the Contractor's account. The Contractor must submit the following information to the Owner's Representative:

- .1 Bank Transit Number for the Contractor's bank into which the electronic deposit will be made.
- .2 Bank Account Number for the Contractor's account into which the electronic deposit will be made.
- .3 Contractor's E-Mail address so that formal notification of the deposit by the Owner can be provided.

9.2 Contract Sum

9.2.1 The Owner shall compensate the Contractor for all Work described herein, and in the Contract Documents the Contract Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

9.3 Schedule of Values

9.3.1 Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner's Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner's Representative may require. This schedule, unless objected to by the Owner's Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner's option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

9.3.2 The progress and payment schedule of values shall show the following:

- .1 Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner's Representative.
- .2 Line items, when being performed by a Subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner's Representative.

9.4 Applications for Payment

9.4.1 The Contractor shall submit monthly to the Owner's Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner's Representative or the Architect may require, such as

copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

9.4.2 Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier

9.4.3 Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

9.4.4 If approved in writing and in advance by the Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. The Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by the Owner for payment for materials and equipment delivered and suitably stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor's demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor's inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the Work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the Work and incorporated into the Work, except as noted below. For the purposes of this Contract, offsite is defined as any location not owned or leased by the Owner. The Contractor shall submit a list of materials that they are requesting payment for offsite storage within sixty (60) days of Notice to Proceed.

- .1** Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices
- .2** Determination of acceptable "major items of considerable magnitude" and "suitably stored" shall be made by the Owner's Representative.
- .3** Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.
- .4** The Contractor shall submit to the Owner's Representative a list of the material for which

application for payment for offsite storage is anticipated no less than forty-five days (45) prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity, and discounts offered to the Owner for early payment. The Contractor shall also submit the location the material will be stored and the method of protection

- .5** The storage facility shall be subject to approval by the Owner's representative, shall be located within an acceptable distance of the project sites as established by the Owner's Representative and all materials for the Owner's project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of "The Curators of the University of Missouri."
- .6** The Owner's Representative shall be provided a minimum of two weeks' notice to visit the storage facility and inspect the stored material prior to submission of the pay request.
- .7** Upon favorable inspection by the Owner's Representative, the Contractor shall, at the Owner's option, submit a Bill of Sale on forms provided by the Owner's Representative, transferring title of the material or equipment to "The Curators of the University of Missouri."
- .8** An invoice provided by the supplier shall be included with the applicable pay request.
- .9** The Contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.
- .10** The Contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.
- .11** The Contractor shall furnish and maintain insurance covering the replacement cost of the material stored offsite against all losses and shall furnish proof of coverage with the application for payment for material stored offsite.
- .12** The Contractor is responsible for all costs related to storage and handling of material stored offsite unless otherwise directed by the Owner's Representative.

9.4.5 The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

9.4.6 The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the Contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. The Owner shall hold the remaining five (5) or ten (10) percent, as applicable, as retainage until Substantial Completion of the work as set forth in 9.9.3 below.

9.5 Approval for Payment

9.5.1 The Owner's Representative will, within fifteen (15) days after receipt of the Contractor's Application for Payment, either approve Contractor's Application for Payment for such amount as the Owner's Representative determines is properly due or notify the Contractor of the Owner's Representative's reasons for withholding certification in whole or in part as provided in Section 9.6.

9.6 Decisions to Withhold Approval

9.6.1 The Owner's Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner's Representative is unable to approve payment in the amount of the Application, the Owner's Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner's Representative cannot agree on a revised amount, the Owner's Representative will promptly issue approval for payment for the amount for which the Owner's Representative is able to determine is due to the Contractor. The Owner's Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may be necessary in the Owner's Representative opinion to protect the Owner from loss because of:

- .1** defective or non-compliant Work not remedied, or damage to completed Work;
- .2** failure to supply sufficient skilled workers or suitable materials;
- .3** third party claims filed or reasonable evidence indicating probable filing of such claims;
- .4** failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, the Owner may, at its sole option issue joint checks to Subcontractors who have presented evidence that it has not been paid in accordance with the Contract;
- .5** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .6** damage to the Owner or another contractor;
- .7** reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by the Contractor;
- .8** The Contractor's failure to comply with applicable laws;
- .9** The Contractor's or Subcontractor's failure to comply with applicable wage requirements; or
- .10** The Contractor's failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

9.7 Progress Payments

9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner's Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor

as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to the Contractor for amounts due and approved by the Owner's Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by the Contractor, Applications for Payment submitted by the Contractor shall indicate the actual percentage of completion of each portion of the Contractor's Work as of the end of the period covered by the Application for Payment.

9.7.5 Within fifteen (15) days following receipt payment from the Owner, the Contractor shall pay each Subcontractor and supplier out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner. If the Owner, the architect or engineer of record, and the Contractor all determine that a particular Subcontractor's portion of the Work has been satisfactorily completed, including corrective work and closeout requirements, payment equal to one hundred percent (100%) of the subcontract amount for that Subcontractor can be made to the Contractor prior to Substantial Completion. The Contractor shall request such adjustment as necessary to enable the Contractor to pay the Subcontractor in full. This does not relieve the Contractor of any responsibilities under the terms of the Contract and any deficiencies subsequently discovered shall be corrected at no cost to the Owner.

9.7.6 Neither the Owner nor the Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of the Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained and held for the sole protection of the Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by the Owner's Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.8 Failure of Payment

9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by the Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

9.9 Substantial Completion

9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.14 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner's Representative will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Owner's Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner's Representative. If the Owner's Representative determines the work is not substantially completed and accepted, then the Owner or the Owner's Representative shall provide a written explanation of why the work is not considered substantially completed and accepted within fourteen calendar days to the Contractor, who shall then provide such notice to the subcontractor or suppliers responsible for such work. The Contractor shall then submit a request for another inspection by the Owner's Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall the Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.9.3 At the date of Substantial Completion, the Contractor may apply for, and if approved by Owner's Representative, the Owner, subject to the provisions herein, shall release the retainage, increasing the total payments to one hundred percent (100%) of the Contract Sum less one hundred fifty percent (150%) of the value of any incomplete

Work and unsettled claims, as determined by the Owner's Representative.

9.10 Partial Occupancy or Use

9.10.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and the Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, security, maintenance, heat, utilities, damage to the Work and insurance. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by the Owner's Representative.

9.10.2 Immediately before such partial occupancy or use, the Owner, and the Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.11 Final Completion and Final Payment

9.11.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner's Representative and the Architect will promptly make such inspection and, when the Owner's Representative and the Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner's Representative will promptly issue a final approval for payment; otherwise, the Owner's Representative will return the Contractor's Final Application for Payment to the Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner's Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner's Representative until all warranties and guarantees have been received and accepted by the Owner.

9.11.2 The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:

- .1** Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.
- .2** Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.
- .3** The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.
- .4** The acceptance by the Contractor of its final payment, by check or electronic transfer, shall be and operate as a

release of all claims of the Contractor against the Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of the Owner arising out of the Work.

9.11.3 Final payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after the Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and the Owner's receipt of all information and documents set forth in Section 9.11.

9.11.4 No payment under this Contract, including but not limited to final payment, shall constitute acceptance by the Owner of any Work or act not in accordance with the requirements of the Contract Documents.

9.11.5 No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

10.1 Safety Precautions and Programs

10.1.1 The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules, regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.

10.1.2 The Contractor and all Subcontractors to the Contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675, RSMo, unless they have previously completed the program and have documentation of having done so. The Contractor will forfeit a penalty to the Owner of \$2,500 plus an additional \$100 for each employee employed by the Contractor or Subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training." (Section 292.675, RSMo).

10.1.3 In the event the Contractor encounters on the site, material reasonably believed to be asbestos,

polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner's Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner's Representative and the Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner's Representative and the Contractor. "Rendered Harmless" shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

10.2 Safety Of Persons and Property

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

- .1** students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;
- .2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and
- .3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

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

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of the Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either

of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.

10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner's Representative and the Architect. The Contractor shall hold regularly scheduled safety meetings to instruct the Contractor's personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment and enforce the use of such equipment by its employees and its Subcontractors of any tier.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

10.2.8 The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately.

10.2.9 The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the Work, either by or against the Contractor.

ARTICLE 11 INSURANCE AND BONDS

11.1 Insurance

11.1.1 The Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect the Contractor, the Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by the Owner, but, regardless of such approval, it shall be the responsibility of the Contractor to maintain the insurance coverages set forth herein.

11.1.2 The Contractor shall not be allowed on the Owner's property without proof of the insurance coverages set forth herein

11.2 Commercial General Liability

11.2.1 The Contractor shall secure and maintain from the date of the Contract, and for a period of at least ten (10)

years from the date of Final Completion of the entire Work, Commercial General Liability insurance ("CGL") with a combined single limit of not less than \$2,000,000 per occurrence, \$5,000,000 general aggregate, \$5,000,000 products and completed operations aggregate, and \$1,000,000 personal injury and advertising injury. General Aggregate must apply per project. An umbrella policy may be used to satisfy these limits.

11.2.2 CGL insurance shall be written on a Commercial form CG 00 01 or an equivalent form providing the same coverages and shall cover claims and liability in connection with or resulting from the Contractor's operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

11.2.3 CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL insurance shall cover the Contractor's indemnity obligations contained in the Contract Documents.

11.2.4 There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

11.2.5 The Contractor waives all rights against the Owner and its agents, officers, representatives, and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

11.3 Licensed for Use Vehicle Liability

11.3.1 The Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect the Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than \$2,000,000 combined single limit for bodily injury and property damage per accident.

11.3.2 The Contractor waives all rights against the Owner and its agents, officers, directors, and employees for recovery

of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

11.4 Workers' Compensation Insurance

11.4.1 The Contractor shall purchase and maintain workers' compensation insurance and employers' liability insurance which shall protect the Contractor from claims for injury, sickness, disease or death of the Contractor's employees or statutory employees. The insurance policies required hereunder shall include an "all states" or "other states" endorsement. In case any Work is subcontracted, the Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Paragraph.

11.4.2 The Contractor's workers' compensation insurance coverage shall be in compliance with all applicable laws, including the statutes of the State of Missouri. The Contractor's employers' liability coverage limits shall not be less than \$1,000,000 each accident for bodily injury by accident or \$1,000,000 each employee for bodily injury by disease.

11.5 General Insurance Requirements and Professional Liability

11.5.1 Any Consultant/Contractor providing professional design services as part of the Contract shall be required to provide and maintain, from the date of this Contract and for a period of ten (10) years after the date of Final Completion, Professional Liability insurance, in a claims made form, to cover any claims, including but not limited to errors, omissions, and negligence, which may arise from the design and related services performed by the Consultant. The minimum limits for such policy shall be \$1,000,000.00 per claim/\$1,000,000.00 aggregate.

11.5.2 "The officers, employees, and agents of The Curators of the University of Missouri" shall be added as Additional Insured with respect to the CGL, umbrella/excess and Automobile Liability policies required herein. A certificate of insurance evidencing all coverage required is to be provided at least ten (10) days prior to the inception date of the Contract between the Contractor and the University. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The University reserves the right to require higher limits on any contract provided notice of such requirement is stated in the request for proposals for such contract. The Contractor shall request that its insurer(s) include the following disclaimer in any insurance policy, rider or endorsement issued pursuant to this Additional Insured requirement: "Neither the requirement for Additional Insured status nor any of the Contractor's action in compliance with such requirement, either direct or indirect, is intended to be and neither shall be construed as a waiver of any sovereign immunity, governmental immunity or any other type of immunity enjoyed by The Curators of the University of Missouri, the Board of

Curators of the University of Missouri, or any of its officers, employees or agents."

The Additional Insured status must be conveyed by using the ISO CG 20 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors' insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.5.3 All insurance coverages procured by the Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. All insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier, except that the Professional Liability insurance required herein may be provided by any insurance company legally authorized to do business in the State of Missouri. The form and content of all insurance coverage provided by the Contractor are subject to the approval of the Owner. All required insurance coverages shall be obtained and paid for by the Contractor. Any approval of the form, content or insurance company by the Owner shall not relieve the Contractor from the obligation to provide the coverages required herein. All insurance coverage procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than "A-" and financial ratings not lower than "XI" in the Best's Insurance Guide, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than \$10,000.00 and shall not be subject to a per-occurrence deductible of more than \$25,000.00. Insurance procured by the Contractor covering the Additional Insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.4 All insurance required hereunder shall provide that the insurer's cost of providing the insureds a defense and appeal, including attorneys' fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer's separate responsibility. The Contractor shall cause its insurance carriers for all required coverages, except for workers' compensation, to waive all rights of subrogation against the Owner and its officers, employees and agents.

11.5.5 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the Work. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The Contractor fails to provide, procure, and deliver acceptable policies of insurance or satisfactory

certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.6 With respect to all insurance coverages required to remain in force and affect after final payment, The Contractor shall provide the Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with the Contractor's application for final payment and shall provide certificates, policies and binders thereafter as requested by the Owner.

11.5.7 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to the Contractor's exercise or enforcement of any rights under the Contract Documents.

11.5.8 Failure of the Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by the Owner of such certificates, policies and binders or failure of the Owner to identify a deficiency from evidence that is provided by the Contractor shall not be construed as a waiver of the Contractor's obligations to maintain the insurance required by the Contract Documents.

11.5.9 The Owner shall have the right to terminate the Contract if the Contractor fails to maintain the insurance required by the Contract Documents.

11.5.10 If the Contractor fails to maintain the insurance required by the Contract Document, the Owner shall have the right, but not the obligation, to purchase said insurance at Contractor's expense. If the Owner is damaged by the Contractor's failure to maintain the insurance required by the Contract Documents, the Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.11 By requiring the insurance set forth herein and in the Contract Documents, the Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect the Contractor, and such coverages and limits shall not be deemed as a limitation on the Contractor's liability under the indemnities granted to the Owner in the Contract Documents. For those policies requiring the Owner to be added as an Additional Insured, as set forth herein, the Owner and all other indemnified parties shall be an Additional Insured for the full limits carried by the Contractor, not just the limits required herein.

11.5.12 If Contractor's liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.13 If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or

risks of loss designated in accordance with Article 11; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

11.5.14 It is understood and agreed that the insurance coverages required by the provisions of this Contract are required in the public interest and that the Owner does not assume any liability for acts of the Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

11.6 Builder's Risk Insurance

11.6.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder's risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

11.6.2 The insurance as required herein shall name as insureds the Owner, the Contractor, and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to the Owner.

11.6.3 The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect's services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site and shall also cover portions of the Work in transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance, or regulation.

11.6.4 The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism, malicious mischief, collapse, lightning, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, the Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

11.6.6 The insurance as required herein shall be maintained in effect until the earliest of the following dates:

- .1** the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;

- .2 the date on which final payment of this Contract has been made by the Owner to the Contractor; or
- .3 the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

11.6.7 The Owner and the Contractor waive all rights against (1) each other and any of their Subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect's consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or the Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the Subcontractors of any tier, suppliers, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

11.6.8 A loss insured under the Contractor's property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Sub-subcontractors in similar manner. The Contractor shall waive its rights to subrogation for any loss or damage to the Contractor's property or equipment coverage in favor of the Owner and other indemnified parties.

11.7 Bonds

11.7.1 When the Contract Sum exceeds Fifty Thousand Dollars (\$50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of this Contract, including but not limited to the Contractor's obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through

the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.7.2 The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best's rating of no less than A-/XI. The Contractor 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 this power of attorney indicating the monetary limit of such power.

11.7.3 If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Section, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of the Contractor at the Contractor's expense.

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

11.7.5 The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety's consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of the Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

11.7.6 The Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any claims, expenses, losses, costs, including reasonable attorneys' fees, as a result of any failure of the Contractor to procure the bonds required herein.

ARTICLE 12

UNCOVERING AND CORRECTION OF THE WORK

12.1 Uncovering of the Work

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

12.1.2 If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

12.2 Correction of the Work

12.2.1 The Architect or the Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by the Architect or the Owner's Representative, the Architect or the Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless, if such removal and replacement results in "economic waste." The Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, or non-compliant Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor, or anyone for whom either is responsible uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

12.2.2 If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner's discretion. Such twelve (12) month period is referred to as the "Guarantee Period." The obligations under this Paragraph shall cover any repairs, removal, and replacement to any part of the Work or other property caused by the defective Work.

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

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the Contractor's expense.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

12.3 Acceptance of Nonconforming Work

12.3.1 The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In such case, the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

ARTICLE 13 MISCELLANEOUS PROVISIONS

13.1 Written Notice

13.1.1 All notices required to be given by the Contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

13.2 Rights and Remedies

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

13.2.2 No action or failure to act by the Owner, the Architect, or the Owner's Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.2.3 The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

13.2.4 The Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and the Contractor may otherwise agree to in writing.

13.3 Tests and Inspections

13.3.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, codes, or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory, the Owner's Authorized Agent, or entity acceptable to the Owner, and the Contractor shall bear related costs of tests, inspections, and approvals as required in the Contract Documents. The Contractor shall give the Architect, the Owner's Representative, and the Owner's Authorized Agent timely notice of when and where tests and inspections are to be made so the Architect, the Owner's Representative and/or the Owner's Authorized Agent may observe procedures or perform the necessary tests or inspections.

13.3.2 If the Architect, the Owner's Representative, or the Owner's Authorized Agent determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, the Owner's Representative or the Owner's Authorized Agent, of when and where tests and inspections are to be made so

the Architect, the Owner's Representative and/or the Owner's Authorized Agent, may choose that the tests or inspections can be performed or observed. The Owner will bear such costs except as provided elsewhere in Article 13.

13.3.3 If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's and Owner's Authorized Agent's services and expenses.

13.3.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor, and promptly delivered to the Owner's Representative and the Architect.

13.3.5 The Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.3.6 The Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable laws, unless prior defective Work provides the Architect or the Owner with a reasonable belief that additional defective Work may be found, in which case the Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or the Architect, whether or not such tests or inspection reveals that Work is in compliance with the Contract Documents.

13.4 Nondiscrimination

13.4.1 In connection with the furnishing of equipment, supplies, and/or services under the Contract, the Contractor and all subcontractors shall not discriminate against any recipients of services, or employees or applicants for employment on the basis of race, color, national origin, ancestry, religion, sex, pregnancy, sexual orientation, gender identity, gender expression, age, disability, protected veteran status, or any other status protected by applicable state or federal law.

13.4.2 The University serves from time to time as a contractor for and/or receives grant funding from the United States government and/or State of Missouri. Accordingly, the Contractor shall comply with all applicable state and federal laws, rules, regulations and executive orders applicable to subcontractors of government contractors or to contractors of grant recipients, including those relating to equal employment of minorities, women, persons with disabilities, certain veterans and based on sexual orientation and gender identity, as each may be amended from time to time. Contract clauses required by the

United States government or State of Missouri in such circumstances are incorporated herein by reference.

13.5 MBE/WBE/SDVE Participation Goals

13.5.1 The Contractor shall provide participation of MBE/WBE/SDVE Firms in the Project, through self-performance, if a MBE/WBE/SDVE Firm, or by subcontracting with MBE/WBE/SDVE Firms as Subcontractors, suppliers or manufacturers, in an amount that is no less than the percent of the Contract Sum that was promised in the Contractor's bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any MBE/WBE/SDVE Firm as a Subcontractor, supplier or manufacturer under the Contract, the Contractor shall replace the MBE/WBE/SDVE Firm with one or more MBE/WBE/SDVE Firms in an amount equal to the dollar value of the work awarded to the MBE/WBE/SDVE Firm that was removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor's intent to remove any MBE/WBE/SDVE Firm as a Subcontractor, supplier or manufacturer, and the Contractor's plan to provide the promised amount of MBE/WBE/SDVE Participation. All changes of a MBE/WBE/SDVE Firm as a Subcontractor of any tier, supplier or manufacturer under the Contract shall be approved by the Executive Director of Facilities Planning and Development.

13.5.3 If the Contractor fails to meet or to maintain the promised amount of MBE/WBE/SDVE Participation, the Contractor shall immediately notify in writing the Owner's Representative and the Executive Director of Facilities Planning and Development. Such notice shall include a description of the Contractor's good faith effort to provide the promised MBE/WBE/SDVE Participation.

13.5.4 If the Executive Director of Facilities Planning and Development finds that the Contractor has failed to comply in good faith with the promised MBE/WBE/SDVE Participation the Executive Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be declared a material breach of the Contract and that the Contract be terminated.

13.5.5 In the enforcement of the non-discrimination requirements in Section 13.4 and 13.5, the Owner may use any reasonable procedures available, including but not limited to: requests, reports, site visits, and inspection of relevant documents of Contractors and Subcontractors of any tier. The Contractor shall submit a final Affidavit of MBE/WBE/SDVE Participation for each MBE/WBE/SDVE Firm at the end of the project stating the actual amount paid to the MBE/WBE/SDVE Firm.

13.6 Wage Rates (If the Contract amount is less than \$75,000, the requirements of this Section will not apply. Any adjustments that increase the Contract cost above \$75,000 will be subject to this Section, per Section 290.230, RSMo.)

13.6.1 The Contractor and its Subcontractors shall pay all workers performing work under the Contract not less than the prevailing hourly rate of wages or the public works contracting minimum wage, whichever is applicable, as set out in the Annual Wage Order that is attached to and made part of the specifications for work under the Contract, in accordance with Sections 290.210 to 290.340, RSMo (Missouri Prevailing Wage Law) and related regulations. The Annual Wage Order(s) published by the Missouri Department of Labor and Industrial Relations (MDLIR) for the location where the Work is performed is incorporated into the Contract by this reference. The Contractor shall use applicable MDLIR regulations, including, but not limited to, 8 CSR 30-3.010-3.060, in determining the appropriate occupational titles and rates for workers used in the execution of this Contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Executive Director of Facilities Planning and Development.

13.6.2 If this Project is financed in whole or in part from Federal funds (as indicated in the bid or Contract Documents), then this Contract shall be subject to all applicable federal labor statutes, rules, and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. § 3141 et seq., and the "Federal Labor Standards Provisions." Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this Contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification-by-classification basis.

13.6.3 The Contractor will forfeit a penalty to the Owner of \$100 per day (or portion of a day) for each worker that is paid less than the specified rate for any work done under the Contract by the Contractor or by any Subcontractor. The Owner shall deduct from any unpaid amounts then or thereafter due the Contractor under the Contract all sums and amounts due and owing as a result of any violation of Sections 290.210 to 290.340, RSMo. (Section 290.250, RSMo) The Contractor agrees to abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as penalties for underpayment of wages.

13.6.4 The prevailing wage rate(s) and public works contracting minimum wage(s) included in the Annual Wage Order(s) include fringe benefits as set forth in Sections 290.219 and 290.257, RSMo. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical

or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in Section 290.210(5), RSMo.

13.6.5 The Contractor shall make full payment of the applicable required wages to workers in legal tender. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker's term of employment, and such agreement is approved by the Owner as fair and reasonable in accordance with Section 290.315, RSMo.

13.6.6 The Contractor shall submit to the Owner with the Contractor's periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner's web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. Do not include personal social security numbers in payroll records. The Owner's acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll records. The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within ten (10) days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within twenty-four (24) hours of written notice. Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. Falsification of the certified payroll records may result in the debarment of the Contractor or Subcontractor from future work with the University.

13.6.7 If applicable, the Contractor shall comply with the Copeland "Anti-Kick Act, 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

13.6.8 The Contractor shall specifically incorporate the obligations of Section 13.6 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.9 If Contractor fails to comply with the provisions of Section 13.6 of this Contract or with Sections 290.210 to 290.340, RSMo and related regulations, the Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of the Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

13.6.10 The Contractor may pay entry-level workers or federally-registered apprentices fifty percent (50%) of the pay of a journeyman in their same occupational title, in accordance with Section 290.235, RSMo and 8 CSR 30-3.030. Per 8 CSR 30-3.030, an entry-level worker is "[a]ny worker who is not a journeyman and who is not otherwise enrolled in a federally-registered apprenticeship program but is participating in an on-the-job training program provided by the contractor for whom they perform work on a public construction project." The University of Missouri may require documentation showing, to the University's sole satisfaction, that an entry-level worker is participating in an on-the-job training program with the Contractor. The combined total of such entry-level workers and federally registered apprentices shall not exceed a one-to-one ratio with the number of journeyman workers in any occupational title on the project.

13.6.11 The Contractor shall post the wage rates for the Contract in a dry, accessible place at the field office on the project or, where there is no field office, at the Contractor's local office or batch plant so long as a copy is provided to workers upon request, as required by 8 CSR 30-3.050. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.12 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request, demand or receive, either before or after such worker is engaged, that such worker pay back, return, donate, contribute, or give any part or all of said worker's wages, salary, or thing of value, to any person, upon the statement, representation, or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment, and no person shall, directly or indirectly, pay, request or authorize any other person to violate this Section as set forth in Section 290.305, RSMo, the exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization. No Contractor or Subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the applicable wage rate as provided in the Contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the

date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record.

13.6.13 The Contractor will pay workers overtime for all hours worked over ten (10) hours per day and forty (40) hours per week in accordance with Section 290.230, RSMo. For all overtime work performed, not less than one and one-half the prevailing hourly rate of wages for work of a similar character in the locality in which the Work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid. For all work performed on a Sunday or holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply in accordance with Section 290.230, RSMo. For purposes of this Section, holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

13.7 Records

13.7.1 The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

13.8 Codes and Standards

13.8.1 The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these codes and standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

- .1 ICC International Building Code and reference standards
- .2 ICC International Plumbing Code
- .3 ICC International Mechanical Code
- .4 ICC International Fire Code
- .5 ICC International Fuel Gas Code
- .6 NFPA 70 National Electric Code (NEC)
- .7 Americans with Disabilities Act – Standards for Accessible Design.
- .8 American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving

Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1

- .9 NFPA 101 Life Safety Code (as noted above)
- .10 American Concrete Institute (ACI)
- .11 American National Standards Institute (ANSI)
- .12 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .13 American Refrigeration Institute (ARI)
- .14 American Society for Testing and Materials (ASTM)
- .15 Missouri Standard Specification for Highway Construction, Missouri State Highway Commission
- .16 National Electrical Manufacturers Association (NEMA)
- .17 Underwriter's Laboratories, Inc. (UL), Federal Specifications
- .18 Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

13.9 General Provisions

13.9.1 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

13.9.2 This Contract shall be interpreted, construed, enforced, and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. The Contractor and the Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, this Contract shall be reformed to replace such prohibited or invalid provision or portion thereof with a valid and enforceable provision which comes as close as possible to expressing the intention of the prohibited or invalid provision.

13.9.3 The Contractor and the Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between the Contractor and the Owner. The Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against the Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

13.9.4 The Owner's total liability to the Contractor and anyone claiming by, through, or under the Contractor for any Claim, cost, loss, expense, or damage caused in part by the fault of the Owner and in part by the fault of The Contractor or any other entity or individual shall not exceed the percentage share

that the Owner's fault bears to the total fault of the Owner, the Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

13.9.5 The Contractor agrees that the Owner shall not be liable to the Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by the Owner's negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

13.9.6 Nothing contained in this Contract or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

13.9.7 No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. The Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to the Contractor.

13.9.8 The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If the Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and the Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner's consent to any assignment is conditioned upon the Contractor entering into a written assignment which contains the following language: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials."

13.10 Certifications

13.10.1 Suspension and Debarment

The Contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any department or agency in accordance with Federal Executive Orders 12549 (2/18/86) and 12689 (8/15/89).

13.10.2 Anti-Discrimination Against Israel Act

If this Contract is for \$100,000 or more, and if the Contractor is a company with ten (10) or more employees, then Contractor certifies that it, and any company affiliated with it,

does not boycott Israel, and will not boycott Israel during the term of this Contract. In this Paragraph, the terms "company" and "boycott Israel" shall have the meanings described in Section 34.600 of the Missouri Revised Statutes.

13.10.3 Byrd Anti-Lobbying Amendment

- .1** If this Contract exceeds \$100,000 and is funded by Federal funding, Contractor agrees to file the required certification, in compliance with 31 U.S.C. § 1352 (as amended).
- .2** Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352.
- .3** Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

13.10.4 Work Authorization

The Contractor and all subcontractors performing work under this Contract shall enroll and participate in a federal work authorization program operated by the United States Department of Homeland Security, E-Verify or an equivalent federal work authorization program, to verify information of newly hired employees, under the Immigration Reform and Control Act of 1986 (IRCA), P.L.99-603. By executing a contract with The Curators of the University of Missouri, the Contractor shall affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with the contracted service and affirm that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. The Contractor shall maintain documentation of its participation in a federal work authorization program and make such documentation available to the University upon request.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 Termination by Owner for Cause

14.1.1 In addition to other rights and remedies granted to the Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:

- .1** refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;
- .2** refuses or fails to supply sufficient or proper materials;
- .3** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .4** disregards laws, ordinances, rules, codes, regulations or orders of an authority having jurisdiction;

- .5 disregards the authority of the Owner's Representative, the Architect, or the Owner's Authorized Agent;
- .6 breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;
- .7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
- .8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;
- .9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or
- .10 violates in any substantial way any provisions of the Contract Documents.

14.1.2 When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner, terminate this Contract by delivering a written notice of termination to the Contractor and the Contractor's surety, and may:

- .1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 accept assignment of subcontracts pursuant to Section 5.3; and
- .3 finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

14.1.3 The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architect's services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of the Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

14.1.4 In exercising the Owner's right to secure completion of the Work under any of the provisions hereof, the Owner shall have the right to exercise the Owner's sole discretion as to the manner, methods, and reasonableness of costs of completing the Work.

14.1.5 The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

14.1.6 Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Section 14.1.

14.2 Suspension by the Owner for Convenience

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

14.2.2 An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under Section 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

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

14.3 Owner's Termination for Convenience

14.3.1 The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

14.3.2 Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

- .1 cease operation as specified in the notice;
- .2 place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;
- .3 terminate all subcontracts and orders to the extent they relate to the Work terminated;
- .4 proceed to complete the performance of Work not terminated; and
- .5 take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

14.3.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation,

anticipated profits, consequential damages and other economic losses.

14.3.4 The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

14.3.5 Upon determination by a court that termination of Contractor or its successor in interest pursuant to Section 14.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Section 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in ++

SECTION 1.E

SPECIAL CONDITIONS

1. DEFINITIONS

a. “Drawings”

Drawings referred to in and accompany Project Manual consist of Drawings prepared by and bearing the name of the below defined Architect, bearing Date of December 22, 2025, entitled “GENERAL SITE – STEAM AND WATER LINE REPLACEMENT, STEPHENS AND LEFEVRE HALLS”, project number CP253171.

b. Primary Consultant, Mechanical Engineer, Electrical Engineer
PRVN Consultants, Inc.
1617 Second Ave., Suite 110
Rock Island, IL 61201
(319) 359-7808

c. Civil Engineer, Structural Engineer
Crockett Engineering Consultants
1000 W. Nifong Blvd., Bldg. 1
Columbia, MO 65203
(573) 447-0292

d. Other Definitions: See Article 1., General Conditions

2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form

Contractor may not begin work in the designated areas until **5/18/2026**.

Contractor shall complete all work for the new water line service by **8/1/2026**.

Contractor shall complete all steam and condensate work to allow for the systems to be energized by **10/15/2026**.

Final completion of project must be achieved in **180 calendar days** from the start of onsite construction.

Contractor shall perform all work in the designated areas outside of regular working hours, which are **7:00 a.m. to 5:30 p.m.**, Monday through Friday.

Contractor shall coordinate construction activities in the Memorial Union area and their timing with the Owner’s Representative prior to starting work.

3. SCOPE OF WORK

- a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on the Drawings and specified herein.
- b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.
- c. General Description of Work:
 - (1) Project consists of, but is not limited to,
 - Construction of new steam manhole SMH-737.
 - Structural refurbishment of existing steam chase from utility tunnel to SMH-737 to SMH-105.
 - Structural refurbishment of existing steam chase from SMH-105 to SMH-100.
 - Structural refurbishment of existing steam chase from SMH-100 to Stephens Hall.
 - Structural refurbishment of existing steam chase from SMH-737 to Schweitzer Hall.
 - Structural refurbishment of SMH-100.
 - Structural refurbishment of SMH-105.
 - Demolition of steam and condensate piping and supports in chases, SMH-100, and SMH-105.
 - New steam and condensate piping, valves, anchors, and supports in chases, SMH-100, SMH-105, and SMH-737.
 - Pavement removal and replacement.
 - New water service, including open cut and directional boring installation.
 - Utility relocations to facilitate construction of new steam manhole.
 - Insulation of steam and condensate utilities in the chases, buildings, SMH-100, SMH-105, and SMH-737.
 - Electrical work in steam manholes.
 - Site lighting removal and replacement.
 - Asbestos abatement of chase and SMH waterproofing, and chase and SMH piping insulation.
 - (2) Demolition consists of, but is not limited to, site clearing, partial demolition of structures, fencing, paving, demolition of steam and condensate utilities, and obstructions as required to complete the work.
 - (3) Civil work consists of, but is not limited to, earthwork, shoring, fencing, traffic control, pedestrian control, paving, and water utilities as required to complete the work.

- (4) Structural work consists of, but is not limited to, concrete, metals, and waterproofing as required to complete the work.
- (5) Mechanical work consists of, but is not limited to, steam piping, condensate piping, storm drain piping, fittings, valves, expansion joints, supports, anchors, specialties, and miscellaneous items as required to complete the work.
- (6) Electrical work consists of, but is not limited to, site lighting and manhole electrical services.

4. LOCATION

- a. Work shall be performed under this Contract on the campus of the University of Missouri – Columbia near the Stephens Hall, Schweitzer Hall, Waters Hall, and Lefevre Hall.

5. NUMBER OF CONSTRUCTION DOCUMENTS

- a. The Owner's Representative will furnish the Contractor a copy of the executed Contract and a complete set of Drawings and Specifications in PDF format.
- b. The contractor may obtain printed sets from the architect at cost of reproduction.
- c. The Owner will furnish explanatory and changed Drawings to the Contractor in PDF format as issued during project.
- d. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the reference project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:
 - (1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.
 - (2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the

electronic files transmitted.

- (3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.
- (4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.
- (5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.
- (6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

6. SUBMITTALS

- a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)
- b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.
- c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be

posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.

- (1) The Contractor shall identify each submittal item with the following:
 - (a) Project Title and Locations
 - (b) Project Number
 - (c) Supplier's Name
 - (d) Manufacturer's Name
 - (e) Contract Specification Section and Article Number
 - (f) Contract Drawing Number
 - (g) Acrobat File Name: Spec Section_Times Submitted_Spec Title:
033000_01-Cast in Place Concrete.pdf
 - (2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.4) for the required submittal information.
- d. The Contractor shall submit to the Architect four (4) bound copies of all required Operating Instructions and Service Manuals for the Architect's and the Owner's sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.5).
- e. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.6) within 30 days following substantial completion of the work. The Owner's Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

7. USE OF PREMISES

- a. Access: Access to construction site shall be as indicated on the drawings and as directed by the Owner's Representative.
- b. Parking:
 - (1) The Owner will issue Contractor two (2) service vehicle parking permits for use in nearby University Parking facility. The permits will be issued at no cost to the contractor up to the contract completion date. After the contract completion date, the permits will be re-issued on an as available basis at the contractor's expense. These permits are to be used for general contractor or subcontractor owned and labeled vehicles only. Personal vehicles are prohibited from use of these permits. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
 - (2) Parking of personal vehicles within project access/lay down/staging areas is prohibited. Violation of this requirement may result in ticketing and/or

towing at the vehicle owner's expense and suspension of progress payments.

- (3) Parking or driving on sidewalks, landscaped areas, within fire and service lanes or generally in areas not designated for vehicular traffic is prohibited except as allowed in the contract documents. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
 - (4) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative through the MU sidewalk permitting process. Restricted use permits will be limited to activities that are constrained by an absolute need to access from a sidewalk. Such activities shall be considered the exception and not the norm. Adequate signage, fencing and alternate routes must be provided in the immediate and adjacent areas.
 - (5) Free parking for contractor employees is available in the Ashland Road Contractor lot on an as available basis. This space is for use by contractor employees for parking their personal vehicles only and is not to be used for staging or storage.
 - (6) Vendor Permits may be purchased by contractor management personnel on an as available basis by contacting the Parking and Transportation office in the General Services Building. These permits will allow contractor management personnel to park in various University lots while conducting business on University construction projects.
 - (7) Temporary University parking permits may be purchased by contractor employees for use with their personal vehicles on an as available basis by contacting the Parking and Transportation office in the General Services Building.
 - (8) Conley Avenue between Missouri Avenue and University Avenue and Hitt Street between University Avenue and the Memorial Union are designated for pedestrian use only during the work week between the hours of 8:15 AM and 3:45 PM. Unless otherwise indicated in the contract documents, this area is strictly off limits to vehicular traffic without authorization from the Owner's Representative.
- c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.

- d. Restroom: The Contractor shall provide and maintain, in a sanitary condition, chemical type portable toilet facilities at work site for use by his personnel. Toilets and toilet location shall be subject to approval by the Owner's Representative.
- e. Smoking is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as the use of any tobacco or marijuana products, including e-cigarettes, cigarettes, and vaping.
- f. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.
- g. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal "Discharge to Sewer Request" form obtained at [Discharge to Sewer Request Form](#). The contractor should submit the form to the Owner's Representative, not to the Department of Environmental Health and Safety as the form indicates.
- h. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.
- i. Artifacts Found During Construction: Contractor shall immediately notify the Owner's Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.
- j. **"Permit Required Confined Space" Entry Communication and Coordination**
(See OSHA 1926 subpart aa – Construction Confined Space for the definition of "permit required confined spaces" – Note: OSHA does not apply to the University. However, the University will provide a list of all known "permit required confined spaces")

The following are the know locations of "permit required confined spaces" currently identified within the project limits:

1. Steam manholes
2. Pipe chases, etc., large enough for entry

The hazards or potential hazards in each “permit required confined space” or the reason it is a “permit required confined space”:

1. Safety or health hazards such as poor air quality, toxic or asphyxiant gas, chemical exposure, fire hazard.
2. Physical hazards such as low lighting, noise, heat, and cold.
3. Safety hazards such as entrapment, engulfment, entanglement, slips, falls, limited egress.
4. Energy hazards.

Any precautions that the owner or previous contractors have implemented for the protection of employees in the “permit required controlled space”:

1. Confined space training, entry permitting, air quality monitoring, ventilation, retrieval system, proper personnel protective equipment, attendant, LOTO of energy hazards, rescue plans and personnel.

The above list of known confined spaces within the project limits may not be a complete listing. Each contractor shall survey the project to identify all confined spaces. It is incumbent upon each contractor to list all “permit required spaces”.

The Contractor shall notify the Owner’s Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a “permit required confined space” after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a “permit required confined space” after evaluation by a competent person; or 3) during the course of construction a “permit required confined space” is created after evaluation by a competent person.

9. PROTECTION OF OWNER’S PROPERTY

- a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner’s Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs. For landscape damage, the Owners shall make such repairs. Compensation for these repairs shall be determined by the Owner’s Representative using the “Valuation of Landscape Trees, Shrubs, and other Plants” as published by the International Society of Arboriculture, as last revised.

- b. Construction Project Fencing:

- (1) Fencing requirements, as indicated on Drawings, shall be constructed of 9 or

11-gauge chain link not less than six (6) feet in height and not more than 2-inch mesh with posts spaced not more than ten (10) feet apart and all corner and gate posts imbedded in concrete. All other posts shall be sufficiently secured in ground to maintain proper and adequate support of fence. Fenced in area shall have at least two (2) access gates and all gates shall be lockable.

- (2) Fence screening fabric shall be used on all perimeter fencing. Fabric shall be black in color, full height of the project fence, securely attached and properly maintained throughout the duration of the project.
- (3) Using existing landmarks, lamp posts, trees or other Owner property for support of fencing is strictly prohibited unless a written waiver is obtained from Owner's Representative.
- (4) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.
- (5) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (6) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

c. Preserving and Protecting Existing Vegetation:

- (1) Protection and compensation for damages:
 - (a) Trees and shrubs within work area designated to remain shall be protected from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative.
 - (b) In the event that damage(s) to the Owner's trees, shrubs or vegetation occurs as a result of the Contractor's unauthorized operations, the Contractor shall pay or allow to the Owner compensation for said damage(s). Compensation shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.
- (2) Plants within work area designated for removal shall be removed by Contractor.

- (3) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.
- (4) Owner's Representative will stop work immediately when proper measures are not being employed to protect trees and shrubs. Contractor will be notified to resume work after required protection measures are implemented.
- (5) Removal and/or pruning of select landscape materials shall be performed by MU Landscape Services department.
- (6) Contractor shall repair tire ruts and other damages to existing lawn areas. Repairs shall match surrounding area.

10. SUBSTITUTIONS AND EQUALS

- a. Substitutions are defined in general conditions Article 3 point 11.84 and equals are defined in general conditions article 3.12.
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals of any item described in the Contract Documents will be allowed only prior to the receipt of bids provided that a request for approval has been received by both the Engineer and the Owner at least ten calendar days prior to the date for receipt of Bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Engineer's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.
- c. If the Engineer and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

11. CODES AND STANDARDS

- a. The Contractor shall comply with applicable codes and standards as listed in the General Conditions. The following codes and standards shall also apply:

12. PERMITS

- a. The Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities except as noted in Article 3.2 of the General Conditions.

- b. Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 30-2.065. Their permit applications are available at <https://dfs.dps.mo.gov/programs/bpv/>.

13. SPECIALTIES

- a. Owner furnished topsoil: The Owner will place the topsoil and provide final grade. The contractor shall rough grade to the following specifications:
 - (1) The sub-grade is to be left at minus six inches (6”) in all areas unless indicated otherwise. All planting bed sub-grades are to be left a minus eighteen inches (18”). The contractor is to remove all deleterious material from the sub-grade prior to placing topsoil. All subgrade areas shall contain at least 6” of subsoil, (ie. cover clean rock backfilled areas). All subgrade areas shall be “ripped” a minimum of 6” deep and a maximum of 12” apart in opposite directions with minimal tire traffic to follow. All exposed deleterious material and unacceptable rock shall be removed.
 - (2) The contractor shall adjust all yard boxes valve boxes, pull boxes, cleanouts, and manhole lid rings etc. (includes irrigation, sewers, water and electric), to the indicated finish grade.
 - (3) Final plantings will be by the Owner. The Owner will water and maintain all seed, sod and landscaping.
- b. Irrigation System: Modifications(s) to existing systems is to match the existing equipment and materials. The Owner will provide to the contractor the product information on the existing irrigation systems so the correct changes and/or repairs can be made.

14. PRE-BID INSPECTION

- a. All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-6800

15. MODIFICATIONS TO INFORMATION TO BIDDERS

- a. Information to Bidders:
 - (1) Referenced Information to Bidders, Page IFB/5.
Add new Article 15.8.5 as follows:

15.8.5 Within 48 hours of the receipt of bids, the apparent low bidder shall submit to the Director of Facilities Planning and Development an “Affidavit of Supplier Diversity Participation” for every diverse subcontractor or supplier the bidder intends to award work to on the contract. The affidavit will be signed by both the bidder and the diverse firm.

16. MODIFICATIONS TO GENERAL CONDITIONS

a. General Conditions

- (1) Add to the Insurance Requirements in General Conditions Article 11, Asbestos Liability Coverage, for specified asbestos abatement in the contract documents, in a limit no less than \$1,000,000 combined single limit, per occurrence and aggregate, for both bodily injury and property damage combined. The Owner will accept coverage from the Asbestos Removal Subcontractor in lieu of the General Contractor subject to all requirements set forth in article 11.

17. PROJECT SCHEDULING

- a. Contractor Schedule – Contractor is responsible for the schedule, that may be provided with in-house personnel or hired a third-party scheduling consultant. See Contractor Schedule Requirements included in these documents.

b. Contractor Schedule Requirements

(1) GENERAL

- (a) Time is of the essence for this contract. The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure to that the critical milestone and end dates spelled out in the contract are achieved.

(b) Related Documents

- (i) Drawings and general provisions of the Contract, including General Conditions' Article 3.18 shall apply to this Section.

(c) Stakeholders

- (i) A Stake holder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and Subcontractor(s).

(d) Weather

- (i) Contractor acknowledges that there will be days in which work cannot be completed on weather sensitive activities, due to the weather, and that a certain number of these lost

days are to be expected under normal weather conditions in Missouri.

- (ii) Rather than speculate as to what comprises “normal” weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days, on weather sensitive activities of critical path work, due to weather over the course of a calendar year and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.
- (iii) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

Jan – 5 days	Feb – 5 days	Mar – 4 days	Apr – 4 days
May – 3 days	Jun – 3 days	Jul – 2 days	Aug – 2 days
Sep – 3 days	Oct – 4 days	Nov – 4 days	Dec – 5 days

- (iv) The Contractor shall notify the Owner’s Representative via email on the same day a lost weather day occurs and shall maintain a log of weather days to be included in the Narrative described in 2.3.4 herein.

(2) SCHEDULING PROCESS

- (a) The intent of this section is to ensure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor’s ability to perform its work consistent with the contract documents. Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.
- (b) Contractor Requirements
 - (i) Schedule Development

Contractor shall prepare the Project Schedule using the latest version of Phoenix Project Management scheduling software

or other software as approved by the Owner's Representative prior to receipt of bids.

Contractor shall review each major subcontractor's schedule with the sub and obtain the subcontractor's concurrence with the schedule, prior to submitting to the University.

(ii) Schedule Updates

1. Schedule Updates will be conducted once a month, at a minimum. Actual Start and Finish dates should be recorded regularly during the month. Remaining Duration shall be updated as of the data date, just prior to Contractor's submittal of the updated data.
2. Contractor will copy the previous months schedule and will input update information into the new monthly update version.
3. Contractor will meet with the Owner's Representative to review the draft of the updated schedule. At this meeting, Owner's Representative and Contractor will:
 - (a) Review out of sequence progress, making adjustments as necessary.
 - (b) Add any fragnets necessary to describe changes or other impacts to the project schedule and
 - (c) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(c) Schedule Narrative

After finalization of the update, the Contractor will prepare a Narrative that describes progress for the month, impacts to the schedule and an assessment as to the Contractor's entitlement to a time extension for occurrences beyond its control during the month and submit in accordance with this Section.

(d) Progress Meetings

- (i) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if

the progress schedule is not adequately updated to reflect actual conditions.

- (ii) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include four (4) weeks look ahead schedules to allow subs to focus on critical upcoming work.

(2) CRITICAL PATH METHOD (CPM)

- (a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.
- (b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.
- (c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
- (d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
- (e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
- (f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.
- (g) Critical activities are activities on the critical path.
- (h) Predecessor activity is an activity that must be completed before a given activity can be started.
- (i) Milestone: A key or critical point in time for reference or measurement.
- (j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor but is a project resource available to both parties as needed to meet contract milestones and the completion date.

- (k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
- (l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.(d)(iii), above.
- (m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.
- (n) Schedule shall include the following, in addition to Contractor's work.
 - (i) Phasing: Provide activity codes in the schedule to show how the sequence of the Work is affected by the following:
 1. Requirements for phased completion and milestone dates.
 2. Work by separate contractors.
 3. Work by the Owner
 4. Coordination with existing construction.
 5. Limitations of continued occupancies.
 6. Uninterruptible services.
 7. Partial occupancy prior to Substantial Completion.
 8. Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of the Article, a "major area" is a story of construction, a separate building, or a similar significant construction element.
 9. Required delivery dates for Owner furnished equipment, if applicable
 10. Post substantial completion activities and closeout
 11. Floor or Level: Use separate activity codes to identify each floor or level.
 12. Subcontractor: Use Activity Codes to identify each subcontractor's work activities.
 13. Type Work or Craft: Use Activity Codes to identify the type of work, or craft that will execute each activity.

(4) TIME EXTENSION REQUEST

- (a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.

- (b) Changes or Other Impacts to the Contractor's Work Plan. The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment. The Update must include:
 - (i) An activity depicting the event(s) impacting the Contractor's work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.
 - (ii) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.
 - 1. If the adjustments above result in a completion date beyond the contract completion date, the delay shall be deemed excusable, and the contract completion date shall be extended by the number of days indicated by the analysis.
 - 2. Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However, the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.
- (c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding allocated weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days may be considered for equitable adjustment. In review of time extension requests for compensable days, the Owner will consider the actual number of weather days incurred.
- (d) Home office expenditures and staff are NOT compensable.

18. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION MEETING(S)

- a. Before the start of MEP installation, the Owner's Representative will convene an MEP pre-installation meeting. Meeting participants to include contractor (including MEP subcontractors), Owner's Representative and additional contractor and University operational staff invited by the Owner's Representative. Topics will

include underground rough-ins, steam piping, chilled water piping, sprinkler piping, hot water piping, electrical system, duct, telephone/data wiring, control wiring. Additional meetings will be conducted as required for the review of coordination drawings and scope specific installations. Cross section drawings of corridor ceilings and other congested areas will be of highest priority and will be reviewed prior to the start of installations in the affected areas. Meeting minutes and sign-up sheet will be transcribed by contractor and distributed to attendees.

19. SAFETY PRECAUTIONS AND PROGRAMS

- a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site-specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.
- b. The contractor shall provide Emergency Contact Information for the Contractor's on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

20. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

- a. Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and NFPA 51B.
 - (1) Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.
 - (2) The Contractor shall utilize the hot work permit decision tree and permit provided in the NFPA 51B for all Hot Work operations.
 - (3) A hot work permit shall be used on all hot work performed outside a designated hot work area. The hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.
 - (4) Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system outage with

Campus Maintenance personnel.

- (5) Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.

21. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

- a. All crane and hoisting operations shall be performed in compliance with OSHA 29 CFR 1926. All Operators, riggers, and signal persons must have the proper qualifications and training necessary to perform the intended hoisting activities for this project.
- b. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an "Operator in Training" status shall not be used.
- c. Submittal requirements:
 - (1) Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.
 - (2) Submit Rigger and Signal Person qualifications to the Owners Representative.
 - (3) Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer's review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

22. CONSTRUCTION WASTE MANAGEMENT

- a. The goal of Construction Waste Management is to divert waste from the sanitary landfill. This shall be accomplished through reuse, recycling and/or salvage of non-hazardous construction and demolition debris to the greatest extent practical. Track and report all efforts related to reuse, recycling and/or salvage materials from the project (including clean fill material). Report all material types and weights, where material was diverted, type of diversion, documentation of diversion (waste or recycling tickets), and applicable dates. In order to calculate the diversion percentage, total weights of all non-hazardous landfill material must be reported. This information shall be updated monthly utilizing the [Construction Waste Management Worksheet](#). Copies of all applicable receipts, tickets and tracking logs

shall be uploaded to the Owner's information sharing website or reported as required by the Construction Project Manager.

- b. A summary worksheet is required prior to substantial completion.

23. BUILDING SYSTEM COMMISSIONING

- a. Contractor shall provide all personnel and equipment required to complete the commissioning activities referenced in the Commissioning Plan. The requirements of the commissioning plan shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log.
- b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor's commissioning coordinator. The commissioning coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning activities required by the commissioning plan and ensuring all building systems are complete, operable and ready for use by the Owner. At a minimum, building ventilation systems, chilled/hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm systems, as applicable

24. WARRANTY WALKTHROUGH

- a. Contractor shall attend a walk-thru with the Owner at eleven (11) months after acceptance to review and document any warranty items to be addressed as part of the twelve (12) month warranty stated in article 3.1 of the General Conditions.

END OF SECTION

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: GENERAL SITE – STEAM AND WATER LINE REPLACEMENT, STEPHENS AND LEFEVRE HALLS

Project Number: CP253171

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
03 30 00	Product data for each type of product indicated				
03 30 00	Design mixtures for each concrete mixture				
03 30 00	Steel reinforcement shop drawings				
03 30 00	Material certificates				
03 30 00	Material test reports				
03 41 00	Product data for each type of product				
03 41 00	Design mixtures				
03 41 00	Shop drawings				
03 41 00	Material certificates				
03 41 00	Material test reports				
03 41 00	Source quality control reports				
03 41 00	Field quality control and special inspection reports				
26 05 19	Low voltage power conductors and cables				
26 05 26	Product data: Grounding bushings				
26 05 26	Product data: Grounding conductors				
26 05 26	Manufacturer's installation instructions				
26 05 26	Field quality test reports				
26 05 33	Product data: Raceways				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: GENERAL SITE – STEAM AND WATER LINE REPLACEMENT, STEPHENS AND LEFEVRE HALLS

Project Number: CP253171

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Discipline Responsible</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
26 05 53	Product data: Identification					
26 27 26	Product data: Devices					
31 10 00	Demolition procedures, sequence, and schedule					
31 20 00	Product data for each material used					
31 20 00	Test reports, list of materials, and gradations					
31 25 00	Erosion control plan					
31 50 00	Excavation support and protection system design					
31 50 00	Evidence of existing conditions					
32 13 13	Product data for each material and product					
32 13 13	Design mixes					
32 13 13	Test mix reports					
32 13 73	Product data: Joint sealants					
32 13 73	Product certificates for each joint sealant					
33 11 13	Product data for each type of product used					
33 11 13	Coordination drawings					
33 11 13	Field quality control test reports					
33 11 14	Product data for each type of product used					
33 11 14	Coordination drawings					

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: GENERAL SITE – STEAM AND WATER LINE REPLACEMENT, STEPHENS AND LEFEVRE HALLS

Project Number: CP253171

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Discipline Responsible</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
33 11 14	Field quality control test reports					
33 41 00	Product data: Pipe, fittings, drainage system					
33 41 00	Shop drawings: Manholes, basins, inlets, detention structures					
33 41 00	Field quality control reports					
33 61 13	Product data for each type of product					
33 61 13	Coordination drawings					
33 61 13	Field quality control test reports					
33 63 00	Shop drawings for piping system layout					
33 63 00	Insulation and jacketing product data					
33 63 00	Insulation and jacketing shop drawings					
33 63 00	Piping test procedures and certificates					
33 63 00	Welder's certifications					
33 63 00	Product data: Valves					
33 63 00	Product data: Steam traps					
33 63 00	Product data: Modular seals					
33 63 00	Product data: Expansion joints					
33 63 19	Product data for each support type used					
33 63 41	Product data for each product indicated					

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: GENERAL SITE – STEAM AND WATER LINE REPLACEMENT, STEPHENS AND LEFEVRE HALLS

Project Number: CP253171

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Discipline Responsible</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
33 63 50	Product data: Bonding agent, joint devices, attachment accessories					
33 63 50	Manufacturer's installation instructions					
33 63 50	Material certificates					
33 63 50	Project record documents					
33 63 50	Aggregates					
33 63 50	Concrete mixture submittal					
33 63 50	Prequalification of concrete mixtures					
33 63 50	Silica fume manufacturer's statement					
33 63 50	Steel reinforcement shop drawings					
33 63 51	Product data: Repair materials					
33 63 54	Product data for each type of product indicated					
33 63 54	Shop drawings					

SECTION 1.E.6
COMMISSIONING PLAN

CP253171 GS Stm and Wtr Rplcmt Stphns to Lfvr Commissioning Checklist

	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Division	Name	Firm				
<i>1</i>						
Building System Commissioning						
Commissioning Agent - Conduct pre-installation meetings per specifications.					Meeting Minutes	<input checked="" type="checkbox"/>
<i>28233</i>						
Friable and Non-Friable Asbestos Removal						
Develop & Post Emergency Protection Plan					Emergency Protection Plan	<input type="checkbox"/>
Maintain at least 2 10lb ABC fire extinguishers on site (one inside, one outside of abatement area)						<input type="checkbox"/>
<i>33000</i>						
Cast-In-Place Concrete						
Provide a Copy Of Field Cured Concrete Cylinder Test Report to Owner's Rep Prior to Stripping Any Load Bearing Formwork					Test Report From Independent Testing Lab	<input type="checkbox"/>
Submit concrete mix designs prepared by a qualified testing laboratory for approval prior to placement.					mix design reports	<input type="checkbox"/>
<i>34100</i>						
Precast Structural Concrete						
Help 3rd party perform Field Quality Control section of spec					Third Party Report	<input checked="" type="checkbox"/>
Hold Preinstallation meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
260519						
Low-Voltage Electrical Power Conductors and Cables						
Ensure wires are color coded per specifications						<input type="checkbox"/>
260526						
Grounding and Bonding for Electrical Systems						
Conduct grounding tests per specifications					test reports	<input checked="" type="checkbox"/>
260553						
Identification for Electrical Systems						
Ensure identification devices are applied per specifications						<input type="checkbox"/>
Verify all equipment, panels, conduits and conductors are correctly labeled.						<input type="checkbox"/>
262726						
Wiring Devices						
Operate All Devices to verify correct operation					Test Report	<input checked="" type="checkbox"/>
311000						
Site Clearing						
Maintain dust control per contract documents						<input type="checkbox"/>
312500						
Erosion Control						
Perform inspection of installed controls every seven (7) calendar days and within 24 hours of rainfall.					written report after each inspection	<input type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
315000						
Excavation Support and Protection						
Submit Survey of Adjacent Structures and Improvements Monthly to Owner's Rep.					Engineer's or Surveyor's Report	<input checked="" type="checkbox"/>
321313						
Concrete Paving						
Provide protection and curing per specifications						<input type="checkbox"/>
321723						
Pavement Markings						
Assure painting is done immediately after final surfacing as soon as practical. Perform Quality Control section of specs.						<input type="checkbox"/>
331113						
Water Distribution Piping						
Perform "Field Quality Control" section of spec					test report	<input checked="" type="checkbox"/>
331114						
Water Distribution Horizontal Directional Drilling						
Perform "Testing" section of spec					Test Report	<input checked="" type="checkbox"/>
334100						
Storm Utility Drainage Piping						
Perform Field Quality Control section of specifications					Test Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
336113						
Hydronic Energy Distribution Piping						
Perform Field Quality control section of specifications					Test Report	<input checked="" type="checkbox"/>
336300						
Steam Energy Distribution						
Perform Tests section of specifications					Test Report	<input checked="" type="checkbox"/>
336350						
Steam Structure Related Cast-In-Place Concrete						
Perform Field Quality control section of specifications					Test Report	<input checked="" type="checkbox"/>
336351						
Steam Structure Related Concrete Repair						
Hold Pre-Installation Meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Perform checks per "Field Quality Control" section of spec					Test Report	<input checked="" type="checkbox"/>
336354						
General Concrete Requirements-Waterproofing						
Perform Field Quality control section of specifications					Test Report	<input checked="" type="checkbox"/>

PLEASE FOLLOW LINK FOR CHECKLIST FORMS

<https://facilities.missouri.edu/planning-design-construction/commissioning-forms/>

Construction Management Checklist for Energizing Utilities

(Contractor to initial each item upon completion and provide completed form to the Owner's Representative prior to energizing utility)

AM #1

Water – turned on to the first valve past Energy Management's last valve.

- Review all piping and equipment being turned on for proper installation and completed testing.
- Insulation installed (preferred but not required)
- Meter properly installed, working, and in readable location.
- Contractor has swabbed out with chlorine all piping from the backflow preventer to the source while installing.
- All bacteriological tests have been completed and passed.
- Backflow preventer installed and tested. (will need water pressure to test)
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

Steam – turned on to the first valve past Energy Management's last valve.

- Review all piping, equipment, valves, reducing stations, relief valves, etc. for proper installation and complete testing.
- Piping protected from the weather.
- Insulation must be installed.
- All hangers and bolts have been installed.
- Meter installed, working and in readable location. (Don't need metasys to turn on.)
- All needed traps are installed and able to be tested as they are turned on.
- Condensate system is installed and operating including the pumping system.
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

Condensate – turned on to the first valve past Energy Management's last valve.

- Review all piping and equipment being turned on for proper installation and completed testing.
- Piping protected from the weather.
- Insulation installed (preferred but not required)
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

Electric – turned on to the first breaker past 13.8kV transformer.

- Review all wiring and equipment being turned on for proper installation and completed testing
- GFCI set and tested.
- Breakers set and tested.
- All needed permanent grounds are installed.
- Meter installed, working and in readable location.
- Main switchgear protected from the weather.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

Chilled Water – turned on to the first valve inside of building.

- Review all piping and equipment being turned on for proper installation and completed testing.
- Pressure test completed in piping being turned on.
- Insulation must be installed.
- Meter installed, working and connected to Metasys.
- Building pump and automatic isolation/control valve must be installed and under control.
- If chillers are installed, automatic loop pump isolation must be installed.
- Control valves must be installed and automatically controlled on all loads.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off

SECTION 1.F

INDEX OF DRAWINGS

Drawings referred to in and accompanying this Project Manual consist of the following sheets dated 12/22/2025.

DRAWING NO:	TITLE
G000	COVER SHEET, PROJECT LOCATION PLAN AND DRAWING INDEX
C-101	EAST EXISTING CONDITIONS PLAN
C-102	EAST DEMOLITION PLAN
C-103	EAST UTILITY PLAN
C-104	STEAM CHASE PROFILE
C-105	EAST SITE PLAN
C-105.1	EAST GRADING PLAN
C-106	EAST PHASE 1 PLAN
C-107	EAST PHASE 2 PLAN
C-108	WEST EXISTING CONDITIONS PLAN
C-109	WEST DEMOLITION PLAN
C-110	WEST UTILITY PLAN
C-111	WATER PROFILES
C-112	WEST SITE PLAN
C-113	WEST PHASE 1 PLAN
C-114	WEST PHASE 2 PLAN
C-115	STEAM DETAILS
C-116	CHILLED WATER DETAILS
C-117	WATER LINE DETAILS
C-118	PAVEMENT DETAILS
D100	OVERALL DEMOLITION SITE PLAN
D110	SMH-100 DEMOLITION PLAN
D120	SMH-105 DEMOLITION PLAN
D130	STEPHENS HALL DEMOLITION PLAN & PHOTOS
D140	ELECTRICAL DEMOLITION SITE PLAN
M000	MECHANICAL NOTES AND PHASING NOTES
M001	MECHANICAL SYMBOLS AND ABBREVIATIONS
M100	OVERALL MECHANICAL SITE PLAN
M110	SMH-100 PLAN AND SECTIONS
M120	SMH-105 PLAN AND SECTIONS
M130	SMH-737 PLAN AND SECTIONS
M140	STEPHENS HALL MECHANICAL PLAN
M150	THERMAL EXPANSION PLAN - STEAM
M151	THERMAL EXPANSION PLAN - CONDENSATE
M160	MECHANICAL DETAILS
S100	SMH-737 PLAN & DETAILS
S110	STEAM MANHOLE & CHASE DETAILS
S111	STEAM MANHOLE & CHASE DETAILS

S112	TYPICAL WATERPROOFING, REPAIR DETAILS, & NOTES
S113	FOUNDATION & STAIR DETAILS
E100	ELECTRICAL SITE PLAN
E110	SMH-100 ELECTRICAL PLAN AND SECTION
E130	SMH-737 ELECTRICAL PLAN
E140	STEPHENS HALL ELECTRICAL PLAN
E150	SCHWEITZER HALL ELECTRICAL PLAN
E200	ELECTRICAL DETAILS
E300	CABLE SCHEDULE
E310	VOLTAGE DROP CALCULATIONS

END OF SECTION

SECTION 1.G

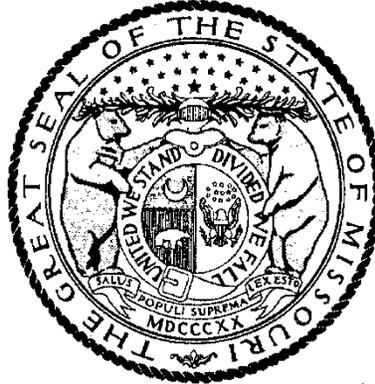
PREVAILING WAGE RATES

1. The prevailing wage rates for Boone County as issued by the Missouri Division of Labor on the following pages.

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



MIKE KEHOE, Governor

Annual Wage Order No. 32

Section 010
BOONE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by _____

Logan Hobbs, Director
Division of Labor Standards

Filed With Secretary of State: _____ **March 10, 2025**

Last Date Objections May Be Filed: **April 9, 2025**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$61.64
Boilermaker	\$34.21*
Bricklayer-Stone Mason	\$57.33
Carpenter	\$54.00
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$47.94
Plasterer	
Communication Technician	\$60.91
Electrician (Inside Wireman)	\$60.73
Electrician Outside Lineman	\$83.75
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$34.21*
Glazier	\$57.72
Ironworker	\$72.58
Laborer	\$45.36
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$63.31
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$67.29
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$43.55
Plumber	\$72.49
Pipe Fitter	
Roofer	\$56.44
Sheet Metal Worker	\$58.82
Sprinkler Fitter	\$69.16
Truck Driver	\$34.21*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

Heavy Construction Rates for
BOONE County

Section 010

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$67.38
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$83.75
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$53.59
General Laborer	
Skilled Laborer	
Operating Engineer	\$69.61
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$34.21*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

SECTION 1.H

ALTERNATES

Base Bid may be increased in accordance with following Additive Alternate proposal(s) as Owner may elect:

1. None

END OF SECTION

Division 02

Existing Conditions

University of Missouri – General Site

Steam and Water Line Replacement, Stephens and Lefevre Halls

Division 02

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PART 1 – GENERAL

Provisions of the General Conditions and Special Conditions are part of this Division.

The Contractor shall inform him/herself of the conditions for the project and is responsible for verifying the quantities and locations of all work to be performed as outlined in this technical specification. Failure to do so shall not relieve the Contractor of his obligation to furnish all materials and labor necessary to carry out the provisions of the Contract.

Contractor shall assume full responsibility and liability for compliance with all codes, ordinances, rules, regulations, orders and other legal requirements of Federal, State, and Local public authorities including, but not limited to, the U.S. Environmental Protection Agency (EPA), Occupational Health and Safety Administration (OSHA), and the Missouri Department of Natural Resources (MDNR), which bear on performance work. Where conflicts occur between these specifications and/or the above-mentioned regulatory agencies, the more stringent shall govern. The Contractor shall hold the Owner and Owner's air monitoring firm harmless for failure to comply with any applicable work, hauling, safety, health, or other regulations on the part of the Contractor, Contractor's employees, or Contractor's subcontractors.

Contractor affirms and shall be solely responsible for ensuring all personnel involved in asbestos abatement and/or universal waste/hazardous building material removal operations are adequately trained, appropriately certified, and qualified for the duties and responsibilities they are conducting. Further, any personnel required to don a respirator shall be medically cleared by a physician to wear such respirator, must be participating in a medical monitoring program, and have a current, acceptable respirator fit test. Contractor further affirms that all certifications, training, qualifications, fit testing results, physician's clearance statement, etc., shall be provided upon demand to the Owner's Abatement Representative.

If the Contractor observes that any of the Contract Documents are at variance therewith in any respect, he shall promptly notify the Owner in writing, and any necessary changes shall be accomplished by appropriate modification. It is not the Contractor's responsibility to make certain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, rules or regulations. If the Contractor performs any work knowing it to be contrary to such laws, statutes, ordinances, building codes, rules or regulations, and without such notice to the Owner, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

The use of the best available technology, procedures, and methods for preparation, execution, cleanup, disposal, and safety are absolutely required. This compliance is the sole responsibility of the Contractor.

Contractor will confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed.

Contractor shall assume full responsibility for protection and safekeeping of products stored on premises.

Contractor shall move any stored products which interfere with operations of Owner or other contractors.

Contractor shall utilize only those areas designated by the Owner for the storage of equipment and the placement of dumpsters/transport containers.

Contractor shall take all precautions necessary to ensure there is no asbestos containing materials or universal waste/hazardous building material contamination to those areas not included in work area. Should areas outside the work area become contaminated with hazardous wastes, the Contractor shall immediately clean them utilizing the wet cleaning and HEPA vacuum methods specified herein. The Contractor is responsible for the proper cleanup of all items in the work areas to maintain a clean and safe environment.

Owner reserves the right to unrestricted access of the work area by qualified and trained individuals, as designated by the Owner, for the purposes of monitoring, evaluating, or otherwise inspecting the condition of the work area and/or progress of work being performed by Contractor. No access shall be granted to untrained personnel and the Contractor shall ensure site security to prevent unauthorized access by untrained personnel.

1.1 SCOPE OF WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 ASBESTOS-CONTAINING MATERIALS REMOVAL AND DISPOSAL

The work specified herein shall be the abatement of asbestos containing materials (ACM) by certified and registered persons who are knowledgeable, qualified and trained in the abatement, handling, and disposal of ACM, and subsequent cleaning of the affected environment.

The Contractor shall furnish all labor, material, equipment, testing, services, permits, insurance, notifications, necessary or required to perform the work for the abatement of ACM and for other work as specified in this section or as indicated in associated drawings, sketches, or reports of the work.

All fees required for notification requirements, renotifications, and/or inspections by the regulatory agencies shall be paid by the Contractor. Bulk sample analysis information required by the Missouri Department of Natural Resources (MDNR), U.S. Environmental Protection Agency (EPA), or local authority having jurisdiction in conjunction with the notification shall also be provided by the Contractor unless provided within this section.

Based upon a survey conducted by MU EHS the work shall include the removal and legal disposal of:

Friable asbestos:

The Contractor shall remove and legally dispose of:

Nine hundred (900) linear feet of friable ACM pipe insulation, in fair condition, on steam and condensate lines

Non-friable asbestos:

The Contractor shall remove and legally dispose of:

Two thousand one hundred seventy five (2,175) square feet of non-friable asbestos waterproofing, in fair condition, from lids and chases

1.1.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

The Contractor shall be responsible for the coordination of the universal waste/hazardous building materials removal for this project with the Owner's Abatement Representative. The Contractor shall coordinate with the Owner's Abatement Representative, all other on-site contractors, and all subcontractors working under separate contracts so as to facilitate the general progress of the work. Each trade shall afford all trades every reasonable opportunity for the installation/completion of their work.

For all universal waste/hazardous building materials designated for removal, the default process will be that the Owner shall provide appropriate containers, the Contractor shall remove and place materials in their respective containers, and the Owner shall arrange for proper disposal of all containerized universal waste/hazardous building materials. Any deviations from this process need to be identified and agreed upon between the Owner and Contractor prior to implementation.

Based upon a survey conducted by MU EHS the work shall include the removal of the following types and quantities of universal waste/hazardous building materials:

Hazardous Building Materials

- **Polychlorinated Biphenyls (PCBs)**
Not Applicable
- **Radioactive Sources**
Not Applicable

Universal Waste

- **Mercury-Containing Equipment**
Not Applicable
- **Mercury-Containing Lamps**
Not Applicable
- **Batteries (non-alkaline)**
Not Applicable

Reclaimable/Recyclable Materials

Not Applicable

Building Materials Painted with Regulated Heavy Metals

Not Applicable

These materials shall be disposed with Construction/Demolition debris in an approved waste disposal site authorized by the appropriate designated regulatory agency for the state in which the site is located.

CONTRACTOR OPERATIONS

The Contractor is responsible for contacting EHS at least three (3) business days prior to beginning the project for training procedures related to universal waste/hazardous building materials removal, handling, and collection of these materials. Any light fixtures, housings, etc., containing Universal Wastes/Hazardous Building Materials shall also be included in collection efforts for disposal by EHS. This does not include refrigerant or CFC/HCFC-containing equipment, which are being recovered by the Contractor.

- **Materials With RCRA-Metals Paint (Intact)**

It is anticipated that demolition debris with regulated paint that is intact (not peeling/chipping/flaking) will be removed as part of the demolition process and will be hauled away and disposed by the Contractor at an approved waste disposal site authorized by the appropriate designated regulatory agency for the state in which the site is located to accept construction and demolition waste.

- **Fluorescent Light Tubes**

Fluorescent light tubes may contain small amounts of mercury. This can potentially be harmful to human health and the environment. If fluorescent light tubes are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2. Care shall be taken by the Contractor to minimize breakage during removal and placement into containers.

- **Polychlorinated Biphenyls (PCBs)**

PCBs are a known carcinogenic material. Their use was discontinued January 1, 1979. It shall be assumed that light ballasts contain PCBs unless they are labeled as "PCB-free" by the manufacturer. If light ballasts are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2. The Contractor shall segregate and containerize PCB ballasts separate from non-PCB ballasts. PCB and non-PCB ballasts shall be properly disposed by EHS.

- **Smoke Detectors**

Ionization-type smoke detectors may contain a small amount of radioactive material. If smoke detectors are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2 and will be properly disposed by EHS.

- **Fire Alarm Strobe Lights**

Fire alarm strobe lights are typically not considered a universal or hazardous waste. If fire alarm strobe lights are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2. EHS will dispose of the strobe lights as E-waste.

- **Exit Signs and Emergency Lights**

These items typically have backup batteries that may contain small amounts of heavy metals. Certain exit signs are powered by a small amount of radioactive material. If exit signs and/or emergency lights are part of the scope of this project, they shall be managed by the default process set out in Section 1.1.2. The Contractor shall remove and containerize non-alkaline batteries for EHS to properly manage. The Contractor shall assume any non-powered exit signs to contain radioactive material and will containerize for University EHS to properly dispose.

- **Drinking Fountains**

Some drinking fountains have reservoirs that may contain lead and a CFC/HCFC refrigerant that must be recovered. If drinking fountains are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2. Any lead reservoirs shall be removed and containerized by the Contractor for recycling by EHS. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work and documented. The final disposition of reclaimed refrigerants will be determined between Owner and Contractor for each project. The remainder of the unit shall be managed as scrap by the Contractor.

- **Door Closers**

Some older door closer units have oil reservoirs for lubrication. These oils may contain small amounts of PCBs. If door closers are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2.

- **Thermostats**

Thermostats may contain elemental mercury, which can potentially be harmful to human health and the environment. If elemental mercury-containing thermostats are part of the scope of the project, they shall be managed by the default process set out in Section 1.1.2.

- **Window Air-Conditioning Units**

Where possible, these window units should be removed and offered to the Owner for use elsewhere. If directed by the Owner, they shall be discarded. These units may contain CFC/HCFC refrigerants that must be recovered. CFC/HCFC refrigerants are suspected to damage the atmosphere. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work and documented. The final disposition of reclaimed refrigerants will be determined between Owner and Contractor for each project. The remainder of the unit shall be discarded by the Contractor.

1.2 DEFINITIONS

1.2.1 ASBESTOS ABATEMENT

1. **Abatement** – Procedures to decrease or eliminate the source of fiber release from asbestos containing building materials. Includes encapsulation, enclosure, and removal.
2. **Adequately Wet** – To sufficiently mix or penetrate with liquid to prevent the release of particulate.
3. **Aggressive Air Sampling** – Sweeping of floors, ceilings and walls and other surfaces with the exhaust of a minimum of one (1) horsepower leaf blower or equivalent immediately prior to air monitoring.
4. **Approved Waste Disposal Site** – A solid waste disposal area that is authorized to receive

asbestos containing solid wastes by the appropriate designated regulatory agency for the state in which the site is located. (For Missouri, the agency is the Missouri Department of Natural Resources.)

5. **Asbestos** – Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered. (Additionally, it has been shown that vermiculite insulation is often contaminated with tremolite and may be managed as asbestos out of an abundance of caution.)
6. **Asbestos Abatement Supervisor** – An individual who directs, controls, or supervises others in asbestos abatement projects.
7. **Asbestos Containing Building Material (ACBM)** – Surfacing ACM, thermal system insulation ACM, or miscellaneous ACM that is found in or on interior structural members or other parts of a building.
8. **Asbestos Containing Material (ACM)** – Any material containing more than one percent (1%) asbestos by weight.
9. **Barrier** – Any surface that seals off the work area to inhibit the movement of asbestos fibers during abatement. Barrier may also refer to an engineering control to restrict unauthorized access to the work area.
10. **Category I Nonfriable ACM** – Asbestos-containing packings, gaskets, resilient floor covering and asphalt roofing products containing more than one percent (1%) asbestos as determined using the method specified in 40 CFR part 763, subpart F, Appendix A, section 1, Polarized Light Microscopy.
11. **Category II Nonfriable ACM** – Any material, excluding Category I Nonfriable ACM, containing more than one percent (1%) asbestos as determined using the methods specified in 40 CFR part 763, subpart F, Appendix A, section 1, Polarized Light Microscopy that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.
12. **Competent Person** – one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f). In addition, for Class I, II, III, and IV work, one who is specially trained in training courses, which meet the criteria of EPA's Model Accreditation Plan (40 CFR Part 763) for project designer or supervisor, or its equivalent.
13. **Containment** – Area where asbestos abatement project is conducted. Area must be enclosed either by a glove bag or plastic sheeting barrier. The process of sealing off and containing asbestos-contaminated areas to prevent the spread of asbestos fibers. This can include using enclosures, plastic sheeting, and decontamination systems.
14. **Contractor's Competent Person (Qualified Person)** – One who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32 (f). In addition, for Class I, II, III, and IV work, one who is specially trained in training courses which meet the criteria of EPA's Model Accreditation

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Plan (40 CFR Part 763) for project designer or supervisor, or its equivalent.

15. **Decontamination Area** – Enclosed area adjacent and connected to the regulated area which is used for decontamination of workers, materials, and equipment that are contaminated with asbestos. (See also Remote Decontamination Area)
16. **Demolition** – The wrecking or taking out of all material not being reused including any load bearing structural member of a facility together with any related handling operations.
17. **Disposal Bag** – A properly labeled six (6) mil thick leak-tight plastic bag used for transporting asbestos waste from work area to disposal site.
18. **Environmental Health & Safety (EHS)** – The University's contact for container(s) to collect universal wastes, hazardous building materials, and reclaimed/recycled materials. Select EHS staff who are properly trained and certified are also authorized to serve as Owner's Abatement Representatives to oversee abatement operations and enforcement of the specifications.
19. **Encapsulant (Sealant)** – A liquid material which can be applied to asbestos-containing material and which prevents the release of asbestos fibers from the material either by creating a membrane over the surface or by penetrating the material and binding its components together.
20. **Encapsulation** – Treatment of asbestos containing materials with an encapsulant.
21. **Enclosure** – The construction of an airtight, impermeable, permanent barrier around asbestos containing material to control the release of asbestos fibers into the air.
22. **Friable Asbestos Material** – Any material containing more than one percent (1%) asbestos as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763 Section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
23. **Glove Bag** – A manufactured or fabricated device, typically constructed of six (6) mil transparent polyethylene or polyvinyl chloride plastic. This device consists of two (2) inward projecting long sleeves, an internal tool pouch and an attached, labeled receptacle for asbestos waste.
24. **HEPA Vacuum Equipment** – High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining hazardous particulates. Filters should be of 99.97% efficiency for retaining particulates greater than 0.3 microns.
25. **Homogeneous Work Site** – Continuous areas with the same type of ACM and in which one type of abatement process is performed.

26. **Negative Initial Exposure Assessment** – An assessment by a "Competent Person" in which it is concluded that employee exposures during the job are likely to be consistently below the Permissible Exposure Levels; that non-friable asbestos will be removed and maintained in a non-friable condition.
27. **Outside Air** – Air outside of the containment.
28. **Owner's Air Monitoring Firm** – An entity who is not under the direct control of the asbestos abatement contractor and who has been selected by the Owner to conduct air monitoring. This may be a representative of University EHS or a contracted service provider working directly on behalf of the Owner.
29. **Owner's Air Sampling Professional** – An individual who holds a valid Air Sampling Professional certification from the State of Missouri (643.225 RSMo) and who is not under the direct control of the asbestos abatement contractor. The individual shall conduct, oversee, or be responsible for air monitoring of asbestos abatement projects before, during, and after the project has been completed. This may be a representative of MU EHS or a representative of a contracted service provider working directly on behalf of the Owner.
30. **Owner's Air Sampling Technician** – An individual who has been trained by, and is under the direct supervision of, the certified Owner's Air Sampling Professional and who has met requirements of training found in OSHA's 29 CFR 1926.1101 (643.225 RSMo) to do air monitoring before, during, and after the asbestos abatement project on behalf of the Owner's Air Monitoring Firm.
31. **Owner's Abatement Representative** – the University's representative responsible for air monitoring and enforcement of the technical specifications. The Owner's Abatement Representative may be either the University's Project Manager or a member of EHS who are adequately trained and hold a Missouri Asbestos Occupation Competent Person certification or are a Certified Industrial Hygienist.
32. **Personal Monitoring** – Sampling of the asbestos fiber concentrations within the breathing zone in a manner consistent with abatement operation regulations, i.e., sample 25% of each job description of the work force plus one peak (excursion) sample per shift.
33. **Regulated Asbestos Containing Material (RACM)** – Friable asbestos material; Category I nonfriable ACM that has become friable; Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading; Category II nonfriable ACM that has a high probability of becoming, or has become, crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.
34. **Remote Decontamination Area** – Enclosed or controlled area which is used for decontamination of workers performing Class I, II, or IV asbestos abatement activities. A designated space, often a mobile unit, located away from the immediate work area where workers can decontaminate themselves and their equipment after exposure to asbestos, typically when it's not feasible to have a decontamination area directly adjacent to the regulated abatement zone due to location or accessibility constraints; essentially a shower and change area situated at a distance from the asbestos removal site.

35. **Remove** – To take out RACM or facility components that contain or are covered with RACM from any facility.
36. **Renovation** – Altering a facility or one or more facility components in any way, including the stripping or removal of RACM from a facility component.
37. **Repair** – The restoration of asbestos material that has been damaged. Repair consists of the application of rewettable glass cloth, canvas, cement or other suitable material. It may also involve filling damaged areas with non-asbestos substitutes and re-encapsulating or painting previously encapsulated materials.
38. **Strip** – To take off RACM from any part of a facility or facility components.
39. **Waste Shipment Record** – The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos containing waste material.
40. **Wet Cleaning/Wiping** – The process of eliminating contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by, afterwards, properly disposing of these cleaning tools as necessary.
41. **Work Area** – A specific isolated area, other than the space enclosed within a glove bag, in which asbestos-containing materials is required to be handled. The area is designated as a work area from the time that the area is secured and access restrictions are in place. The area remains designated as a work area until the time that it has been cleaned in accordance with any requirements applicable to the operations conducted.

1.2.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

1. **Approved Waste Disposal Site** – A solid waste disposal area that is authorized to receive construction and demolition (C/D) wastes by the appropriate designated regulatory agency for the state in which the site is located. (For Missouri, the agency is the Missouri Department of Natural Resources.)
2. **Authorized Visitor** – The Owner, the Owner's Representative, or a representative of any regulatory or other agency having jurisdiction over the project and properly trained.
3. **Building Owner** – A designated representative of the University of Missouri.
4. **Disposal Container** – A properly labeled container for universal waste, hazardous building materials, reclaimed/recycled materials, or, potentially, any regulated paint debris. Disposal containers will be provided by EHS as part of the hazard remediation contractor's pre-work.
5. **Environmental Health & Safety (EHS)** – The University's contact for container(s) to collect universal wastes, hazardous building materials, and reclaimed/recycled materials. Select EHS staff who are appropriately trained and certified are also authorized to serve as Owner's Abatement Representatives to oversee abatement operations and enforcement of the specifications.

6. **Hazardous Building Material** – Materials such as PCB-containing waste or radioactive sources (smoke detectors, etc.), that are not considered Universal Waste, but that the Owner will rely upon a Hazardous Waste Shipment Record for documentation to support proper disposal.
7. **Hazardous Waste Shipment Record/Disposal Receipt** – The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of universal waste, hazardous wastes, and specific hazardous building materials.
8. **HEPA Vacuum Equipment** – High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining hazardous particulates. Filters should be of 99.97% efficiency for retaining particulates greater than 0.3 microns.
9. **Owner's Abatement Representative** – The University's representative responsible for monitoring and enforcement of the technical specifications. The Owner's Abatement Representative may be either the University's Project Manager or a member of EHS who are adequately trained and certified to serve as a technical expert regarding management of Universal Waste/Hazardous Building Materials.
10. **Universal Waste** – EPA's universal waste regulations streamline the hazardous waste management standards for certain categories of hazardous waste that are commonly generated by a wide variety of establishments. The streamlined regulations:
 - promote the collection and recycling of universal waste,
 - ease the regulatory burden on retail stores and other generators that wish to collect these wastes and transporters of these wastes, and
 - encourage the development of municipal and commercial programs to reduce the quantity of these wastes going to municipal solid waste landfills or combustors.
11. **Work Area** – A specific isolated area in which universal waste/hazardous building materials are required to be handled. The area is designated as a work area from the time that the area is secured and access restrictions are in place. The area remains designated as a work area until the time that it has been cleaned in accordance with any requirements applicable to the operations conducted.

1.3 CODES AND REGULATIONS

1.3.1 ASBESTOS ABATEMENT

General Applicability of Codes, Regulations and Standards - All applicable codes, regulations, standards, statutes, laws, and rules have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. Where conflicts arise, the most stringent specification shall apply.

Contractor Responsibility - The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state, and local regulations pertaining to work practices, hauling/disposal of regulated materials, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations. The Contractor shall hold the Owner harmless for failure to comply with any applicable work, hauling, disposal, safety, health, or other regulations on the part of the Contractor, Contractor's employees, or Contractor's

subcontractors.

Federal and State requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include, but are not limited to, the following:

1. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) including but not limited to:
 - 29 CFR 1910.1001 and 29 CFR 1926.1101.
 - Respiratory Protection, 29 CFR 1910.134.
 - Construction Industry, 29 CFR 1926.1101
 - Access to Employee Exposure and Medical Records, 29 CFR 1910.2.
 - Hazard Communication, 29 CFR 1910.1200.
 - Specifications for Accident Prevention Signs and Tags, 29 CFR 1910.145.
2. U.S. Environmental Protection Agency (EPA) including but not limited to:
 - National Emission Standards for Hazardous Air Pollutants (NESHAP) 40 CFR, Part 61, Subpart M.
3. U.S. Department of Transportation (DOT) including but not limited to:
 - 49 CFR, Part 172, Section 101.
4. State of Missouri including but not limited to:
 - Missouri Air Conservation Law Chapter 643. (643.225-643.250 RSMo)
 - Missouri Department of Natural Resources, Division 10, Chapter 6 of the Code of State Regulations as follows:
 - (1) 10 CSR 10-6.020, Definitions
 - (2) 10 CSR 10-6.080, Emission Standards for Hazardous Air Pollutants
 - (3) 10 CSR 10-6.230, Administrative Penalties
 - (4) 10 CSR 10-6.250, Asbestos Abatement Projects - Certification, Accreditation, and Business Exemption Requirements

1.3.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

All applicable codes, regulations, standards, statutes, laws, and rules have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. Where conflicts arise, the most stringent specification shall apply.

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Federal and State requirements which govern universal waste and hazardous waste removal work or hauling and disposal of such waste materials include, but are not limited to, the following:

1. U.S. Department of Labor, Occupational Health and Safety Administration (OSHA), 29 CFR 1910 and 29 CFR 1926.
 - Construction Industry - 29 CFR 1926.1101
 - Respiratory Protection – 29 CFR 1910.134
 - Hazard Communication – 29 CFR 1910.1200
 - Accident Prevention Signs – 29 CFR 1910.145
2. U.S. Environmental Protection Agency (EPA)
 - Resource Conservation and Recovery Act (RCRA), 40 CFR Parts 239-282 [Hazardous Waste includes Universal Waste]
 - Toxic Substances Control Act (TSCA), 40 CFR Parts 700-761
3. Missouri Department of Natural Resources
 - Hazardous Waste Management Law, Chapter 260, Sections 350-433, RSMo
 - 10 CSR 25, includes MO Universal Waste Rule (Pub 2058), Ch 16

1.4 NOTIFICATIONS (ASBESTOS ABATEMENT ONLY)

Notifications meeting the requirements of Missouri's Air Conservation Law shall be completed and sent by the Contractor not less than ten (10) days before the intended starting date of the project. Contractors with annual abatement notifications must provide at least twenty-four (24) hours notification before the intended starting date of the project. Send notification to:

MDNR/Air Pollution Control Program (Asbestos Unit)
P.O. Box 176
Jefferson City, Missouri 65102
573-751-4817 / 800-361-4827

Completed and signed notifications may be sent electronically to
asbestosnotifications@dnr.mo.gov

Provide a copy to the Owner's Abatement Representative. Five (5) day notification to the Owner's Abatement Representative is required on jobs less than the reportable quantity ("Courtesy Notifications").

If the project is also within the jurisdiction of the Kansas City Health Department's Air Quality Program, St. Louis County Health Department's Asbestos Program, St. Louis City's Division of Air Pollution Control, or the City of Springfield, send additional required notification directly to

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the appropriate local agency.

Kansas City Health Department, Air Quality Program
2400 Troost Ave., Suite 3000
Kansas City, MO 64108
816-513-6314

St. Louis County Health Department, Asbestos Program
6121 N Hanley Road
Berkeley, MO 63114
314-615-8924

St. Louis City, Division of Air Pollution Control
1520 Market St., Room 4051
St. Louis, MO 63103
314-657-1479

City of Springfield
290 E. Central Street
Springfield, MO 65802
417-864-2031

1.5 SUBMITTALS

1.5.1 ASBESTOS ABATEMENT

General Requirements The following will be submitted by Contractor, in electronic format or paper copy, a minimum of 10 days prior to commencement of work for approval by the Owner's Abatement Representative (EHS or Project Manager). Owner's Abatement Representative may provide comments that must be addressed before concurrence and, otherwise, will provide concurrence that documents received are acceptable:

- 1 One copy of Safety Data Sheets (SDS) for products to be used by the Contractor in the performance of his work. Contractor will also maintain copies of SDS's on site per OSHA.
- 2 One copy of the notifications to, or any correspondence with, the regulatory agencies.
- 3 Documentation that the regulatory authority has approved of the planned abatement.
- 4 Submit a listing of all prior regulatory violations.

1.5.1.1 Friable ACM Abatement Operations

In addition to the **General Requirements**, submit the following:

- 1 A summary of project personnel, job titles, and contact phone numbers.

- 2 Name, address, and contact person's name of testing laboratory or laboratories to be utilized analyzing samples for bulk analysis or air samples. The laboratory(ies) must be certified through the National Voluntary Laboratory Accreditation Program (NVLAP).
- 3 A detailed plan of the procedures proposed for use in complying with requirements of this specification, the Missouri Air Conservation Law, and 29 CFR 1926.1101. Include in the plan the layout and location of barriers, decontamination units, routes of ingress and egress for work area, methods used to assure safety of building occupants and visitors, methods used to isolate or closing out of HVAC system, personal air monitoring strategy, method of removal of material, and engineering controls utilized to prevent emissions from the work area.
- 4 A disposal plan to detail type of disposal container, method of transportation to disposal site, waste hauler, and disposal site.
- 5 Copy of the Emergency Protection Plan that includes notifications.

1.5.1.2 Non-Friable ACM Abatement Operations

In addition to the **General Requirements**, submit the following:

- 1 A summary of project personnel, job titles, and contact phone numbers.
- 2 A detailed plan of the procedures proposed to minimize emissions and to prevent the material from becoming friable during removal.
- 3 Copy of the Emergency Protection Plan that includes notifications (to be used if the nonfriable material should become friable during removal).
- 4 One copy of the Negative Initial Exposure Assessment.

1.5.1.3 Post-Abatement

Upon completion of the abatement work, the Contractor shall provide the following information to the Owner's Abatement Representative within 10 working days.

- Waste disposal receipts and waste shipment records on all asbestos waste removed from the project.

Upon completion of the abatement work, the Owner shall provide the following information to the Contractor.

- Air sampling test results of final clearance air samples taken under the supervision of Owner's Air Sampling Professional will be provided to both the Contractor and the Project Manager by EHS. Results must be in written report form. Electronic transmittal is acceptable.
- Written certification from the Project Manager that abatement is complete. Electronic transmittal is acceptable.

1.5.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

1.5.2.1 Pre-Removal

General Requirements The following will be submitted by Contractor 10 days prior to commencement of work for approval by the Owner's Abatement Representative (EHS or Project Manager). Owner's Abatement Representative may provide comments that must be addressed before concurrence or, otherwise, will provide concurrence that documents received are acceptable:

1. One copy of any Safety Data Sheets (SDS) for products to be used by the Contractor in the performance of his work. Contractor will also maintain copies of SDS's on site per OSHA.
2. A list of project personnel and contact phone numbers.
3. A detailed plan of the procedures proposed for use in complying with requirements of this specification. Include in the plan the layout and location of work areas, routes of ingress and egress for the work areas, methods to be used to assure safety of building occupants and visitors, method(s) of removal of material, and disposal container requirements for the wastes anticipated to be removed for disposal lead based paint waste to be disposed.
4. Proposed disposal site for any materials that EHS will not be directly managing disposal for, including a disposal plan to detail type of disposal container, method of transportation to disposal site, and waste hauler.
5. Any other submittals as required by Owner.

1.5.2.2 Post-Removal

Upon completion of universal waste/hazardous building materials removal operations, the Contractor shall submit to the Owner's Abatement Representative, copies of all shipping records, disposal receipts, recycling documentation, etc., for all materials removed from the project site by Contractor for disposal.

Upon completion of the universal waste/hazardous building materials removal operations, the Owner's Representative will provide written certification to the Contractor that all applicable universal waste/hazardous building materials wastes have been removed from the facility. Electronic transmittal is acceptable.

PART 2 – PRODUCTS

2.1 MATERIALS

All materials shall be delivered in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.

Contractor shall store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.

Damaged or deteriorating materials shall not be used and shall be removed from the premises.

Contractor shall provide suitable materials for asbestos abatement and universal waste/hazardous building materials removal operations including, but not limited to:

Plastic Sheeting: A minimum 6-mil (or as specified).

Tape: Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheets to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water, duct tape, poly prep tapes or approved equal.

Adhesives: Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water. Adhesives will not be used on any property without prior written approval from the Owner's Abatement Representative (EHS or Project Manager)

Impermeable Containers: Suitable to receive and retain any universal waste/hazardous building materials until disposal by the Owner's Abatement Representative (EHS). The containers shall be labeled as required by Owner. Containers must be resistant to damage and rupture.

Warning Labels and Signage: As required by law and/or Owner.

Other Materials: Provide all other materials, such as, but not limited to, lumber, plywood, nails, and hardware, which may be required to properly prepare and complete this project.

2.2 TOOLS AND EQUIPMENT

Provide suitable tools for asbestos abatement and universal waste/hazardous building material removal operations including, but not limited to:

Water Sprayer: Airless or a low pressure sprayer for amended water application as applicable.

Air-Purifying Equipment: High Efficiency Particulate Air Filtration Systems (HEPA) shall comply with ANSI Z9.2-91. No air movement system or air equipment should discharge particulates outside the work area. Thus, the negative air unit shall be equipped with a three filter bank with the last being the HEPA filter capable of removing 99.97% of fibers/particulates >0.3 microns.

Scaffolding: As required to accomplish the specified work and meet all applicable safety regulations.

Vacuums: Use HEPA type from a known manufacturer.

Other tools and equipment as necessary.

PART 3 – EXECUTION

3.1 SUPERVISION

3.1.1 ASBESTOS ABATEMENT

The Contractor shall designate a competent Supervisor subject to the approval of the Owner's Abatement Representative. The Supervisor shall be the Contractor's representative on the project, shall meet the requirements of all applicable laws and regulations, and meet/perform the following tasks, at a minimum:

1. Be certified by the State of Missouri as an Asbestos Abatement Supervisor, have a minimum of one year prior full time experience in asbestos abatement work, a minimum of two years' experience as a supervisor, and be qualified as a Competent Person in accordance with OSHA regulation 1926.1101.
2. Be on-site and supervise all abatement work in accordance with all applicable laws and regulations.
3. Conduct all OSHA-required personal exposure air monitoring during abatement operations.
4. Maintain a daily log on the project documenting events, visitations, problems, equipment failures, accidents, and inspections.
5. Be responsible for implementation of first aid, safety training, respiratory protection, and ensuring all workers are trained in emergency procedures.
6. Be responsible for conducting a visual inspection of the work area prior to a visual inspection by the Owner's Abatement Representative. Inspection shall be documented.

3.1.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

The Contractor shall designate a competent Supervisor subject to the approval of the Owner's Abatement Representative. The Supervisor shall be the Contractor's representative on the project, shall meet the requirements of all applicable laws and regulations, and meet/perform the following tasks, at a minimum:

1. Be knowledgeable in all aspects of removal, cleanup, and proper handling of universal waste/hazardous building materials as listed in the Scope of Work.
2. Be on-site and supervise all removal, cleanup and handling of universal waste/hazardous building materials as listed in the Scope of Work.
3. Maintain a daily log on the project documenting events, violations, problems, equipment failures, accidents, and inspections.
4. Be responsible for implementation of first aid, safety training, respiratory protection, and ensuring all workers are trained in emergency procedures.
5. Be responsible for conducting a visual inspection of the work area prior to a visual inspection by the Owner's Abatement Representative. Inspection shall be documented.

3.2 NEGATIVE INITIAL EXPOSURE ASSESSMENT (ASBESTOS ABATEMENT ONLY)

When not starting removal with Type C protection, the Contractor must conduct a Negative Initial Exposure Assessment (non-friable asbestos) prior to removal of the asbestos material. The Negative Initial Exposure Assessment shall be performed by a "Competent Person" to determine whether the material may be removed and maintained in a non-friable condition. If the material cannot be removed without becoming friable then the Contractor shall comply with all legal and regulatory requirements for managing friable asbestos at no additional cost to the Owner.

The method of removal is the Contractor's option. However, in the event of any of the following:

1. Visible emissions are observed
2. Sanding, grinding, cutting, or abrading of the material
3. Air samples exceed 0.1 f/cc (fibers per cubic centimeter)

The Contractor shall immediately stop work, implement corrective work practices, make any necessary notifications to all regulatory agencies of the changes in work practices and material conditions, and comply with the requirements as set forth in this specification.

3.3 WORKER PROTECTION & TRAINING

3.3.1 ASBESTOS ABATEMENT

1. The Contractor shall be responsible for providing their employees with proper respiratory protection, respiratory training, a written respiratory program, medical monitoring program (medical examinations, maintaining medical records), and protective clothing and equipment to comply with OSHA requirements.
2. The Contractor shall be responsible for all testing and costs incurred for complying with requirements of OSHA regulations for Personal Air Sampling.
3. All workers shall be trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and protective measures.
4. All workers shall be certified as accredited Asbestos Abatement Workers as required by 10 CSR 10-6.250.

3.3.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

1. The Contractor shall be responsible for providing their employees with proper respiratory protection, respiratory training, a written respiratory program, medical examinations, maintaining medical records, protective clothing and equipment to comply with OSHA requirements, if applicable and necessary.
2. All workers shall be trained in the dangers inherent in handling universal waste/hazardous building materials, in proper work procedures, and personal protective measures.

3. Prior to commencement of work, the workers shall be instructed and shall be knowledgeable on the hazards of the universal waste/hazardous building materials involved and other environmental exposures, use and fitting of respirators, protective clothing, decontamination procedures, and all aspects of removal work procedures.
4. The Contractor acknowledges that he alone is responsible for enforcing personnel protection requirements and that these specifications provide only a minimum acceptable standard for each phase of operation.
5. If required or requested of the workers, provide workers with personally issued and marked respiratory equipment approved by NIOSH and accepted by OSHA.
6. Where required or if requested by the workers, provide workers with sufficient sets of disposable protective full-body clothing. Such clothing shall consist of full-body coveralls, footwear, and head gear, one-piece coveralls or equal. Provide eye protection and hard hats as required by applicable safety regulations. Disposable clothing shall not be allowed to accumulate and shall be disposed of as contaminated waste.
7. No visitors shall be allowed in work areas, except as authorized.
8. Provide authorized visitors with suitable protective clothing, headgear, footwear, and gloves as described above whenever they are required to enter the work area.

3.4 INDEPENDENT TESTING LABORATORY (ASBESTOS ABATEMENT ONLY)

Testing laboratories utilized by the Contractor for sample analysis during the project shall meet the following minimum requirements and be approved by the Owner's Abatement Representative. This information shall be submitted to the Owner's Abatement Representative for review.

1. All air monitoring samples shall be analyzed by a testing laboratory accredited by the American Industrial Hygiene Association (AIHA) or by an individual who is currently on the Asbestos Analyst Registry.
2. All bulk samples shall be analyzed by a testing laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

3.4.1 ASBESTOS BULK SAMPLE ANALYTICAL METHODS

3.4.1.1 Friable Materials:

Asbestos Analysis of Bulk Materials via AHERA Method 40 CFR 763, Subpart E, Appendix E supplemented with EPA 600/R-93/116 (Calibrated Visual Estimate, reporting limit to <1%) using Polarized Light Microscopy

3.4.1.2 Non-Friable (caulking):

Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 (Calibrated Visual Estimate, reporting limit to <1%) using Polarized Light Microscopy

3.4.1.3 Non-Friable (mastics, adhesives):

Asbestos Analysis of Non-Friable Organic Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 (Calibrated Visual Estimate, reporting limit to <1%) using Polarized Light Microscopy

3.4.1.4 Non-Friable (vinyl floor tile):

Asbestos Analysis of Non-Friable Organically Bound Materials by TEM via EPA/600/R-93/116 Section 2.5.5.1 (target reporting limit 0.5%) with Gravimetric Reduction)

3.4.2 ASBESTOS AIR MONITORING ANALYTICAL METHODS

3.4.2.1 PCM – Air:

Use NIOSH 7400

3.4.2.2 PCM – Air That Fails:

Using NIOSH 7400. Reclean area and retest. If area fails a third time, contact EHS for further instructions. Possible retesting using AHERA (40 CFR Part 763 Appx. A subpart E) or NIOSH 7402

3.5 OWNER'S REMEDIATION PROFESSIONAL

3.5.1 ASBESTOS ABATEMENT

It will be the Owner's responsibility to provide and/or hire an Air Sampling Professional. The Owner's Air Sampling Professional for this project shall be **[specify either provided by EHS staff or a contracted service working on Owner's behalf, if applicable or "Not Applicable"]**. The Owner's Air Sampling Professional will be required to perform the following duties at a minimum:

1. Approval of the Contractor's work plan and methods of ACM abatement to meet regulatory requirements and ensure the health and safety of University faculty, staff, and students.
2. Visual inspection of the work area and final clearance air monitoring.
3. Issue final air clearance to the Contractor and the University Project Manager.

3.5.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

It will be the Owner's responsibility to provide and/or hire a Specialist certified, trained, and knowledgeable in handling and managing universal waste/hazardous building materials. The Specialist for this project shall be **[specify either provided by EHS staff or a contracted service working on Owner's behalf, if applicable or "Not Applicable"]**. The Specialist will be required to perform the following duties as a minimum:

1. Approval of the Contractor's work plan and methods of remediation to meet regulatory requirements and ensure the health and safety of University faculty, staff, and students.

2. Verify that the Contractor is satisfactorily performing the work in accordance with OSHA regulations.
3. Visual inspection of the work areas.

3.6 SEPARATION OF WORK AREAS FROM NON-WORK AREAS

In addition to other physical barriers/controls required to isolate work areas and prevent unauthorized access/entry, universal waste/hazardous building materials removal operations work areas shall integrate visual separation. Visual separation shall be accomplished at all "see-through" locations using opaque polyethylene. This separation shall not be incorporated within the other seals involved on this project.

3.7 EMERGENCY PROTECTION PLAN

1. The Contractor shall be responsible for developing a written Emergency Protection Plan and shall maintain this plan on site. The plan shall include considerations of asbestos and/or universal waste/hazardous building material releases, fire, explosion, toxic atmospheres, electrical hazards, slips, falls, and heat related injuries. All employees shall be instructed and trained in the procedures.
2. The Emergency Protection Plan shall include written notification procedures for police, fire and medical personnel of the planned abatement activities, work schedule, and layout of work area, particularly barriers that may affect response capabilities.
3. The Contractor shall designate and maintain emergency and fire exits from the work area(s) in accordance with local codes and regulations. All exits shall be clearly marked with fluorescent tape or red paint and shall be clearly visible from any part of the work area.

3.8 LOCAL AREA PROTECTION & SITE SECURITY

1. The Contractor shall be responsible for all areas of the building used by them and/or subcontractors in the performance of the work. Contractor shall exert full control over the actions of all its employees and other persons with respect to the use and preservation of the existing building, except such controls as may be specifically reserved to the Owner.
2. Contractor shall secure the work areas to make sure of no inadvertent entry. Any breach to the exterior of the building shall be secured by the Contractor. The Contractor shall be responsible for maintaining security of the remediation area throughout the contract period.
3. Contractor has the right to exclude from the work area all persons who have no purpose related to the work or its inspection and shall require all persons in the work area to observe the same regulations required of Contractor's employees.
4. The Contractor shall have control of site security during abatement operations in order to protect work environment and equipment. Contractor shall have the Owner's assistance in notifying building occupants of impending activity and enforcement of restricted access by Owner's employees.

5. The Contractor shall keep a minimum of two 10 lb., Type-ABC fire extinguishers on-site. One shall be maintained outside the work area and one inside the work area. Contractor's employees shall be trained in the operation of extinguishers.
6. Where remediation areas cannot be isolated by existing walls and doors from University employees, students, or the public, barriers must be constructed of 1/2" plywood sheeting over 2"x4", 16" on-center framing to isolate the area. The barriers must be installed in a manner to prevent damage to existing walls, floors, or ceilings. Barrier(s) may have a lockable door.
7. The Contractor shall maintain the work area free from rubbish, debris, and dirt and keep a clean, safe working area.
8. The Contractor shall provide warning signage around the regulated remediation area as required by OSHA. Owner reserves the authority to require additional signage, if it is deemed appropriate.
9. If applicable, the Contractor shall isolate any and all air supply and returns to the abatement space as required by OSHA. Contractor shall coordinate these efforts with the Owner's Abatement Representative.
10. If applicable, the Contractor shall keep all areas where adhesive stripper is in use (such as mastic removal) under negative pressure and exhausted to the outside ambient air.

3.9 FINAL CLEARANCE REQUIREMENTS (FRIABLE ASBESTOS ABATEMENT ONLY)

1. Upon completion of the abatement work, the Contractor's Asbestos Abatement Supervisor shall perform a visual inspection of the work area. If satisfactory, the Supervisor shall then request the Owner's Abatement Representative and/or Air Sampling Professional to perform a visual inspection. When the Owner's Abatement Representative and/or Air Sampling Professional deems the area is ready based on the results of their visual inspection, the Contractor shall apply a lockdown encapsulant. Following application of lockdown encapsulant, the Owner's Air Sampling Professional shall perform the final clearance sampling for airborne fiber concentrations.
2. The Owner's Air Sampling Professional will perform final clearance testing per the following requirements:
 - Aggressive sampling shall be required for all areas where removal has taken place with the exception of glove bag projects where nonaggressive sampling is permitted.
 - Phase contrast microscopy (PCM) samples analyzed on-site shall be counted by an accredited registered microscopist.
 - For areas specifically designated for clearance by Transmission Electron Microscopy, the method shall be NIOSH 7402.
3. Any work areas failing to meet the clearance requirements of this section shall be recleaned and retested at the Contractor's expense until satisfactory levels are obtained.

4. The Owner's Abatement Representative and/or Air Sampling Professional shall provide a written report of the air monitoring activities to the Contractor within seven (7) days after the final clearance testing. Electronic transmittal is acceptable.

3.10 REESTABLISHMENT OF THE WORK AREA AND SYSTEMS

3.10.1 ASBESTOS ABATEMENT

1. Reestablishment of the work area shall only occur after the Contractor has received final clearance in writing from the Owner's Abatement Representative. Electronic transmission is acceptable.
2. Any damages to finishes, equipment, and/or the area affected by the abatement shall be repaired by the Contractor to equal or better condition as it was prior to the work, at no cost to the Owner.

3.10.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS REMOVAL

1. Reestablishment of the work area shall only occur after the Contractor has received a final visual inspection from the Owner's Abatement Representative documenting that the universal waste/hazardous building materials have been removed from the project site.

3.11 WASTE DISPOSAL

3.11.1 ASBESTOS

1. All asbestos-containing waste and/or asbestos-contaminated debris shall, at a minimum, be adequately wet, double bagged in approved 6-mil polyethylene leakproof disposal bags or containers. Each bag or container shall be tagged to meet requirements of NESHAP with an asbestos caution label and a source identification label.
2. Transportation shall meet the requirements of all regulatory agencies for asbestos containing materials and shall be transported in an enclosed truck.
3. The waste disposal site shall be approved by the designated regulatory agency for the state in which the site is located (Missouri Department of Natural Resources in Missouri) for asbestos disposal. A chain-of-custody letter/waste shipment record and disposal receipts shall be provided to the Owner for all ACM and contaminated debris disposed.

3.11.2 UNIVERSAL WASTE/HAZARDOUS BUILDING MATERIALS

1. University EHS shall assume responsibility for the proper disposal of all universal waste/hazardous building materials being removed on behalf of the Owner as a part of this Scope of Work. As the Generator of the waste, EHS will document and maintain records on the transportation and fate of universal waste/hazardous building materials disposed on behalf of the University.
2. The fate of recyclable materials and recovered refrigerants will be identified prior to work beginning.

3.12 DRAWINGS

1. Drawings, when provided, are not intended to be used for anything but a "reference" to the work area. Information is not specific to quantities or to exact location of ACM and/or universal waste/hazardous building materials unless explicitly noted. Contractor will be required to field verify the conditions and quantities.

3.13 REPORTS

1. Reports, when provided, are intended to be used as a basis for the type and composition of the asbestos and/or universal waste/hazardous building materials present for both bidding purposes and for the information required for the notifications to the governing agencies.

Division 03

Concrete

University of Missouri – General Site

Steam and Water Line Replacement, Stephens and Lefevre Halls

Division 03

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete for exterior work, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. Concrete Testing Service: Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials of the same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150 Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.4 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.9 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data or both according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 20 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete as required for placement and workability.
- D. Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: As required by prints at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50 – footings; 0.45 – all other mixes
 - 3. Slump Limit: Four (4) inches (125 mm) or eight (8) inches (200 mm for concrete) with verified slump of two (2) to four (4) inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus one (1) inch (25 mm).
 - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3%.
 - 5. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
 - a. Add water vapor reducing admixture per manufacturer's specified dosage rate to ready mix truck at the batch plant or jobsite before discharge and mix rapidly for seven (7) minutes. (Follow manufacturer's instructions).

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. 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.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

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 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints six (6) inches (150 mm) and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations as indicated.
- E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.6 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. Deposit concrete continuously in one (1) 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.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.

- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two (2) high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm) at the gymnasium floor and 1/4" (6.4mm) at all other locations.

3.9 CONCRETE PROTECTING AND CURING

- A. General: 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.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- C. Cure concrete according to ACI 308.1, by one (1) or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Cure for not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound

manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor shall engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION

SECTION 034100
PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Precast structural concrete.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
B. Design Mixtures: For each precast concrete mixture.
C. Shop Drawings:
1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Material certificates.
B. Material Test Reports: For aggregates.
C. Source quality control reports.
D. Field quality control and special inspection reports.

1.5 QUALITY ASSURANCE

- A. Quality Control Standard: For manufacturing procedures, testing requirements, and quality control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

1.6 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: MMFX deformed.

- B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
- 2.3 CONCRETE MATERIALS
- A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.
 - B. Normal-Weight Aggregates: Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
 - D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
- 2.4 BEARING PADS
- A. Provide bearing pads for precast structural concrete units to level and properly support panels.
- 2.5 GROUT MATERIALS
- A. Nonmetallic, Non-shrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
 - B. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.
- 2.6 CONCRETE MIXTURES
- A. Prepare design mixtures for each type of precast concrete required.
 - B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
 - C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C1218.
 - D. Normal-Weight Concrete Mixtures: Proportion **full-depth mixture** by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - E. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
 - F. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.
- 2.7 FABRICATION
- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during

pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

- B. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
- C. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- D. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- E. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
- F. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
- G. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

2.8 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 2. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

3.2 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

- C. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.4 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

END OF SECTION

Division 26

Electrical

University of Missouri – General Site

Steam and Water Line Replacement, Stephens and Lefevre Halls

Division 26

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SECTION 26 05 19
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

1.1 GENERAL

- A. The scope of this document is to provide requirements for low voltage (600 volts and below) electrical power conductors and cables.

1.2 DESIGN GUIDELINES

- A. All conductors shall be copper.
- B. Dedicated neutral conductors shall be used for all single-phase loads unless approved in writing by the Project Manager.
- C. All neutral conductors will be a minimum of full size. Designer will evaluate the need for oversized neutral conductors.
- D. Circuits that are dedicated to power pre-wired equipment such as office furniture partitions that require multiple branch circuits may use shared neutrals if the following conditions are met:
1. Line to neutral voltage is 120 volts (nominal).
 2. The neutral conductor is oversized (#10 AWG minimum for a 20-amp circuit).
 3. The pre-wired equipment has oversized neutral conductors (#10 AWG minimum for a 20-amp circuit).
- E. Minimum Conductor size is #12 AWG.
- F. Minimum Insulation rating is 90°C.
- G. Conductor Rating:
1. For 100 amps and below: Conductor shall be rated per the 60°C table.
 2. For over 100 amps: Conductor shall be rated per the 75°C table.
- H. MC Cable is allowed in the following locations for 20-amp circuits:
1. In dry locations.
 2. Above ceiling suspended ceilings.
 3. In walls with cavities between and through structural members.
 4. In cable trays.
 5. Lighting fixture whips.
- I. MC Cable shall not be permitted in the following locations:
1. MU Health Care Facilities, except as instructed in the MUHC Planning, Design and Construction Guidelines (see [Appendix for UM Health Care Facilities](#)).
 2. Where subject to physical damage.
 3. In damp and wet locations.
 4. Underground.
 5. In masonry or concrete walls.
 6. Where exposed to corrosive fumes or vapors.
 7. Embedded in plaster finish.
 8. Sleeved through conduits.
 9. Where exposed to physical touch and visual sight.
 - a. Exceptions:
 - 1) Mechanical and electrical rooms above 7'.
 - 2) Drops to suspended lighting when painted to match ceiling above.
- J. MC Cable installation requirements are as follows:
1. Installed per NFPA 70.
 2. Installed with listed fittings permissible by the manufacturer.
 3. Homeruns from power source to areas served shall be prohibited.
 - a. Conduits shall be run from the source of power to an accessible space above ceiling J- box, receptacle, switch, or other device within room or area

- to be served.
- b. MC lengths shall be limited to 50'.
- 4. Anti-short bushings to be used at terminations.
- 5. Cable with 0–10-volt conductors is permissible for lighting.
- 6. Lighting is allowed to be daisy chained with full sized MC cable.
 - a. No more than two (2) MC cables terminated per light fixture.

1.3 NOT PERMITTED

- A. No aluminum conductors shall be used.
- B. Pre-wired systems such as type AC (armored cable) and type NM (nonmetallic-sheathed cable) shall not be used.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors and connectors for grounding and bonding.
- C. Ground rod electrodes.
- D. Ground access wells.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.
 - 2. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 780 – Standard for the Installation of Lightning Protection Systems.
- C. National Electrical Contractors Association (NECA):
 - 1. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA GR 1 – Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.
- E. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal building frame.
 - 2. Rod electrode.
 - 3. Grounding conductors.
 - 4. Building concrete reinforcing steel.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, fittings, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where grounding conductor size is not specified, size shall comply with NFPA 70 but be no less than minimum sizes specified.

1.4 ACTION SUBMITTALS

- A. Product data: Submit data on grounding electrodes and connections.

1. Grounding bushings.
2. Grounding conductors.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's installation instructions.
- B. Field quality control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Project record documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemicals, and mechanical damage by storing in original packaging.

1.9 COORDINATION

- A. Complete installation, grounding, and bonding of reinforcing steel prior to concrete placement.
- B. Verify exact locations of underground metal water service pipe entrances into building.
- C. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements of concrete encased electrode.
- D. Do not install ground rod electrodes until final backfill and compaction is completed.

PART 2 PRODUCTS

2.1 BONDING AND EQUIPMENT GROUNDING

- A. Provide bonding for equipment grounding conductors, equipment grounding busses, metal equipment enclosures, raceway and boxes, and equipment grounding terminals.
- B. Provide insulated equipment grounding conductor with all power cables raceways. Use of raceways as sole grounding path is prohibited.
- C. Provide bonding for metal building structural steel and frames.
- D. Provide products listed and labeled as suitable for the intended purpose and installation location.

2.2 WIRE

- A. In ductbank: #4/OAWG, 600V, THWN green insulated, Class B stranded bare copper conductor.

- B. In electrical vaults: #4/0 AWG bare Class B stranded copper conductor.
- C. Grounding bushing bonding: #6AWG bare Class B stranded copper conductor.
- D. Direct buried material: #4/0AWG, Class B stranded bare copper unless noted otherwise.
- E. Grounding conductor shall be identified by the use of a spirally applied set of two (2) orange stripes over the green conductor insulation. Each orange stripe shall be 1/16 inch minimum width.

2.3 ROD ELECTRODES

- A. Product description:
 - 1. Material: Copper-bonded steel.
 - 2. Diameter: 3/4".
 - 3. Length: ten (10) feet.
- B. Connector: Use exothermic weld connections between conductors and ground rods.
- C. NEMA GR 1 compliant.

2.4 MECHANICAL CONNECTORS

- A. Provide grounding bushings at the base of RGS conduits as they enter the electrical vaults. Provide grounding bushings on every conduit and bond the grounding bushings to the vault grounding conductor loop.
- B. All other connections shall be by exothermic weld.
- C. Grounding bushings shall be UL listed for the intended installation and shall be capable of being installed behind the end bells.

2.5 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Burndy.
 - 2. ERICO.
- B. Product description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
- C. Provide required materials and accessories to make the following grounding conductor connections:
 - 1. Connections to existing vault grounding loops.
 - 2. Connections to ground rods.
 - 3. Connections to reinforcing steel.
- D. Provide exothermic dies in sizes and shapes as recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction have been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142 and NECA 1.
- B. Grounding Electrode:
 1. Metal underground water pipes: Provide connection to underground domestic, chilled water, and fire protection water service pipes that are in contact with earth for at least 15 feet at a readily accessible location within 5' of entering the building.
 2. Concrete encased electrode: Connect to concrete encased electrode consisting of no less than 20 feet of either steel reinforcing bars or copper conductor no smaller than #4/0AWG that's embedded in the concrete foundation or has footing in contact with earth.
 3. Grounding Ring: Provide a ground ring encircling the building structure consisting of bare copper conductor no less than #4/0AWG in contact with earth and installed at a depth of no less than 30" of finished grade.
 4. Ground rod electrodes: Provide three (3) electrodes in an equilateral triangle no less than 10' apart from one another and any other grounding electrode.
 5. Ground bar: Provide a grounding bar separate from the service entrance enclosure for a common point of connection for the grounding electrode system jumpers. Bar shall be ¼" thick, 2" wide, 18" long unless otherwise specified.
 6. Ground Rod Electrodes: Install ground rod electrodes vertically.
- C. Install grounding and bonding conductors so they're concealed from damage and out of the way. Equipment grounding and bonding conductors shall be routed in dedicated Schedule 80 PVC conduit to protect from damage.
- D. Perform tests and inspections listed in NETA ATS, Section 7.13. Perform ground resistance tests during dry conditions, where there has been no precipitation in the previous five (5) full calendar days.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

- 1.1 The scope of this document is to provide requirements for low voltage (600 volts and below) electrical power raceway and boxes.

PART 2 DESIGN GUIDELINES

- 2.1 All conductors shall be installed in a raceway system within the room or area served by the conductors. From the termination point of said raceway system, MC cable may be allowed for 20-amp circuits with a maximum length under 50 ft. for the room or area served by the raceway system. Refer to "26 05 19 Low Voltage Electrical Power Conductors and Cables" of the UM CPDGs for all requirements regarding use of MC cable.
- 2.2 Indoor raceway shall be EMT, Rigid Metal Conduit, or approved surface raceway.
- 2.3 Schedule 80 PVC conduit will be utilized anywhere underground conduit emerges from concrete.
- 2.4 Rigid metal conduit or Schedule 80 PVC conduit shall be used for exterior locations. Expansion shall be considered for all exterior conduit.
- 2.5 Elbows for rigid metal conduit three (3) inches and larger shall be either plastic coated or tape coated (for corrosion control) rigid metal conduit to prevent damage from pulling ropes. Rigid metal conduit shall be used for at least the first five (5) feet of horizontal run out from the building to allow for building settling over time.
- 2.6 EMT will not be used outdoors, in wet/damp locations, or in floor crawl spaces. Exposed EMT will also not be allowed below seven (7) feet AFF in areas where raceway may receive physical abuse (such as hallways, mechanical rooms, storage rooms, and janitor closets) unless the conduit is 2" or larger in diameter.
- 2.7 Garages and similar areas shall be considered a wet location. Electrical rooms in a garage shall be considered a wet location. All panels and electrical devices shall be installed on Unistrut in electrical rooms in garages.
- 2.8 Conduit will be supported from the building structure. Attachment to other pipes, conduits, ductwork, etc. will not be allowed.
- 2.9 No conduit will be allowed to be embedded in a concrete slab. All conduits below a slab shall be a minimum of 12" below the concrete slab.
- 2.10 All empty conduits shall contain a pull string.
- 2.11 Non-metallic conduit or boxes will not be used unless approved in writing by the Project Manager prior to construction. In cases where they are used, conduit 2" and smaller will be a minimum of Schedule 80.
- 2.12 PVC Conduit will be used for underground electric circuits less than 600 volts that are:
- A. Under paved areas and areas scheduled to be paved.
 - B. Next to permanent buildings, under formal planting beds, and in extremely high traffic (vehicular and pedestrian) areas that would be difficult to excavate due to regular heavy use.
 - C. All other applications 277 volt or less may be direct buried if approved by the Project Manager.
 - 1. If direct buried, 24 inches of cover is required unless approved by the Project Manager.

- D. A red plastic tracer tape is to be buried 12" above the cable or conduit in all installations.
- 2.13 PVC conduit shall be a Schedule 80 minimum weight unless otherwise indicated and shall be designed for the electric application with all connections solvent welded.
- 2.14 All metallic fittings will be compression type rated for ground connection.
- 2.15 All exposed conduit installed in a finished space will be painted to match the background.
- 2.16 Conductors carrying more than 150V to ground will not be installed in conduits with conductors carrying less than 150V to ground.
- 2.17 Feeders:
- A. All feeders will have a separate copper grounding conductor installed. In no case will the conduit or raceway be used as the grounding conductor. However, all metallic raceway shall be electrically continuous and bonded to the grounding conductor.
- B. All conduit sizes and conductor numbers and sizes will be shown on the Drawings.
- C. Conduit shall be sized at least one (1) size above the NEC requirement of wire being installed or anticipated to be installed, with the minimum size to be 1".
- 2.18 Branch Circuits:
- A. A separate grounding conductor will be installed. Use of the conduit or raceway is not an acceptable grounding method. However, all metallic raceway shall be electrically continuous and bonded to the grounding conductor.
- B. For Branch circuits, the minimum conduit size will be $\frac{3}{4}$ " except for switch legs, lighting whips (supplying a single fixture circuit), and control wiring which may be $\frac{1}{2}$ ".

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

1.1 GENERAL

- A. The scope of this document is to provide requirements for Identification for Electrical Systems.

1.2 DESIGN GUIDELINES

- A. Electrical equipment shall be identified with permanent engraved nameplates.
- B. All switchboards, panelboards, motor control centers, motor starters, and equipment local disconnects shall be identified with an engraved nameplate.
- C. All overcurrent protective devices installed in electrical service entrance panels, switchboards, and power panel shall have individual engraved nameplate indicating the load they feed. Lighting panels shall also have an engraved nameplate indicating which panel it is served from.
- D. Lighting panels shall have index cards neatly typed with “as built” branch circuit information. The index card holder should be metal construction permanently attached to the panel door.
- E. Nameplates:
1. Nameplates shall be engraved three-layer laminated plastic. Nameplates used for identification shall be white background with black lettering. Nameplates used for warnings shall be red background with white lettering.
2. Lettering should be ¼ inch high for identifying grouped equipment and loads. Lettering should be 1/8 inch high for identifying individual equipment and loads.
- F. Fire Alarm Raceways:
1. All exposed conduit used for fire alarm systems shall be colored red.
2. All covers for wiring boxes used for fire alarm systems shall be colored red and labeled “Fire Alarm” using a nameplate as described above.
- G. Color code secondary service, feeder, and branch circuit conductors with factory-applied heat shrunk (no cold applied) color as follows:

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	White or Gray
Green	Ground	Green

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SECTION 26 27 26
WIRING DEVICES

1.1 GENERAL

- A. The scope of this document is to provide requirements for wiring devices.

1.2 DESIGN GUIDELINES

- A. All receptacles and switches will have a minimum rating of 20 amps and will be commercial Specification grade. A standard of quality for switches is Leviton and for receptacles is Hubbell or Leviton.
- B. Preferred color for receptacles and switches is ivory. Other colors may be used to match existing devices or for special uses.
- C. In areas required to have ground fault interrupting capability, GFI receptacles shall be used in lieu of GFI breakers unless approved by the Director of Facilities Planning & Development (AHJ).
- D. Designer will evaluate the need for steel, nylon, or other special types of covers depending on the usage of the area.
- E. The preferred mounting heights above finished floor are 48" for switches and 18" for receptacles.
- F. Each restroom shall have a minimum of one (1) receptacle, and it shall be a GFCI receptacle.
- G. All wire connections with the exception of screw terminals shall be wire nut or lever secured wire splicing connector and shall be suitable for copper wire. Wire nuts and splicing connectors shall be UL468c and UL 467 listed.
1. Lever secured wire splicing connectors shall be Wago 221 or 222 or equivalent. Use of splicing connectors is only allowed for circuits not exceeding 20A, solid or stranded copper wire, and for general lighting and receptacle power applications.
 2. Spring secured push connectors are not allowed.
 3. Exception: MUHC patient care areas shall be screw terminals or wire nut only.
- H. For LEED certified Projects, 50% of all 125-volt receptacle outlets in private offices, open offices, and computer classrooms shall be automatically switched off when the space in which they are located is not occupied. This energy saving method is a mandatory requirement for LEED certification.
- I. For Projects not involving LEED, the AHJ has taken exception to the ASHRAE 90.1 provision for automatic receptacle control.

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Division 31

Earthwork

**University of Missouri – General Site
Steam and Water Line Replacement, Stephens and Lefevre Halls**

Division 31

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SECTION 31 10 00
SITE CLEARING & DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Removal of drainage structures, pavements, surfacing, base courses, curb, curb and gutter, sidewalks, steps, buildings, foundation walls, utility pipes, and other existing improvements as noted on the Drawings.
- B. It is the intent that the demolition be complete and adequate for the intended purpose. This work shall include the removal of all items, whether in view or hidden underneath the surface of the ground, regardless of whether shown on the Drawings or encountered during construction.

1.2 PERMITS

- A. Contractor shall comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess waste materials.
- B. Contractor shall obtain and pay for all required inspections, permits, and fees.

1.3 SUBMITTALS

- A. The Contractor shall submit demolition and clearing procedures and operational sequences and schedules for review and acceptance by the Owner's Representative.

1.4 GENERAL PROCEDURES

- A. Erect barriers, fences, guardrails, enclosures, chutes, and/or shoring to protect personnel, structures, and utilities remaining intact.
- B. Protect on-site trees and plants noted on Drawings. All landscaping and trees outside of construction limits are to be protected from damage.
- C. Protect all existing objects intended to remain. In case of damage, make repairs or replacements necessary at no additional cost to the Owner.
- D. Minimize interference with roads, streets, driveways, sidewalks, and adjacent facilities.
- E. Do not close or obstruct streets, sidewalks, alleys, or passageways without permission from authorities having jurisdiction.
- F. If closure is permitted, provide signage indicating closure and signage to direct traffic to alternate route.
- G. Moisten surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

PART 2 EXECUTION

2.1 PREPARATION

- A. Notification: Provide the Owner's Representative a minimum of two (2) business days' notice prior to commencing work of this section.
- B. The Contractor shall locate existing utility lines and services traversing the site and determine the requirements for their protection. The Contractor shall preserve active utilities on the site that are designated to remain.
- C. Before starting site operations, the Contractor shall disconnect or arrange for the disconnection

of all utility services designated to be removed. The Contractor shall perform all such work in accordance with the requirements of the utility company or agency involved.

2.2 PAVEMENTS

- A. In removing pavement, curb and gutter, sidewalks, etc., where a portion is left in place, removal shall be to an existing joint or to a joint sawed to a minimum depth of 2" with a true saw line and a vertical face. Remove sufficient pavement to provide for proper grade and connections in the new work regardless of any limits indicated on the Drawing.

2.3 SEWERS

- A. Existing castings and culverts, if salvageable and removed intact, remain the property of the Contractor.
- B. All drainage pipes, which have been or are to be abandoned, shall be permanently sealed at the ends with bulkheads constructed of concrete, having a minimum thickness of 8".
- C. Abandon storm sewer structures by breaking the concrete bottom of the structure into pieces no larger than 12" in any direction and removing the top of the structure to 3' below finished grade. Plug all pipes with concrete and fill structure with 1" clean gravel.

2.4 BLASTING

- A. Blasting is not permitted.

2.5 DISPOSAL

- A. All debris shall be disposed of off-site.
- B. Do not store or burn materials on-site.
- C. All asphalt or concrete materials shall be disposed of off-site.
- D. Materials acquired through demolition, other than those required to complete the construction Project and designated for return to Owner, will become the property of the Contractor and will be removed from the site and off University property. The material will be disposed of in a legal manner.
- E. Abated items shall be disposed of per Section 02 80 00.
- F. Refer to Section 01 74 19 for further direction related to diversion and tracking.

2.6 CONSTRUCTION LIMITS

- A. The Contractor's operations shall be restricted to those areas inside the construction limits indicated on the Drawings. If limits are not indicated, restrict work to the Owner's property, easement, or public rights-of-way.
- B. Complete work within public rights-of-way under the permission of the governing agency.
- C. The Owner will place the top lift of soil (6" topsoil) and will do the surface restoration.
- D. The Contractor shall repair damage outside the construction limits at no additional expense to the Owner.

2.7 UTILITY ADJUSTMENT

- A. The Contractor is responsible for the adjustment of all gas vents, manholes, castings, and water valves within the grading limits to match the finished surface.
- B. Adjustments shall be coordinated with the utility companies and the cost for all adjustments

shall be incidental to construction unless noted as a bid item.

- C. The Contractor shall repair any damage to utility structures and appurtenances that occurs during construction at no additional cost to the Owner.

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SECTION 31 20 00
EARTH MOVING

PART 1 GENERAL

1.1 SUMMARY

- A. Provide earthwork operations. The Contractor shall be responsible for the excavation of all footings and foundations in addition to preparing the pavement subgrade. The Contractor shall extend all utility excavations and services and make final, permanent connections to utility services as required.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Test Reports: Submit for approval test reports, list of materials and gradations proposed for use. **Obtain samples of any proposed fill material and Contractor to provide standard proctor test reports to Engineer. Supply in-place compaction reports from an independent testing service for all fill materials placed.**

1.3 QUALITY ASSURANCE

- A. Compaction:
1. Under structures, building slabs, steps, pavements, and walkways, 95% Standard Proctor minimum density, ASTM D 698.
 2. Under lawns or unpaved areas, 85%, ASTM D 698.
- B. Grading Tolerances Outside Building Lines:
1. Lawns, unpaved areas, and walks, plus or minus one (1) inch.
 2. Pavements, plus or minus 1/2 inch.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Earthwork:
1. Application: Excavation, filling, compacting and grading operations both inside and outside building limits as required for below-grade improvements and to achieve grades and elevations indicated. Provide trenching and backfill for mechanical and electrical work and utilities. Note: All graded gravel or crushed stone shall be provided by the Contractor.
 2. Application: Subbase materials, drainage fill, common fill, and structural fill materials for slabs, pavements, and improvements.
 3. Application: Suitable fill from off-site if on-site quantities are insufficient or unacceptable, and legally disposal of excess fill off-site.
- B. Acceptable Materials:
1. Subbase Material: MoDOT Type 5 Base Rock. Waste lime is not a suitable material.
 2. Drainage Fill: Washed gravel or crushed stone.
 3. Common Fill: Mineral soil free from unsuitable materials.
 4. Structural Fill: Clean, well graded gravel.
 5. Suitable Soil: Cohesive soils in the soil classification groups ML, CL, CH or a combination thereof free of rock or gravel larger than 1" in any dimension, debris, waste, frozen material, vegetation, and other deleterious material.
 6. Embedment Material: 3/4" minus waste rock with fines or Suitable Soil.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All activities will be contained within construction boundaries indicated on site plan. Specified excavation requirements, precautions, and protective systems will be observed at all times.
- B. Movement of trucks and equipment on Owner's property will be in accordance with Owner's instructions.
- C. Topsoil will be stripped from the construction site and stockpiled in designated area. Excess topsoil will be stripped and disposed of legally off site.
- D. Trenches will not be backfilled until all required tests are completed and the utility systems as installed conform to requirements specified by the Contract documents.
- E. Excavation is unclassified and includes excavation to subgrade regardless of materials encountered. Repair excavations beyond elevations and dimensions indicated as follows:
 - 1. At Structure: Concrete or compacted structural fill.
 - 2. Elsewhere: Backfill and compact as directed.
- F. Maintain stability of excavations; coordinate shoring and bracing as required by authorities having jurisdiction. Prevent surface and subsurface water from accumulating in excavations. Stockpile satisfactory materials for reuse, allow for proper drainage, and do not stockpile materials within drip line of trees to remain.
- G. Compact materials at the optimum moisture content as determined by ASTM D 698 and by aeration or wetting to the following percentages of maximum dry density:
 - 1. Structure, Pavement, Walkways: Subgrade and each fill layer to 95% (-2%+4%) of Standard Proctor maximum dry density to suitable depth. Compaction testing shall be performed immediately prior to the placement of reinforcing steel and new paving materials. Contractor shall be responsible for scheduling testing with Owner's designated testing agency.
 - 2. Unpaved Areas: Each fill layer to be 85% maximum dry density.
 - 3. A proof-roll shall be required of the subgrade prior to placement of the base course. Proof rolling shall consist of passing a loaded, 20-ton, tandem dump truck over the prepared subgrade soil with a maximum allowable displacement of 1". Any areas that displace more than 1" shall be compacted until this criterion is met, or those areas may be excavated and backfilled with compacted Type 1 aggregate used for base material. All proof rolling shall be performed in the presence of the Owner's Representative.
 - 4. **Cut areas under proposed asphalt or concrete pavements shall be cut and compacted. After grading to subgrade elevation, scarify the top six (6) inches of the sub-base and compact as outlined above.**
 - 5. Landscaped areas to be left 6" or 18" below proposed finish grade. Fill within 36" of finish grade to be filled per "Suitable Soil" as defined by 2.1-B.
- H. Place acceptable materials in layers not more than 6" loose depth for materials compacted by heavy equipment and not more than 4" loose depth for materials compacted by hand equipment to subgrades indicated as follows:
 - 1. Structural Fill: Use under foundations, slabs on grade in layers as indicated.
 - 2. Drainage Fill: Use under designated building slabs, at foundation drainage, and elsewhere as indicated.
 - 3. Common Fill: Use under unpaved areas.
 - 4. Subbase Material: Use under pavement, walks, steps, piping, and conduit.
 - 5. Fill in landscape areas (excluding topsoil): Use suitable soil within 36" of finished grade in lawn and planter areas.
 - 6. Embedment Material: Use above new utilities as indicated.
- I. Grade to within 1/2" above or below required subgrade and within a tolerance of 1/2" in 10'.
- J. Protect newly graded areas from traffic and erosion. Recompact and regrade settled, disturbed, and damaged areas as necessary to restore quality, appearance, and condition of work.

- K. Control erosion to prevent runoff into sewers or damage to sloped or surfaced areas.
- L. Control dust to prevent hazards to adjacent properties and vehicles. Immediately repair or remedy damage caused by dust, including air filters in equipment and vehicles. Clean soiled surfaces.
- M. Disposal of excavation waste and unsuitable materials shall be the responsibility of the site work Contractor. No specific or pre-approved location is being provided by the Owner.

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SECTION 31 2500
EROSION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of temporary water pollution control measures to prevent discharge of pollutants such as chemicals, fuels, lubricants, bitumen, raw sewage, or other harmful material from the project

1.2 GENERAL

- A. The Contractor shall manage his operations to control water pollution in accordance with this specification and applicable State regulations. Construction of permanent drainage facilities and other contract work, contributing to control of erosion, shall be scheduled at the earliest practicable time.
- B. The Contractor shall furnish, install, maintain and remove temporary erosion control measures. The Contractor shall prevent discharging silt or polluted storm water from the site.
- C. The Owner's Representative may require installation of additional erosion control facilities by the Contractor, if in the sole opinion of the Owner's Representative the Contractor's efforts are adequate.

1.3 DEFINITIONS

- A. Temporary Berm: A temporary ridge of compacted soil, with or without a shallow ditch, constructed at the top of slopes or transverse to the centerline of a slope. The berm diverts storm runoff to temporary outlets to discharge water with minimal erosion.
- B. Temporary Seeding and Mulching: Placement of a quick ground cover to reduce erosion in areas expected to be re-disturbed.
- C. Silt Fence: A geotextile barrier fence to contain sediment by removing suspended particles from water passing through the fence.
- D. Sediment Removal: Removal of accumulated sediment to restore the efficiency of sediment control features.

1.4 SUBMITTALS

- A. The Contractor shall submit any coordinate any field modifications to the "Erosion Control Plan" for review and approval by the Owner's Representative. Approval of the plan changes does not relieve the Contractor of his contractual responsibility to prevent the discharge of pollutants into the receiving drainage ways.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Wire Supported and Self-Supporting Silt Fence:
 - 1. Geotextile Fabric
 - a. Fibers used in geotextiles shall consist of longchain synthetic polymers, composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages.
 - b. The geotextile shall be free of any treatment or coating which might adversely alter its physical properties after installation.
 - c. Geotextile shall be furnished in 36" width rolls.
 - d. Geotextile rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure.

- e. Each roll shall be labeled or tagged to provide product identification sufficient for inventory.
- f. Rolls shall be stored in a manner which protects them from the elements.
- g. Geotextile shall conform to the following:

TABLE 1
PHYSICAL REQUIREMENTS FOR
TEMPORARY SILT FENCE GEOTEXTILES

Property	Test Method	Wire Fence Supported Requirements	Self Supported Requirements
Tensile Strength, Lbs.	ASTM D4632	90 Minimum	90 Minimum
Elongation at 50% Minimum			
Tensile Strength (45 Lbs.)	ASTM D4632	N/A	50 Maximum
Filtering Efficiency, %	VTM-51	75	75
Flow Rate gal/ft/min	VTM-51	0.3	0.3
Ultraviolet Degradation at 500 hrs.	ASTM D4355	Minimum 70% Strength Retained	Minimum 70% Strength Retained

- 1. Notes: All numerical values represent minimum average roll value when tested in any principal direction. Virginia DOT test method.
- 2. Posts: Wood, steel, or synthetic post may be used. Posts shall have a minimum length of 36" plus embedment depth (24" min.). Posts shall have sufficient strength to resist damage during installation and to support applied loads.
- 3. Support Fence: Wire or other support fence shall be at least 24" high and strong enough to support applied loads.
- 4. Prefabricated Fence: Prefabricated fence systems may be used provided they meet all of the above material requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Owner's Representative may limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, or fill operations.
- B. The Owner's Representative may direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams, other watercourses, lake, ponds, or other areas of water impoundment. Work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, use of temporary mulches, seeding or other control devices or methods to control erosion.
- C. The Contractor shall incorporate permanent erosion control feature at the earliest practicable time.
- D. The Contractor at no additional cost shall provide temporary pollution control measures needed to control erosion during normal construction practices to the Owner.

3.2 LIMITATION OF AREA DISTURBED

- A. The Owner's Representative may limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, or fill operations. The Contractor's operations shall be scheduled to install erosion control features immediately after clearing and grubbing.
- B. The Owner's Representative may limit the area of clearing and grubbing, excavation, borrow, and embankment operations commensurate with the Contractor's capability and progress in completing the finish grading, mulching seeding,
- C. The Contractor shall respond to seasonal variations. If required by weather, temporary erosion control measures shall be taken immediately.

3.3 BORROW AND WASTE AREAS

- A. Material pits other than commercially operated sources and material spoil areas shall be subject to pollution control measures of this specification. An offsite location does not relieve the Contractor of his contractual obligation to prevent the introduction of silt or other pollutants into receiving waterways.

3.4 CONFLICT WITH FEDERAL, STATE OR LOCAL LAWS, RULES OR REGULATIONS

- A. In case of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.5 SILT FENCE

- A. General:
 - 1. Install along the toe of fills over 10' in height, along the right-of-way line, parallel to drainageways or around an inlet to prevent sediment from entering the pipe system.
- B. General Requirements:
 - 1. The Contractor shall install a temporary silt fence in locations shown on the drawings, around inlets that accept flows containing silt, and other locations necessary to prevent the discharge of silt from the site.
 - 2. Installation shall conform to the detail at the end of this section.
 - 3. Fence construction shall be adequate to handle the stress from hydraulic and sediment loading.
- C. Installation:
 - 1. Geotextile at the bottom of the fence shall be buried as indicated on the detail.
 - 2. The trench shall backfilled and the soil compacted over the geotextile. The geotextile shall be spliced together as indicated on the detail.
- D. Post Installation:
 - 1. Post spacing shall not exceed 8' for wire support fence installation or 5' for self-supported installations.
 - 2. Posts shall be driven a minimum of 24" into the ground. Where rock is encountered, posts shall be installed in a manner approved by the Owner's Representative.
 - 3. Closer spacing, greater embedment depth and/or wider posts shall be used in low areas, soft, or swampy ground to ensure adequate resistance to applied loads.
 - 4. When support fence is used, the mesh shall be fastened securely to the upstream side of the post.
 - 5. The mesh shall extend into the trench a minimum of 2" and extend a maximum of 36" above the original ground surface.
 - 6. When self-supported fence is used, the geotextile shall be securely fastened to fence posts.
- E. Maintenance:
 - 1. The Contractor shall maintain the integrity of silt fences as long as they are necessary to contain sediment runoff.

2. The Contractor shall inspect all temporary silt fences immediately after each rainfall. Inspect daily during prolonged rainfall.
3. The Contractor shall immediately correct deficiencies.
4. The Contractor shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness.
5. Where a single fence is not adequate to handle the volume of silt or flows are not completely intercepted, additional silt fences shall be installed.
6. The Contractor shall remove and dispose of sediment deposits when the deposit approaches one-half the height of the fence.
7. The silt fence shall remain in place until the upstream surface is stabilized. Upon removal, the Contractor shall remove the silt fence, dispose of excess silt, and restore the disturbed area.

3.6 SEDIMENT REMOVAL

A. General:

1. Sediment deposits shall be removed when:
 - a. The deposits reach approximately one-half the height of a ditch check, straw bale barrier or silt fence.
 - b. The sediments have reduced the ponded volume of sediment basins to one-third of the original volume.
 - c. Requested by the Owner's Representative.
2. Sediment removed from erosion control features shall be deposited in a location where it will not erode into construction areas or watercourses.

END OF SECTION

SECTION 31 50 00
EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes temporary excavation support and protection systems including support of utilities within the excavations.

1.2 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
1. Provide Professional Engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified Professional Engineer for both excavations and utility support.
 2. Install excavation support and protection systems without damaging existing building, pavements, and other improvements adjacent to excavation.

1.3 SUBMITTALS

- A. Shop Drawings for Information: Prepared by or under the supervision of a qualified Professional Engineer for excavation support and protection systems. Include Shop Drawings signed and sealed by the qualified Professional Engineer responsible for their preparation. This includes excavation support and utility support structures.
- B. Photographs or videotape sufficiently detailed of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.4 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Project-Site Information: A geotechnical report has been prepared for this Project.
1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
- C. Survey adjacent structures and improvements, employing a qualified Professional Engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of three (3) inches.
- E. Shotcrete: Comply with Division 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcing, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 SOLDIER BEAMS AND LAGGING

- A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging.
- B. Accurately align exposed faces of flanges to vary not more than two (2) inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil and compact.
- D. Install wales horizontally at centers indicated and secure to soldier beams.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than two (2) inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified Professional Engineer responsible for design of excavation support and protection system.
 - 2. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Engineer.
 - 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 - 2. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

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Division 32

Exterior Improvements

University of Missouri – General Site

Steam and Water Line Replacement, Stephens and Lefevre Halls

Division 32

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SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Placement of asphaltic concrete, in one (1) or more courses, on prepared base or underlying course in conformity with the line, grade, thickness, and typical cross section shown on the Drawings.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials and composition of Plant Mix Bituminous Base shall conform to MODOT 401.2 through 401.4.5 inclusive.

PART 3 EXECUTION

3.1 EQUIPMENT

- A. Equipment shall meet the requirements of MODOT 403.7 through 403.9.

3.2 WEATHER LIMITATIONS

- A. Asphalt shall not be placed when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 50 degrees Fahrenheit for the surface course or below 40 degrees Fahrenheit for the subsurface courses. It shall not be placed on any wet or frozen surface. It shall not be placed when weather conditions prevent the proper handling or finishing of the mixture.

3.3 SPREADING AND FINISHING

- A. Spreading and finishing shall conform to MODOT 403.13 through 403.16.2
- B. Spot wedging and surface leveling shall conform to MODOT 402.10.4 through 402.10.9
- C. The surface of each layer shall be substantially free from waves or irregularities.

END OF SECTION

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SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. This section applies to all site concrete, including but not limited to sidewalks, curb and gutters, and pavement.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Design Mixes: Submit for approval design mixes, including adjustments for variations in Project conditions.
1. Mixes to be designed in accordance with the Portland Cement Association.
 2. All exposed concrete shall be air entrained. Allowable ranges shall be as follows:
 - a. $\frac{3}{4}$ " to 1" aggregate size shall contain 6.0% average entrained air. The total air content range shall be between 5%-7%.
 3. All concrete shall achieve 4000 psi compressive strength in 28 days.
 4. Flint and chert to be limited to 1% maximum, by weight of the coarse aggregate, in all exposed concrete. Lignite will be limited to 0.5% by weight of both the coarse and fine aggregates in all exposed concrete.
 5. Sand shall be from local sources meeting ASTM C-33 Size 67 for concrete.
 6. The use of calcium chloride or flyash in concrete mixes will not be permitted.
 7. Maximum water-to-cement ratio shall be .45.
 8. Concrete slump shall be a maximum of 4" +/- 1" (ASTM C- 143) as delivered in the field. Contractor may use chemical admixtures to attain a maximum slump of 8" for workability. No water may be added to the concrete mix on site unless water is withheld at the batching facility. If water is withheld at the batching facility, it should be reflected on the load ticket. The total amount of water in the mix shall not exceed what is noted on the approved mix. This shall be noted in the special inspector's records.
- C. Test Mix Reports: Submit test reports for approval prior to construction.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three (3) years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Construction Tolerance: 1/8' in 10' for grade and alignment of top of forms; 1/4' in 10' for vertical face on longitudinal axis.
- C. Testing: Independent testing agency shall be obtained by the Owner. Testing requirements shall be as follows:
1. An ACI certified Grade I field technician shall perform the testing.
 2. Test shall be performed for strength, air entrainment, temperature, and slump. Strength tests will require four (4) cylinders (one [1] broken @ seven [7] days; two [2] broken @ 28 days, one [1] spare). Test results should be sent to the Contractor, Architect, and Owner's Representative.
 3. Concrete will be tested at the minimum rate of one (1) test for the first 25 cubic yards placed each day, and one (1) test for each additional 50 cubic yards placed thereafter.
 4. Test data from concrete cylinder breaks will be evaluated using procedures of ACI 214.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete Paving Materials:
 - 1. Accessories:
 - a. Wire Mesh Reinforcement: Welded plain steel wire fabric, ASTM A 185.
 - b. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60.
 - c. Fabricated Bar Mats: Steel bar or rod mats, ASTM A 184, using ASTM A 615, Grade 60 steel bars.
 - d. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60.
 - e. Hook Bolts: ASTM A 307, Grade A threaded bolts.
 - f. Liquid-Membrane Forming and Sealing Curing Compound: ASTM C 309, Type I, Class A.
 - g. Bonding Compound: Polyvinyl acetate or acrylic base.
 - h. Color Pigment: ASTM C 979.
 - i. Epoxy Adhesive: ASTM C 881.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with ACI 301 for measuring, mixing, transporting, and placing concrete.
- B. Proof roll subbase and check for unstable areas. Report unsatisfactory conditions in writing to the Owner's Representative.
- C. Comply with concrete section for concrete mix, testing placement, joints, tolerances, curing, repairs, and protection.
- D. All concrete trucks shall be directed to washout at plant.
- E. Dispose of over-mixed concrete off-site in a legal manner.
- F. Protect concrete paving until weight of a person will not leave any impression. Remove and replace concrete paving, which shows impressions or other defects. Skim coating defects is not acceptable.
- G. Contraction joints shall be tooled during finishing or sawed within 18 hours of concrete placement. If the joint edge ravel, do not proceed until concrete has sufficient cure time to saw without damage.
 - 1. Contraction joints shall have a minimum depth of $\frac{1}{4}$ of the pavement thickness and a minimum width of $\frac{1}{8}$ ".
 - 2. Transverse contraction joints will be provided at a maximum of 2.5 times the pavement thickness (in inches) in feet for street pavements and 2.0 times for all other pavements.
 - 3. Longitudinal joints shall have a maximum separation of 14 feet for streets and drives and nine (9) feet for sidewalks.
 - 4. The ratio of slab width to length should not exceed 1.67 for street pavements and 1.25 for all other pavements.
 - 5. All joints to be sealed per Section 32 13 73.

END OF SECTION

SECTION 32 13 73
CONCRETE PAVING JOINT SEALANTS

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. This section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
- B. Related sections include the following:
 - 1. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealed product indicated.
- B. Product Certificates: For each type of joint sealant and accessory signed by product manufacturer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one (1) source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one (1) of the products listed in other Part 2 articles

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- 2.3 COLD-APPLIED JOINT SEALANTS
- A. Type NS Silicone or Polyurethane Sealant for Concrete: Single-component, low-modulus, neutral-curing, non-sag silicone sealant complying with ASTM D 5893 for Type NS.
 - 1. Products:
 - a. Tremco Spectrum 900.
 - b. BASF Sonolastic.
- 2.4 JOINT-SEALANT BACKER MATERIALS
- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
 - B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and are installed at the same time as backing:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform

beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION

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SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY OF WORK INCLUDED

- A. Pavement markings in parking lots, roadways, safety zones, ADA zones, loading zones, and no parking zones as indicated on Drawings.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Material shall be either:
 - 1. Epoxy pavement marking material with drop-on glass beads in accordance with MODOT Specifications 620.20.3, 1048.20.2, and 1048.30; or
 - 2. Geveko PlasticRoute™ (MMA); or
 - 3. Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1925F, Type II, with drying time of less than 45 minutes; or
 - 4. Latex, MPI #97, Latex traffic-marking paint.
- B. Material type must be compatible with the surfaces to be marked.

2.2 COLORS

- A. Markings shall be applied per the following color code: White for standard parking space lines, sidewalk crossings, and drive lanes as noted on the plans. Blue for ADA parking stall and symbols and associated cross-hatched areas. Yellow for drive lanes as noted on the plans.

2.3 DELIVERY AND STORAGE

- A. Deliver materials to the site in original containers with seals unbroken and labels intact.
- B. Protect all material from freezing.

PART 3 EXECUTION

3.1 PROTECTION

- A. Prior to beginning cleaning or marking operations, Contractor shall protect all items or surfaces not included in area to be marked. Protect vehicles, equipment, structures, or other items from material spatters, over spray, or damage.
- B. Contractor shall provide barricades and any signage needed to protect all marked areas from pedestrian and vehicular traffic until achieving sufficient drying time.

3.2 INSTALLATION REQUIREMENTS

- A. Perform pavement markings as soon as feasible and practical after the finishing of the pavement or as directed by the Owner's Representative.
- B. Adequate lighting shall be available at the time of pavement marking.
- C. The surface on which permanent pavement marking is to be placed shall be clean, dry, and free of all debris, laitance, curing compound, and any other contaminants that may hinder the adhesion of the system to the surface. Permanent pavement marking shall not be applied in damp conditions or if there is any evidence of surface moisture on the pavement. Examine all surfaces to receive pavement marking to make sure there are no defects in the surface to be striped. Do not mark pavement over rust, scale, grease, oil, fuel, dust, wet pavement, or other conditions detrimental to pavement marking adhesion. Remove grease, oil, or fuel on any

surface before marking pavement. Correct all surface defects before marking pavement.

- D. Contractor shall examine areas to have pavement marking. Notify the Owner's Representative in writing of conditions that might delay timely completion of the work.

3.3 WEATHER CONDITIONS

- A. The pavement marking shall only be applied during dry weather and on dry pavement surfaces. The pavement surface temperature and ambient air temperature shall be in accordance with the material manufacturer's recommendations throughout the application and during the specified time for curing of the material.

3.4 APPLICATION

- A. Areas to be marked shall be not less than 25 mils thickness with the proper application of glass beads. In locations requiring multiple coats, prior coat shall be dry to manufacturer's recommendations before applying the next coat.
- B. Finished work shall be uniform, of approved color, free of runs, drips, defective brushing, spraying, and clogging. Parking lines and symbols shall be neat and well defined. Only skilled applicators shall apply pavement markings.

3.5 QUALITY CONTROL

- A. Remove pavement marking splatter from adjacent areas or areas not designated to receive pavement marking.
- B. Contractor shall repair or touch up any surfaces if exposed to vehicular and pedestrian traffic, to the satisfaction of the Owner's Representative, at no additional cost to the Owner.
- C. When color, dirt, stains, existing pavement markings, etc., show through the final coat, re-mark the surface until the film is uniform in finish, coverage, color, and appearance.

END OF SECTION

Division 33
Utilities

University of Missouri – General Site
Steam and Water Line Replacement, Stephens and Lefevre Halls

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SECTION 33 11 13
WATER DISTRIBUTION 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 water-distribution piping and related components outside the building for water service and fire-service mains.

1.3 DEFINITIONS

- A. HDPE: High-Density Polyethylene Plastic.
- B. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Water valves and specialties to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with standards of Missouri Department of Natural Resources for potable-water-service piping, including materials, installation, testing, disinfection, and all requirements of the MU system guidelines.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. 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.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including yard hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection, then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrant if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 MATERIALS, PIPE, AND PIPE FITTINGS

- A. All underground water piping shall be PVC.
1. EXCEPTION 1: Domestic water service lines 2" or less shall be Type K copper or high-density polyethylene (HDPE) piping.
 2. EXCEPTION 2: Lines passing directly over or under steam tunnels or direct buried steam/condensate lines must be ductile iron or Type K copper (2" or less) with 4" R-5 extruded polystyrene insulation board between the pipe and steam lines.
- B. PVC Pipe (Open Trench Construction):
1. Four (4) Inches to 12 Inches: AWWA C900; Pressure Class 235 (DR 18); Cast Iron O.D. equivalent; with bell end and elastomeric gasket.
 2. 14 Inches to 48 Inches: AWWA C905; Pressure Rating 165 (DR 25); Cast Iron O.D. equivalent; with bell end and elastomeric gasket.
 3. Gaskets: ASTM F 477, elastomeric seal.
- C. Ductile-Iron Pipe:
1. Four (4) Inches to 12 Inches: AWWA C151; Mechanical Joint Pipe; Minimum Thickness Class 52 or Pressure Class 350; with integrally cast flanged bell, cast iron gland, and rubber gasket.
 2. Lining: Standard cement lining with asphalt coating.
 3. Encasement: AWWA C105, polyethylene film.
- D. High-Density Polyethylene (HDPE) Pipe and Fittings:
1. Two (2) Inches and Less: SDR9 CTS Premium Grade Pipe, AWWA C901, ASTM D3035, NSF 14 and 61, 200 psi pressure rating. Pipe to be CenCore HDPE as manufactured by Centennial Plastics or approved equivalent.
 2. Fittings and Joints: All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe pressure rating. All fittings shall be molded or fabricated by the pipe manufacturer. Connections must be made by either the use of brass/stainless steel compression couplings with insert rings or by creating a fusion butt weld all in strict accordance with manufacturer's recommendations. All brass fittings shall be lead free.
- E. Pipe Fittings:
1. Four (4) Inches to 24 Inches: AWWA C153; 350-psi pressure rating.
 2. Lining: Standard cement lining with asphalt coating.
 3. All pipe fittings shall be ductile-iron construction, installed wrapped with AWWA C105 polyethylene film.

F. Restraints:

1. Mechanical joint: AWWA C111. Provide retainer type packing glands with rubber gasket for use with PVC pipe and conforming to Uni-B-13-92.
2. Pipe sizes 4" to 12" must also be FM approved. Mechanical joint restraints shall be Megalug 2000 PV, as manufactured by EBAA Iron Inc., Eastland TX, or approved equivalent.
3. Joint Retainers: Provide ductile iron split serrated ring harnesses and rod type joint retainers for PVC bell and spigot joints. Clamps shall be designed for use with PVC pipe and shall meet Uni-B-13-92 Standards and be FM approved on sizes 4" to 12". Restraint harnesses shall be Series 1500 for pipe four (4) inches to 12 inches, and Series 2800 for pipe 14 inches and larger, all as manufactured by EBAA Iron Inc., Eastland TX, or approved equivalent.
4. Rods, nuts and washers: 3/4" SS304 all thread rods, nuts and washers.
5. All pipe restraints and ductile iron fittings shall be installed wrapped with AWWA C105 polyethylene film.
6. Link Assembly: Seal annular space for piping passing through walls with interlocking synthetic rubber link assembly, Link-Seal® as manufactured by PSI-Thunderline Corporation, Houston TX, or approved equivalent.
7. Pipes, fittings, valves, meters, and other appurtenances containing more than .25 percent lead calculated by weighted average shall not be used. System design, materials, and installation of water systems shall comply with "Minimum Design Standards for Missouri Community Water Systems" (latest edition) as published by Missouri DNR.

G. Trace Wire:

1. Tracer wire shall be #14 AWG Solid, steel core soft drawn high strength tracer wire, 250# average tensile break load, 30 mil high molecular weight-high density blue polyethylene jacket complying with ASTM-D- 1248, 30 volt rating. No THHN insulated wire shall be allowed. Tracer wire shall be Copperhead Industries HS-CCS or approved equivalent.
2. Tracer wire shall have moisture resistant splices for direct bury applications. Splices shall be Copperhead Industries Snakebite or 3M DBR or approved equivalent.
3. Tracer wire test stations shall be designed to be easily detected by magnetic and electronic locators. A magnet shall be securely attached at the top of the upper tube of the box for locating purposes. Lid shall be blue and have a brass terminal for attaching locating equipment and a brass 5-sided nut for removing cap. Tracer wire test station shall be Copperhead Industries Snake Pit or approved equivalent.

2.2 JOINING MATERIALS

- A. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as and with pressure rating at least equal to ends compatible with piping to be joined.
1. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
 2. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple, complying with ASTM F 1545.
 - 3) Pressure Rating: 300 psig (2070 kPa) at 225°F (107°C).
 - 4) End Connections: Male threaded and grooved.

- 5) Lining: Inert and noncorrosive, propylene.

2.4 VALVES AND VALVES BOXES

- A. Non-rising Stem Gate Valves: ANSI/AWWA C509, resilient seated, lead free, bronze stem, cast-iron or ductile-iron body and bonnet, epoxy coated disc, stem nut, 250 psig working pressure, mechanical joint ends. Valves shall be Model A-2360 as manufactured by Mueller Company, Decatur IL, or approved equivalent. Valves shall turn clockwise to close.
- B. Ball Valves: Threaded lead-free bronze, 125 lb., 2-piece design, full port. Valves shall be Model T-FP-600A-LF-LL as manufactured by NIBCO, Elkhart IL, or approved equivalent.
- C. Valve Boxes: Valve box shall be 6" PVC C900 pipe with cast iron cover No. 2195 as manufactured by Clay and Bailey Manufacturing Company, Kansas City MO, or approved equivalent. Lid shall be marked "WATER."
- D. Multi-fit Adaptor: All valve boxes shall be installed upon the valve with the use of a Multi-Fit Adaptor (MFA) as manufactured by Adaptor Inc. or an approved equivalent. SKU # 90004.

2.5 METERS

- A. All externally installed water meters shall be bronze disc as manufactured by BadgerMeter, Milwaukee, WI. Substitutes will not be accepted.
- B. Nutating Disc Meter:
 - 1. Construction shall comply with ANSI and AWWA C700 standards as required for domestic water metering applications.
 - 2. Meter housing and housing top plate shall be lead free cast bronze construction. The measuring chamber, disc, strainer, and generator housing shall be thermoplastic construction. Register lid and box shall be thermoplastic and bronze and trim shall be stainless steel or bronze.
 - 3. Register shall be a straight-reading odometer-type totalization display (gallons), 360-degree test circle with center sweep hand and flow finder to detect leaks. Register shall be installed using TORX tamper resistant seal screws. Meters shall be provided with an integral strainer. A tamper resistant calibration plug seal shall also be provided to protect from unauthorized personnel.
 - 4. Meters shall be Recordall disc models 35, 70, 120 and 170.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fitting may be used instead of joints indicated on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) 1-inch to 2-inch shall be the following:
 - 1. PE, ASTM pipe; insert fittings for PE pipe; and clamped joints.

3.3 PIPING INSTALLATION

- A. Preparation of Trench:
1. Trench bottom shall be graded to provide a smooth, firm, stable, and rock-free foundation throughout the length of the piping.
 2. All rock greater than one (1) inch in diameter found in the trench shall be removed for a depth of six (6) inches below the bottom of the pipe and replaced by suitable bedding material.
 3. Unstable, soft, and unsuitable materials shall be removed at the surface upon which pipes are to be laid and backfill with crushed stone as indicated on the Drawings.
 4. Layers of crushed stone shall be installed in the bottom of trench as indicated on the Drawings. Shape stone layer to fit bottom of piping. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.
- B. Pipe Separation:
1. Finished pipe installation shall have minimum 12" separation to all other utilities.
 2. Maintain at least a ten foot (10') horizontal separation of water mains from any existing or proposed sanitary sewer. The distance must be measured edge to edge. Installation of the water main closer to a sanitary sewer is acceptable where the water main is laid in a separate trench or on an undisturbed earth shelf located on one (1) side of the sanitary sewer at an elevation so the bottom of the water main is at least eighteen inches (18") above the top of the sanitary sewer.
 3. Provide a minimum vertical distance of eighteen inches (18") between the outside of the water main and the outside of the sanitary sewer where water mains cross the sanitary sewer mains. This shall be the case where the water main is either above or below the sanitary sewer. At crossings, one (1) full length of water pipe must be located so both joints will be as far from the sanitary sewer line as possible. Special structural support for the water and sanitary sewer pipes may be required.
 4. Provide at least a ten-foot (10') horizontal separation between water mains and sanitary sewer force mains. There shall be an eighteen-inch (18") vertical separation at crossings
 5. Locate water mains so that they do not pass through or come into contact with any sanitary sewer manhole
 6. Consult the system Owner where above conditions cannot be met.
- C. Installation of Pipe and Pipe Fittings:
1. Piping 2" and less:
 - a. All domestic water service piping from the water main to the building with a nominal diameter of two (2) inches and less shall be Type K copper or HDPE piping.
 - b. In all installations, Type K copper shall be used where the water line enters the building. If the water meter is located in a meter pit, the piping within the meter pit and stubbed out on either side shall also be Type K copper.
 - c. All buried copper piping shall be wrapped.
 - d. For pulled pipe installations, tracer wire shall be pulled with pipe, without splices. Upon completion of installation, a continuity test on the wire shall be performed, and all breaks shall be repaired.
 - e. For trenched pipe installation, tracer wire shall be taped to the pipe at the three o'clock position every five (5) feet. Upon completion of installation, a continuity test on the wire shall be performed, and all breaks shall be repaired.
 2. PVC (Polyvinyl Chloride) Pipe: Install in accordance with AWWA C605.
 3. All joints shall be restrained with joint retainers. All fittings shall be restrained with retainer type packing glands.
 4. Install stainless steel rods between fittings on all offsets and between fittings, valves, and blind flanges, in addition to the Megalugs. On isolated fittings, valves, etc., attach restraint rings to PVC pipe and install stainless steel rods between fitting and restraint rings. Rods shall be positioned through the bolt holes in fitting and Megalug. Each rod will require four (4) nuts and washers. Duct lugs are acceptable. The number of stainless steel rods required per fitting flange shall be as follows:

Pipe Diameter	No. of Rods
10" and Less	2
12"	3
14"	4
16"	5
18"	6

5. All ductile iron pipe, fittings, valves, bell end restraints, etc. shall be wrapped with a polyethylene cover conforming to AWWA C105 and installed per AWWA C600.
 6. All dead end mains shall have a dry barrel fire hydrant at the end to facilitate flushing of the main.
 7. Pipe shall be installed in clean condition and shall never be laid in trenches with standing water. The trench shall be dewatered during installation of the water line. Open pipe ends shall be protected with a hard cap or inflatable plug at the end of the work day. NO PLYWOOD OR DUCT TAPE COVERINGS WILL BE ALLOWED.
- D. Backfill:
1. Under Pipe: All backfill under the barrel of the pipe shall be free from debris, organic matter, and stones larger than one (1) inch, and shall be tamped into place. Sand or crushed stone aggregate (95% passing a ½" screen but not more than 10% passing a #200 sieve) are acceptable substitutes for soil.
 2. Adjacent To and Top of Pipe: The first one (1) foot of backfill over the top of pipe shall be "¾ inch minus waste rock with fines" uncleaned crushed stone aggregate or suitable soil. Backfill shall be free of debris, brush, roots and stones, or rubble more than one (1) inch.
 3. Rough final grading of subgrade and the placement of final topsoil shall be detailed on the Drawings.
 4. All sidewalks, paving, etc. which are removed or damaged during construction shall be replaced and shall match existing.
- E. Identification:
1. Install continuous plastic underground warning tape during back-filling of trench for underground water piping. Tape shall be located twenty-four (24) inches above pipe, directly over each water line.
 2. Tape trace wire to the top of each water line with duct tape every five (5) feet. Wire splices shall be minimized. Terminate trace wires inside building and inside valve boxes. Drill ¼" hole in PVC valve box one (1) inch below cast iron cover. Route wire up outside of valve box through ¼" hole and knot. A tracer wire test station shall be installed at all fire hydrants and at all runs of piping without valves every 400 feet. Upon completion of installation and final grading, a continuity test on the wire shall be performed, and all breaks shall be repaired.
- F. Install HDPE pipe according to ASTM D 2774 and ASTM F 645.
- G. Bury piping with depth of cover over top at least 42 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least 42 inches (910 mm) cover over top.
 2. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) additional cover.
- H. Extend water-service piping and connect to water-supply source and building-water piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

3.4 VALVE/VALVE BOX INSTALLATION

- A. Valve Installation:
1. Domestic Water Service: AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with valve box.
 2. Valve boxes shall be installed vertically with top of box even with final grade.

3. All valve boxes shall be installed upon the valve with the use of a Multi-Fit Adaptor (MFA). The MFA shall be installed in lieu of hardwood blocking and shall be incidental to the valve and box installation. Install per manufacturer’s published installation procedures.

3.5 CONNECTIONS

- A. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.6 FIRE HYDRANT INSTALLATION

- A. Installation of fire hydrants maintained by the University shall be installed per “Fire Hydrant Detail” and in strict accordance with manufacturer’s written instructions.
- B. The pumper nozzle shall be installed pointing to the street and/or away from the building.
- C. Newly installed fire hydrants shall be cleaned and pressure tested in accordance with standards set forth in section 3.7 below.

3.7 FIELD QUALITY CONTROL

- A. Cleaning:
 1. All domestic potable water systems shall be clean and free of foreign matter and shall be disinfected and tested for bacteriological contamination before the system is put into operation, as required by the State Division of Health and in accordance with AWWA C651 or C652.
 2. All domestic potable water systems will be pressure tested in accordance with AWWA M23.
 - a. Pressure Test shall be performed at 150 psig for two (2) hours.
 3. Disinfection shall be performed AFTER leak and pressure tests are completed.
 4. Water line shall be completely separated from water system for pressure test and disinfection purposes.
 5. Contractor shall install number and size of taps based on the water line size in the table below:

Pipe Diameter (in)	2" Taps Needed
4"	1
6"	1
8"	1
10"	2
12"	2

6. Contractor shall install water line entrance and exit piping which enters and exits above ground as shown in “Taps for Flushing and Disinfection of Water Line Drawing” referenced below. The purpose of this piping is to provide a means for flushing, pressure testing, and disinfecting the new water line.
7. Contractor shall perform pressure testing and disinfection of new water lines. Contractor shall prepare water line for testing and disinfection. Notify Owner’s Representative at least 72 hours prior to requesting disinfection of a new water line. Contractor shall draw and send samples for testing. Allow 24 hours for disinfection of the water line and an additional 48 hours for return of testing prior to connecting to existing system. Contractor to allow a minimum of five (5) working days in schedule for this work by Owner.
8. Fill the system with a water-chlorine solution containing at least 50 parts per million of chlorine, valve off, and allow to stand for at least 24 hours; or fill system with a water-chlorine solution containing at least 200 parts per million of chlorine, valve off, and let stand for three (3) hours.
9. After allowed standing time, flush the system with clean potable water until no chlorine (in excess of public water supply) remains at any point of outlet.

10. The system shall be thoroughly and completely flushed at maximum water pressure, and if it is shown by a bacteriological examination made by the Owner that contamination still persists in the system, the above procedure shall be repeated.
11. The Contractor shall be responsible for taking and sending the sample for testing.
12. Allow 48 hours for return of testing before making tie-ins to existing system.

3.8 METER INSTALLATION

- A. Installation of water meter, valving, bypass loop, and water sampler/test outlet shall be in strict accordance with manufacturer's printed instructions and recommendations, applicable ANSI and AWWA requirements, and as detailed on University of Missouri "Water Meter Detail" Drawing.
- B. Water meter shall be installed in an exterior below-grade meter pit. These pit installations shall be installed in strict accordance with manufacturer's printed instructions and University of Missouri "Meter Box Pit Detail" Drawing.
- C. Water meters shall be installed with a three-valve bypass design using ball valves (2" or less) or OS&Y rising stem gate valves (larger than 2"). The bypass valve shall be full-flow and capable of being locked. All other valves associated with the meter installation shall be ball valves.
- D. Water meter shall be installed after the backflow prevention device but prior to any booster pumps or pressure reducing valves.

3.9 COMMISSIONING

- A. System shall be placed in operation only after testing shows the absence of bacteriological contamination and approved by system Owner.
- B. Only Campus Facilities - Energy Management Steam and Water personnel will be allowed to operate valves on new water systems. All valves installed as part of new construction shall remain fully closed during construction.

END OF SECTION

SECTION 33 11 14
WATER DISTRIBUTION HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes horizontally directional drilled water-distribution piping and related components outside the building for water service and fire-service mains.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 33 11 13 – Water Distribution Piping.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated.
- B. Informational Submittals:
 - 1. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
 - 2. Field quality-control test reports.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data: water valves and specialties to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with standards of Missouri Department of Natural Resources for potable-water-service piping, including materials, installation, testing, disinfection, and all requirements of the MU system guidelines.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. 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.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance dirt, debris, and moisture.

- B. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- C. Protect flanges, fittings, and specialties from moisture and dirt.
- D. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 PRODUCTS

2.1 MATERIALS, PIPE AND PIPE FITTINGS

- A. All underground water piping shall be PVC.
 - 1. EXCEPTION: Lines passing directly over or under steam tunnels or direct buried steam/condensate lines must be ductile iron with 4" R-5 extruded polystyrene insulation board between the pipe and steam lines.
- B. PVC Pipe (Trenchless Construction):
 - 1. Four (4) Inches to 12 Inches: AWWA C900; Pressure Class 235 (DR 18); Cast Iron O.D. equivalent; with grooved ends suitable for restrained joint coupling.
 - 2. Couplings: Non-metallic restrained joint coupling with PVC precision machined housing, nylon joint retaining splines, elastomeric O-ring seals, beveled leading edges, with pressure rating equal to or greater than pipe.
 - 3. Gaskets: ASTM F 477, elastomeric seal.
 - 4. Coupling Lubricant: Coupling manufacturer's standard for permanent joints.
 - 5. Compliance: Complete restrained joint pipe and coupling system shall be Factory Mutual approved, Underwriter's Laboratory Listed and shall comply with National Sanitation Foundation Standard No. 61 and UNIBELL UNI-B-13.
 - 6. Restrained joint piping system shall be Certa-Lok C900/RJ system, as manufactured by CertainTeed, Valley Forge PA, or approved equal.
 - 7. Link Assembly: Seal annular space for piping passing through walls with interlocking synthetic rubber link assembly, Link-Seal® as manufactured by PSI-Thunderline Corporation, Houston TX, or approved equal.
- C. Trace Wire:
 - 1. Tracer wire shall be #14 AWG Solid, steel core soft drawn high strength tracer wire, 250# average tensile break load, 30 mil high molecular weight-high density blue polyethylene jacket complying with ASTM-D- 1248, 30-volt rating. No THHN insulated wire shall be allowed. Tracer wire shall be Copperhead Industries HS-CCS or approved equal.
 - 2. Tracer wire shall have moisture resistant splices for direct bury applications. Splices shall be Copperhead Industries Snakebite or 3M DBR or approved equal.
 - 3. Tracer wire test stations shall be designed to be easily detected by magnetic and electronic locators. A magnet shall be securely attached at the top of the upper tube of the box for locating purposes. Lid shall be blue and have a brass terminal for attaching locating equipment and a brass 5-sided nut for removing cap. Tracer wire test station shall be Copperhead Industries Snake Pit or approved equal.

PART 3 EXECUTION

3.1 TRENCHLESS PIPING INSTALLATION

- A. Assure that trenchless piping installation be completed in a timely, quality and accurate manner utilizing good, well-maintained equipment and trained competent personnel. Trenchless piping must be installed on a route as close to the drawings as possible to prevent interference with buried utilities and other obstructions, and to prevent future accidental excavation damage.

- B. Directional drilling and pipe installation shall be done only by an experienced operator specializing in directional drilling and whose key personnel have at least five (5) years' experience in this work.
- C. Pipe installed by the directional drilled method must be located in plan as shown on the Drawings and must be no shallower than shown on the Drawings unless otherwise approved. The actual horizontal and vertical alignment of the pilot bore shall be plotted at intervals not exceeding twenty (20) feet. This "as built" plan and profile shall be updated as the pilot bore is advanced. Instrumentation shall be utilized at all times that will accurately locate the pilot hole and measure drilling fluid flow and pressure.
- D. Pilot hole shall be drilled on bore path with no deviations greater than five (5) feet left/right/depth over a length of 100 feet. In the event that pilot does deviate from bore path more than this amount, the Engineer shall be notified and Engineer may require the pilot drill to be pulled back and redrilled from the location along bore path before the deviation. The final exit point of pilot hole shall be within five (5) feet of the location shown on the drawings.
- E. Trenchless piping installed using directional drilling equipment shall be installed in full compliance with restrained joint piping system manufacturer's instructions.
- F. Field grooving tools, pulling heads, spline insertion tools, etc. shall be piping system manufacturer's standard.
- G. Comply with piping system manufacturer's requirements on maximum pulling force, minimum bend radius, maximum deflection, etc. During pull-back operations, no more than the maximum safe pipe pull pressure shall be applied at any time. Maximum allowable tensile force imposed on the pull section shall be equal to, or less than 80% of the pipe manufacturer's safe pull (tensile) strength.
- H. Provide pressure relief holes at close enough intervals to prevent buckling of pavement/sidewalks. If damage does occur, the pavement shall be repaired in accordance with pavement details provided.
- I. Trace wire shall be pulled with pipe, without splices. Upon completion of installation, a continuity test on the wire shall be performed and all breaks shall be repaired.
- J. Finished piping installation shall have a minimum of 42" cover on top of pipe.

3.2 PIPE SEPARATION

- A. Finished pipe installation shall have minimum 12" separation to all other utilities.
- B. Maintain at least a ten foot (10') horizontal separation of water mains from any existing or proposed sanitary sewer. The distance must be measured edge to edge. Installation of the water main closer to a sanitary sewer is acceptable where the water main is laid in a separate trench or on an undisturbed earth shelf located on one (1) side of the sanitary sewer at an elevation so the bottom of the water main is at least eighteen inches (18") above the top of the sanitary sewer.
- C. Provide a minimum vertical distance of eighteen inches (18") between the outside of the water main and the outside of the sanitary sewer where water mains cross the sanitary sewer mains. This shall be the case where the water main is either above or below the sanitary sewer. At crossings, one (1) full length of water pipe must be located so both joints will be as far from the sanitary sewer line as possible. Special structural support for the water and sanitary sewer pipes may be required.

- D. Provide at least a ten-foot (10') horizontal separation between water mains and sanitary sewer force mains. There shall be an eighteen-inch (18") vertical separation at crossings.
- E. Locate water mains so that they do not pass through or come in contact with any sanitary sewer manhole.
- F. Consult the system owner where above conditions cannot be met.

3.3 BACKFILL

- A. Rough final grading of subgrade and the placement of final topsoil shall be detailed on the drawings.
- B. All sidewalks, paving, etc. which are removed or damaged during construction shall be replaced and shall match existing.

3.4 TESTING

- A. See Section 33 11 13 for cleaning, disinfection, and pressure testing requirements.
- B. Test Report: Submit Test Reports to the Owner's Representative.

3.5 CLEANING

- A. See Section 33 11 13 for cleaning, disinfection, and pressure testing requirements.

3.6 COMMISSIONING

- A. System shall be placed in operation only after testing shows the absence of bacteriological contamination and approved by system owner.
- B. Only Campus Facilities - Energy Management Steam and Water personnel will be allowed to operate valves on new water systems. All valves installed as part of new construction shall remain fully closed during construction.

END OF SECTION

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes gravity-flow, non-pressure storm drainage outside the building and within manholes, with the following components:
 1. Special fittings for expansion and deflection.
 2. Cleanouts.
 3. Drains.
 4. Precast concrete, cast-in-place concrete, or plastic junction boxes.
 5. Hub-and-spigot, cast-iron soil pipe, and fittings.

1.3 DEFINITIONS

- A. HDPE: High density polyethylene plastic pipe.
- B. PVC: Polyvinyl chloride plastic pipe.
- C. RCP: Reinforced concrete pipe.
- D. HPP or HP Storm: High-performance polypropylene pipe.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silt-tight unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For the following:
 1. Special pipe fittings.
 2. Cast-iron Drain rated for 212°F.
 3. Channel drainage systems.
- B. Shop Drawings: For the following:
 1. Manholes: Include plans, elevations, sections, details, and frames and covers.
 2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
 3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, and design calculations.
- C. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

- 2.1 PVC PIPE AND FITTINGS – FOR 12" AND SMALLER STORM PIPES PER PLANS.
- A. PVC Profile Gravity Sewer Pipe and Fittings: PVC conforming to ASTM D2241, PVC 1120, DR 21, PR 200 (SDR-21). Color: Green. With bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.
- 2.2 RCP PIPE AND FITTINGS
- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M) or AASHTO M170, with bell-and-spigot or groove and tongue ends, and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets.
1. Class III, Wall C.
- 2.3 HPP OR HP STORM – FOR 12" AND LARGER STORM PIPES PER PLANS.
- A. High Performance Polypropylene Pipe (HPP or HP Storm) having a smooth interior and an annular corrugated exterior.
1. Where up to 30 inches in diameter, HPP pipe shall meet or exceed ASTM F2736.
2. Where 36 to 60 inches in diameter, HPP pipe shall meet or exceed ASTM F2881.
3. AASHTO loading requirements shall be met.
4. Minimum gage of piping shall be per manufacturer's recommendations.
- 2.4 HDPE PIPE
- A. All HDPE pipe shall conform to AASHTO M294, Type S. HDPE pipe to be ADS N-12 WT IB (watertight, integral bell) smooth interior, dual wall, or approved equivalent. For 48" diameter pipe and smaller, minimum cover shall be one (1) foot. For 54" and 60" diameter pipe, minimum cover shall be two (2) feet, or per plans. All HDPE pipe shall contain a minimum content of 2% carbon black as required by ASTM D3350. Pipe shall be furnished with an integral reinforced bell with a bell tolerance device and elastomeric gasket to meet ASTM F477 and ASTM D3212.
- 2.5 GENERAL FITTING AND CONNECTION REQUIREMENTS FOR ALL PIPE PRODUCTS
- A. All connections and fittings shall be compatible and approved for use with piping system being installed.
- B. Tee connections into storm sewer piping shall be Inserta-Tee lateral connection manufactured by ADS Pipe or MU Engineer approved equivalent.
- 2.6 NON-PRESSURE-TYPE PIPE COUPLINGS
- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rated at 212°F.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 2.7 CLEANOUTS
- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
- 2.8 JUNCTION BOX/ MANHOLE STRUCTURES

- A. Precast Concrete Junction Box/Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
 - 1. Ballast: Increase thickness of one (1) or more precast concrete sections or add concrete to manhole, as required to prevent flotation.
 - 2. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 - 3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 - 4. Steps: Steps shall be Neenah 1980-J, Deeter 1606, M.A. Industries PS2-PF, or equivalent. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches.
 - 5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 - 6. Protective Coating: Plant-applied, coal-tar; 10-mil (0.26-mm) minimum thickness applied to exterior surfaces.
 - 7. Manhole Frames and Covers: Deeter 1247, Neenah R-1642, or exact equal frame and lid. The lid shall be lettered with the words 'Storm Sewer' or 'Storm Drain'.
 - 8. Manholes shall have eccentric top sections.

2.9 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

2.10 TRACER WIRE AND TEST STATIONS

- A. Tracer Wire shall be #14 AWG solid, steel core soft drawn high strength tracer wire, 250# average tensile break load, 30 mil High Molecular Weight (HMWPE) or High Density (HDPE) polyethylene jacket complying with ASTM D-1248, 30-volt rating. Jacket color shall be green. No THHN insulated wire shall be allowed. Tracer wire shall be Copperhead Industries HS-CCS or approved equivalent. The tracer wire shall be taped to the pipe at the three o'clock position every five (5) feet. The tracer wire ends will terminate at a tracer wire test station.
- B. Tracer wire shall have moisture resistant splices for direct bury applications. Splices shall be Copperhead Industries Snakebite or 3M DBR or approved equivalent.

2.11 WARNING TAPE

- A. Install warning tape at least 12" above the top of pipe. Warning tape shall be 100% plastic.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 20 00 Section "Earthwork."

3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use non-pressure-type flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
 - a. Unshielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force-main joints.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- C. Gravity-Flow, Non-pressure Sewer Piping: Use pipe materials as shown on the Site Development Plans.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- F. Install gravity-flow, non-pressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1% unless otherwise indicated.
 - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
 - 3. Install corrugated steel piping according to ASTM A 798/A 798M.
 - 4. Install corrugated aluminum piping according to ASTM B 788/B 788M.
 - 5. Install HDPE corrugated sewer piping according to manufacturer's recommendations.
 - 6. Install hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - 7. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 8. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 9. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- G. Pipe shall be installed per manufacturer's instructions and ASTM D2321-20.

3.4 PIPE JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, non-pressure drainage piping according to the following:
 - 1. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
 - 2. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
 - 3. Join corrugated HDPE piping according to CPPA 100 and the following:
 - a. Use silt-tight couplings for Type 1, silt-tight joints.
 - b. Use soil-tight couplings for Type 2, soil-tight joints.
 - 4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
 - 5. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 - 6. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 - 7. Join dissimilar pipe materials with non-pressure-type flexible couplings.

3.5 PIPE FITTING INSTALLATION

- A. Fittings shall be installed per manufacturer's instructions and ASTM D2321-20.
- B. Inserta-Tee penetrations into storm sewer pipe shall be made with correctly sized Inserta-Tee core saw per ADS instruction.

3.6 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections according to ASTM C 891.
- C. Construct cast-in-place manholes as indicated.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops three (3) inches above finished surface elsewhere unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete as indicated.
- B. Construct riprap of broken stone as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.9 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.
- B. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:
 - 1. Cast-in-Place-Concrete Manholes: All exterior, except bottom.
 - 2. Precast Concrete Manholes: All exterior.

- C. Prepare ferrous frame and cover surfaces according to SSPC-PA 1 and paint according to SSPC-PA 1 and SSPC-Paint 16. Do not paint surfaces with foundry-applied, corrosion-resistant coating.

3.10 TRACER WIRE INSTALLATION

- A. Tracer Wire test stations shall be installed within two (2) feet of the manhole or structure in the flow line of the pipe. These test stations shall be designed to be easily detected by magnetic and electronic locators. A magnet shall be securely attached at the top of the upper tube of the box for locating purposes. Lid shall be green and have a brass terminal for attaching locating equipment and a brass 5-sided nut for removing cap. Tracer wire test station shall be Copper-head Industries Snake Pit or approved equivalent.

3.11 IDENTIFICATION / WARNING TAPE

- A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape 12" min. over ferrous piping.
 - 2. Use detectable warning tape 12" min. over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.13 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION

SECTION 33 61 13
HYDRONIC ENERGY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes hydronic energy distribution piping and related components outside the building for chilled water service.

1.2 REFERENCES

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

1.3 SUBMITTALS

- A. Action Submittals:
1. Product Data: For each type of product indicated.
- B. Informational Submittals:
1. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
 2. Field quality-control test reports.
- C. Closeout Submittals:
1. Operation and Maintenance Data: valves and specialties to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with all state and federal regulations to properly dispose of unwanted chilled water. Existing chilled water has additives required for operation.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. 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.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use slings to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 PRODUCTS

2.1 MATERIALS, PIPE, AND PIPE FITTINGS

- A. Standard Piping sizes used are as follows:
 1. 6", 8", 12", 16", 20", 24", 30", & 36".
- B. PVC (Polyvinyl Chloride) Pipe (Open Trench Construction):
 1. 6 inches to 12 inches: AWWA C900; Pressure Class 235 (DR 18); Cast Iron O.D. equivalent; with bell end and elastomeric gasket.
 2. 14 inches to 36 inches; AWWA C905; Pressure Rating 165 (DR 25); Cast Iron O.D. equivalent; with bell end and elastomeric gasket.
 3. Gaskets: ASTM F 477, elastomeric seal.
- C. PVC (Polyvinyl Chloride) Pipe (Trenchless Construction):
 1. Six (6) inches to 12 inches: AWWA C900; Class 235 (DR 18); cast iron O.D. equivalent; with grooved ends suitable for restrained joint coupling.
 2. Couplings: Non-metallic restrained joint coupling with PVC precision machined housing, nylon joint retaining splines, elastomeric O-ring seals, beveled leading edges, with pressure rating equal to or greater than pipe.
 3. Gaskets: ASTM F 477, elastomeric seal.
 4. Coupling Lubricant: Coupling manufacturer's standard for permanent joints.
 5. Compliance: Complete restrained joint pipe and coupling system shall be Factory Mutual approved, Underwriter's Laboratory Listed and shall comply with National Sanitation Foundation Standard No. 61 and UNI-BELL UNI-B-13.
 6. Restrained joint piping system shall be Certain Teed Certa-Lok C900/RJ system or approved equal.
- D. Ductile-Iron Pipe:
 1. Six (6) Inches to 36 Inches: AWWA C151; Mechanical Joint Pipe; 150 psi working pressure; Minimum Thickness Class 50, with integrally cast flanged bell, cast iron gland, and rubber gasket.
 2. Lining: Standard cement lining with asphalt coating.
 3. Encasement: AWWA C105, polyethylene film.
- E. Ductile-Iron Pipe Fittings:
 1. Six (6) Inches to 36 Inches: AWWA C153; 350-psi pressure rating.

2. Lining: Standard cement lining with asphalt coating.
 3. Encasement: AWWA C105, polyethylene film.
- F. Fitting Restraint:
1. Mechanical joint: AWWA C111. Provide retainer type packing glands with rubber gasket, for use with PVC pipe and conforming to Uni-B-13-92. Pipe sizes 4" to 12" must also be FM approved. EBAA Megalug 2000 PV or approved equal.
 2. Joint Retainers: Provide ductile iron clamp and rod type joint retainers for PVC bell and spigot joints. Clamps shall be designed for use with PVC pipe and shall meet Uni-B-13-92 Standards and be FM approved on sizes 4" to 12".
 3. Rods, nuts and washers: 3/4" SS304 all thread rods, nuts and washers.
 4. EBAA Series 1600 for pipe four (4) inches to 12 inches or approved equal.
 5. EBAA Series 2800 for pipe 14 inches and larger or approved equal.
 6. Link Assembly: Seal annular space for piping passing through walls with interlocking synthetic rubber link assembly, Link-Seal by Thunderline Corporation or approved equal.
 7. All pipe restraints and ductile iron fittings shall be installed wrapped with AWWA C105 polyethylene film.
- G. Trace Wire:
1. Tracer wire shall be #14 AWG Solid, steel core soft drawn high strength tracer wire, 250# average tensile break load, 30 mil high molecular weight-high density blue polyethylene jacket complying with ASTM-D- 1248, 30-volt rating. No THHN insulated wire shall be allowed. Tracer wire shall be Copperhead Industries HS-CCS or approved equal.
 2. Tracer wire shall have moisture resistant splices for direct bury applications. Splices shall be Copperhead Industries Snakebite or 3M DBR or approved equal.
 3. Tracer wire test stations shall be designed to be easily detected by magnetic and electronic locators. A magnet shall be securely attached at the top of the upper tube of the box for locating purposes. Lid shall be blue and have a brass terminal for attaching locating equipment and a brass 5-sided nut for removing cap. Tracer wire test station shall be Copperhead Industries Snake Pit or approved equal.

2.2 VALVES

- A. All valves shall open counterclockwise.
- B. Butterfly Valves: AWWA C504, Class 150B service, with cast iron body, cast iron disc with stainless steel seating edge, BUNA-N seal retained in body of valve, 304 stainless steel valve shaft, self-lubricating valve bearings, fully grease packed actuator with stops in the open/close position. The actuator shall have a traveling nut which shall engage alignment grooves in the housing and shall have a built-in packing leak bypass to eliminate possible packing leakage into the actuator. Valve interior and exterior surfaces except for seating shall be coated with two coats of asphalt varnish. Valves shall have mechanical joint ends. Valves shall be Pratt Groundhog, Mueller Linesal III or approved equal.
- C. Bronze Angle Ball Valves: Valve shall be 1" brass angle ball valve with 1" FIPxFIP connections. Valve shall have fluorocarbon-coated brass ball and integral stops that allow 90-degree motion. Valve shall have solid one-piece tee-head and stem. Valve shall be rated for 300 psi working pressure. Valve shall be brass and conform to AWWA C800. Valve shall be certified to NSF 61. Valve shall be Ford BA11-444WR-NL or engineer approved equivalent.
- D. Ball Valves: Threaded bronze, 125 lb., 2-piece design, full port. Valves shall be Nibco T-580 or approved equal.

2.3 VALVE BOXES

- A. Valve box shall be 6" PVC pipe, ASTM D3034, SDR 35, with cast iron cover. Clay and Bailey No. 2194 or approved equal. Lid shall be marked "CW" or CHILLED WATER". Provide below grade concrete collar in planted and asphalt areas. Base covering shall be Multi-Fit Adaptor #90004 by Adaptor Co. or approved equal.

2.4 CHILLED WATER VENT BOXES

- A. Minimum internal dimensions shall be 24" x 13" x 18" (L x W x D). Box shall be 4,000 PSI concrete with a galvanized steel cover and frame with open bottom. H-20 load rating. Cover shall be for the entire opening with a slotted pick hole and two recessed flat head galvanized screws with anchors. Concrete shall contain polymesh fibers. Box shall be TB – 1627 by Precision Precast or equivalent.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Refer to Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.2 INSTALLATION

- A. Preparation of Trench:
 1. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the piping. All rock greater than one inch in diameter found in the trench shall be removed for a depth of six (6) inches below the bottom of the pipe and replaced with suitable bedding material.
 2. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with crushed stone as indicated on the Drawings.
 3. Provide layers of crushed stone in the bottom of trench as indicated on the Drawings. Shape stone layer to fit bottom of piping. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.
 4. Finished pipe installation shall have minimum 12 inches separation to all other utilities. Supply and Return piping shall have the following minimum separation:

Pipe Diameter	Pipe Edge to Pipe Edge Separation
6"	12"
8"	12"
12"	18"
16"	18"
20"	18"
24"	18"
30"	24"
36"	24"

- B. Installation of Pipe and Pipe Fittings:
 1. PVC (Polyvinyl Chloride) Pipe: Install in accordance with AWWA C605.
 2. All underground chilled water piping shall be PVC.
 - a. EXCEPTION: Lines passing directly over steam tunnels or direct buried steam/condensate lines must be ductile iron with 2" R-5 extruded polystyrene insulation board between the pipe and steam lines.

3. All joints shall be restrained with joint retainers. All fittings shall be restrained with retainer type packing glands.
4. Install stainless steel rods between fittings on all offsets and between fittings, valves, and blind flanges, in addition to the Megalugs. On isolated fittings, valves, etc., attach restraint rings to PVC pipe and install stainless steel rods between fitting and restraint rings. Rods shall be positioned through the bolt holes in fitting and Megalug. Each rod will require four (4) nuts and washers. Duct lugs are acceptable. The number of stainless-steel rods required per fitting flange shall be as follows:

Pipe Diameter	No. of Rods
6" and 8"	2
12"	4
16"	6
20"	8
24"	12
30"	14
36"	14

5. Ductile iron pipe, fittings, and valves shall be wrapped with a polyethylene cover conforming to AWWA C105. Install per AWWA C600.
6. Pipe shall be installed in clean condition and shall never be laid in trenches with standing water. Contractor shall make provisions to keep the trench dewatered during installation of the chilled water line. Protect open pipe ends with a hard cap or inflatable plug at the end of the workday. NO PLYWOOD OR DUCTTAPE COVERINGS WILL BE ALLOWED.

C. Backfill:

1. Under Pipe: All backfill under the barrel of the pipe shall be free from debris, organic matter, and stones larger than one inch, and shall be tamped into place. Sand or crushed stone aggregate (95% passing a 1/2" screen but not more than 10% passing a #200 sieve) are acceptable substitutes for soil.
2. Adjacent To and Top of Pipe: The first one (1) foot of backfill over the top of pipe shall be "3/4 inch minus waste rock with fines" uncleaned crushed stone aggregate or suitable soil. Backfill shall be free of debris, brush, roots and stones or rubble more than one inch.

D. Identification:

1. Trace wire shall be pulled with pipe, without splices.
2. Tape tracer wire to the top of each chilled water line with duct tape every five (5) feet. Contractor shall minimize wire splices. Terminate trace wires inside building and inside valve boxes. Drill 1/4" hole in PVC valve box 1" below cast iron cover. Route wire up outside of valve box, through 1/4" hole and knot. Trace wire shall be tested for continuity in presence of Owner's Representative, after pulling in completed.
3. Install continuous plastic underground warning tape during back-filling of trench for chilled water and compressed air piping. Locate 24 inches above pipe, directly over each chilled water line.

E. Trenchless Piping Installation (**Not Applicable to this Project**):

1. It is the desire of system owners to assure that trenchless piping installation be completed in a timely, quality and accurate manner utilizing good, well-maintained equipment and trained competent personnel. Trenchless piping must be installed on a route as close to the drawings as possible to prevent interference with buried utilities and other obstructions, and to prevent future accidental excavation damage.
2. Directional drilling and pipe installation shall be done only by an experienced operator specializing in directional drilling and whose key personnel have at least five (5) years' experience in this work.

3. Pipe installed by the directional drilled method must be located in plan as shown on the Drawings and must be no shallower than shown on the Drawings unless otherwise approved. The actual horizontal and vertical alignment of the pilot bore shall be plotted at intervals not exceeding twenty (20) feet. This “as built” plan and profile shall be updated as the pilot bore is advanced. Instrumentation shall be utilized at all times that will accurately locate the pilot hole and measure drilling fluid flow and pressure.
4. Pilot hole shall be drilled on bore path with no deviations greater than 5 feet left/right/depth over a length of 100 feet. In the event that pilot does deviate from bore path more than this amount, the Engineer shall be notified and Engineer may require the pilot drill to be pulled back and re-drilled from the location along bore path before the deviation. The final exit point of pilot hole shall be within five (5) feet of the location shown on the drawings.
5. Trenchless piping installed using directional drilling equipment shall be installed in full compliance with restrained joint piping system manufacturer's instructions.
6. Field grooving tools, pulling heads, spline insertion tools, etc. shall be piping system manufacturer's standard.
7. Comply with piping system manufacturer's requirements on maximum pulling force, minimum bend radius, maximum deflection, etc. During pull-back operations, no more than the maximum safe pipe pull pressure shall be applied at any time. Maximum allowable tensile force imposed on the pull section shall be equal to, or less than 80% of the pipe manufacturer's safe pull (tensile) strength.
8. Provide pressure relief holes at close enough intervals to prevent buckling of pavement/sidewalks. If damage does occur, the pavement shall be repaired in accordance with pavement details provided.
9. Trace wire shall be pulled with pipe, without splices. Upon completion of installation, a continuity test on the wire shall be performed and all breaks shall be repaired.

3.3 VALVE / VALVE BOX INSTALLATION

- A. Valve Storage: Use the following precautions for valves during storage:
 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
 3. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use hand wheels or stems as lifting or rigging points.
- B. Valve Installation:
 1. Chilled Water service and mains: Install butterfly valves. Comply with AWWA C600. Install buried valves with stem pointing up and with valve box.
 2. Buried taps for vents: Bronze Angle Ball Valves.
 3. Indoor vents and drains: Ball valves.
 4. Valve boxes and vent boxes shall be installed vertically with top of box even with final grade.
- C. Valve Testing:
 1. All valves shall be pressure tested in accordance with standards set forth in the Chilled Water Piping.

3.4 FIELD QUALITY CONTROL

- A. Cleaning:

1. Cleaning of all piping shall be performed as detailed in section 33 13 00 Disinfecting of Water Utility Distribution. Chilled water distribution piping does not require disinfection.
- B. Piping Tests: Leak and pressure tests shall follow procedures outlined in AWWA M23. Conduct piping tests before joints are covered. Use only potable water.
- C. Simultaneous Tests: Conduct leak and pressure testing at the same time. All tests shall be conducted in the presence of the Owner's Representative or their designee. Test at not less than 125 psig for two (2) hours.
- D. Test Report: Submit Test Reports to the Owner's Representative.

3.5 COMMISSIONING

- A. System shall be placed in operation only after piping has been leak tested, flushed clean and approved by system owner personnel. Insert subsection information.

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SECTION 33 63 00
STEAM ENERGY DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes piping, fittings, insulation, expansion joints, and accessories for steam energy utility piping systems.
- B. The work shall include all materials, equipment, and labor required for complete and properly functioning process piping systems.
- C. Drawings are intended to be schematic in nature in order to communicate the scope of work and show general arrangement of equipment and piping. Contractor shall make reasonable changes in arrangement and configuration of equipment and piping as directed by Engineer without additional cost to the Owner.
- D. Drawings and Specifications for process piping work are intended to be complementary in conveying the scope of work. Contractor shall complete work shown on one (1) Drawing regardless of whether it is shown on other Drawings or Specifications. Should a conflict be found, Contractor shall immediately contact Owner and Engineer.
- E. Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- F. Not all pipe fittings, access panels, sleeves, and other basic items are shown on the Drawings. Where such items are required by the nature of the work, Contractor shall provide.
- G. Where job conditions require reasonable changes in indicated locations and arrangements, Contractor shall make such changes without additional cost to Owner.
- H. Certain piping or items such as unions or fittings may not be shown, but where such items are required by other sections of the Specifications or where they are required by the nature of the work, they shall be furnished and installed.
- I. Work shall include furnishing the required hoisting equipment to set all materials and equipment in place.

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Contractor shall comply with all such regulations and standards and shall protect and indemnify Owner and Engineer against any and all claims or liabilities arising from, or based upon, non-conformance with the regulations during normal service conditions.
- C. American Society of Mechanical Engineers (ASME):
 - 1. ASME B31.1 – Code for Pressure Piping – Power Piping.
- D. ASTM International (ASTM):
 - 1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
 - 3. ASTM A106/A106M – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - 4. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 5. ASTM C591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

- E. American Welding Society (AWS):
 - 1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
 - 2. AWS D1.1 – Structural Welding Code – Steel.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes. Provide material Specification number (ASTM, API, etc.), grade, class or type, pressure and temperature rating, and schedule number for piping and fittings for each system. Verify field dimensions and conditions before shop Drawings are submitted.
- B. Insulation and jacketing product data:
 - 1. Submit product description, thermal characteristics, and list of materials and thickness for each service and location.
 - 2. Submit Safety Data Sheets (SDS) for all insulation materials, including mastics and adhesives. All SDS sheets shall be approved by the Owner and Engineer prior to use.
 - 3. Cross reference insulation types from insulation schedule to submitted insulation products.
 - 4. Submittal shall be organized such that all data sheets for each insulation type are on consecutive pages.
- C. Insulation and jacketing Shop Drawings:
 - 1. Insulation materials: Specify each type used and state surface burning characteristics.
 - 2. Insulation facings and jackets: Specify each type used. Clearly identify finish color of all jacketing materials.
 - 3. Insulation accessory materials: Specify each type used.
 - 4. Manufacturer's installation and fitting fabrication instructions.
 - 5. Reference applicable Specification paragraph numbers for coordination.
- D. Piping test procedures and piping test certifications.
- E. Welder's certificate: In compliance with AWS D1.1 and ASME B31.1.
- F. Source quality control test reports.
- G. Valves – Gate, globe, check, plug, butterfly, or ball:
 - 1. Catalog cuts showing design and construction.
 - 2. Pressure and temperature ratings.
 - 3. Materials of construction.
 - 4. Accessories.
 - 5. Manufacturer.
- H. Steam Traps:
 - 1. Catalog cuts showing design and construction.
 - 2. Service limitations (maximum pressures and temperatures).
 - 3. Materials of construction.
 - 4. Flow rates at differential pressures.
 - 5. Orifice size for each trap.
 - 6. Manufacturer.
- I. Modular Seals:
 - 1. Catalog cuts showing design and construction.
 - 2. Service limitations (maximum temperatures).
 - 3. Manufacturer.
- J. Expansion joints – Externally Pressurized as specified:
 - 1. Catalog cuts showing design and construction.
 - 2. Pressure and temperature ratings.
 - 3. Materials of construction.
 - 4. Accessories.
 - 5. Manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data: Submit operation and maintenance manuals for all piping materials, insulation materials, valves, equipment, and piping specialties within this section.
- B. Field quality test reports.
- C. Installation and storage information.

1.5 QUALITY ASSURANCE

- A. Entire installation shall comply with ASME Power Piping Code, ASME B31.1, and appendices unless otherwise indicated. All pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69.
- B. Mechanical, electrical, and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified.
- C. Systems shall be comprised of high-quality industrial-class products of manufacturers that are experienced specialists in the required product lines. Manufacturer shall specialize in manufacturing products with minimum five (5) years' experience.
- D. All elements of construction shall be performed by workmen skilled in the particular craft involved and regularly employed in that particular craft. Construction firms and personnel shall be experienced and qualified specialists in power piping.
- E. All work shall be performed in a neat, workmanlike manner in keeping with the highest standards of the craft. Coordinate with the Owner about loud work, times, and protection of objects. All work shall be pre-inspected by Contractor prior to inspection final checkout.
- F. Mechanical systems welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:
 - 1. Perform work in accordance with ASME B31.1 code for installation of piping systems, ASME Section IX for welding materials and procedures, and applicable state of Missouri regulations.
 - 2. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved and that certification is current.
 - 3. Welders' qualifications shall be in compliance with ASME B31.1 and AWS D1.1.
 - 4. Welders and welding procedures: AWS D.1 qualified within previous 12 months for employed weld types.
 - 5. Each welder shall utilize a stamp to identify all work performed by the welder. Owner reserves the right to reject any personnel found unqualified in the performance of work for which they are employed.
- G. Test pipe insulation for maximum flame spread index of 25 and maximum smoke-developed index not exceeding 50 in accordance with ASTM E84.
- H. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- I. Factory-fabricated fitting covers manufactured in accordance with ASTM C450.
- J. Test materials in accordance with the requirements of NFPA 255.
- K. All insulation materials (including adhesives, caulks, mastics, cements, etc.) shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- L. Manufacturer shall stamp all valves with pressure and temperature rating that meets or exceeds specified hydrostatic shell and closure test pressures.

- M. Protect all exposed insulation and coatings from damage due to water, dirt, debris, and weather in strict accordance with Manufacturer’s recommendations.
- N. All insulated piping systems exposed to water must be replaced with new systems.
- O. Replace all damaged items with ones in first class, new operating condition or replace damaged items as determined and directed by the Owner’s Representative at no additional cost to the Owner.
- P. Steam and condensate mains and services shall be installed in reinforced concrete chases, walk tunnels, and manholes. All installed equipment and associated piping shall be accessible for maintenance and installed in manholes. All piping and structure installations shall be designed and installed in a manner to provide drainage of any water introduced into the systems. All systems shall be ventilated either by natural or power ventilation.

1.6 STEAM DISTRIBUTION SYSTEM CONDITIONS

UTILITY SYSTEM	DESIGN CONDITION
Medium-Pressure Steam (MPS)	75 psig at 450° F
Pumped Condensate (PC)	75 psig at 200° F

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All piping shall be stored and kept free of foreign material and shall be internally and externally cleaned of oil, dirt, rust, and foreign material. Deliver and store valves, expansion joints, and pipe hangers in sealed shipping containers with labeling in place. Storage must be in a dry, protected location.
- B. Protection of equipment and materials:
 - 1. Equipment and material placed on the job site shall remain in the custody of the Contractor until acceptance, whether Owner has reimbursed Contractor for equipment and material. Contractor shall be solely responsible for the protection of such equipment and material against any damage.
 - 2. Accept materials on site in original factory packaging labeled with manufacturer’s identification. Protect from weather and construction traffic, dirt, water, chemicals, and damage by storing in original packaging.
 - 3. Place damaged equipment in first class, new operating condition or replace with the same as determined and directed by Owner. Such repair or replacement shall be of no additional cost to Owner.
 - 4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting and placing equipment in operation.
 - 5. Existing equipment and piping being worked on by Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
 - 6. Do not telescope small pipe inside large pipe for shipment or storage.
 - 7. Handle piping by use of slings, hoists, skids, or other approved means. Dropping or rolling of pipe and fittings is not permitted.
- C. Cleanliness of piping and equipment systems:
 - 1. Exercise care in storage and handling of equipment and piping material to be incorporated in work. Remove debris arising from cutting, threading, and welding of piping.
 - 2. Piping systems shall be flushed, blown, or pigged as necessary to deliver clean systems.
 - 3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.
- D. Accept insulation and jacketing materials on site in original factory packaging. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer’s stamp or label giving the name of the manufacturer, description of the material, product density, product thickness, and thermal characteristics.

- E. Protect insulation from weather and construction traffic, dirt, water, chemicals, and damage by storing in original wrapping.
- F. Store materials in a clean and dry environment; pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics, and finishing cements.
- G. Accept valves and expansion joints on site in shipping containers with labeling in place. Inspect for damage.

1.8 JOB CONDITIONS

- A. Phasing of demolition and construction shall be in accordance with the provisions as shown on the plans.
- B. Interruption of existing service: Any interruption of existing utility service shall be coordinated with and approved by the Owner prior to the interruption.

1.9 WARRANTY

- A. Provide a one (1) year manufacturer's warranty on piping specialties, expansion joints, and valves specified herein from the date of substantial completion.

1.10 DEFINITIONS

- A. Large bore piping: Piping detail routed on Drawings is generally 2½" and larger in diameter unless indicated otherwise.
- B. Small bore piping: Piping not routed on Drawings is generally 2" and smaller in diameter. Contractor shall field-route small bore piping based upon requirements of Piping and Instrumentation Diagrams (PIDs) unless indicated otherwise.
- C. Density: Pounds per cubic foot (lb./ft³).
- D. Thermal conductance: Heat flow rate through materials.
 - 1. Pipe or cylinder: BTU per hour per linear foot (BTU/h- ft).
- E. Thermal conductivity (k): BTU per inch thickness, per hour, per square foot, per degree F temperature difference (Btu-in/hr-ft²-°F).

PART 2 PRODUCTS

2.1 PIPING - GENERAL

- A. Provide piping, fittings, flanges, hardware, and accessories for each system as specified herein.
- B. Contractor shall be responsible for completing material take-offs, tools and equipment, materials and methods, fabrication and assembly, field safety program, and manuals and Drawings.
- C. Contractor shall be responsible for field verifying all dimensions, layouts, existing conditions, interface with existing systems, equipment and utilities, and other information necessary for the installation of new piping, fittings, valves, expansion joints, insulation, specialties, and appurtenances associated with each piping system.
- D. Contractor shall lay out the piping system in careful coordination with the design Drawings, determining the proper locations and elevations of all components, and using the minimum number of bends to produce a satisfactory functioning system. The Contractor shall follow the general layout of the design Drawings in all cases except where other work or structures may interfere.

- E. Contractor shall provide pipe supports, anchors, flexible couplings, and expansion joints for all piping systems. The Drawings indicate pipe supports, anchors, flexible couplings, and expansion joints for piping 2½" and larger and for some pipes that are 2" and smaller. If pipe supports are not detailed on the Drawings, Contractor shall design and provide pipe supports per ASME B31.1 and MSS SP-58.
- F. Piping and fitting materials shall be new and shall be furnished and installed in full lengths. Multiple short lengths of pipe with couplings (to assemble long runs) are not acceptable.
- G. If not shown on Drawings, Contractor shall give priority first to equipment, second to process piping and instrumentation, third to HVAC, fourth to fire protection piping and sprinklers, fifth to lighting fixtures, sixth to electrical conduit and cable tray, seventh to service and instrument air, and eighth to vents and drains as applicable.
- H. Drips, drains, vents, and blowdown are designed and materials and equipment are applied in accordance with the maximum pressure and temperature of the system with which they are associated.
- I. Provide piping, fittings, valves, and appurtenances for drains, vents, instrumentation, sample line, etc. not shown on Drawings, but required for complete, safe, and reliable operation of equipment and systems furnished and installed under this Contract. Such piping, fittings, valves, and appurtenances shall be rated in accordance with the piping system to which they are connected.
- J. Backing rings shall not be allowed for welded piping.

2.2 MEDIUM-PRESSURE STEAM (MPS)

- A. Comply with the requirements of ASME B31.1.
- B. Piping (150 psig pressure class): ASTM A53, Grade B, seamless carbon steel.
 - 1. Wall thickness:
 - a. Pipe sizes 2" through 10": Schedule 40.
 - b. Pipe sizes 12" and above: Standard weight (STD).
- C. Joints:
 - 1. Pipe size 2" and below: Socket-welded.
 - 2. Pipe size 2 ½" and above: Butt welded with end preparation in accordance with ASME B16.25.
- D. Fittings:
 - 1. 2" and under: ASTM A105, ANSI B16.11, Class 3000 socket weld forged steel fittings.
 - 2. 2" and under steam trap piping in manholes: ASTM A105, ANSI B16.11, Class 2000 threaded forged steel fittings.
 - 3. 2-1/2" and above: ASTM A234, Grade B, ASME B16.9, seamless, same schedule as adjoining pipe.
 - 4. All fittings shall be long radius type unless indicated as short radius on Drawings.
- E. Unions and Flanges:
 - 1. Unions: ASTM A105, Class 2000 forged steel, threaded.
 - 2. Flanges: ASTM A105, ANSI B16.5, Weldneck, 150#, forged steel.
 - 3. Gaskets: Class 150, Spiral wound, Style CG or CGI, 304 SS/Industrial Grade.
 - a. Manufacturer: Flexicarb as manufactured by Flexitallic Group, Houston, Texas or approved equivalent.
 - 4. Bolting: ASTM A193, Grade B7, Alloy Steel, Stud Bolts with Heavy Hex nuts, ASTM A194, Grade 2H.
 - 5. Link Assembly: Seal annular space for piping passing through walls with interlocking synthetic rubber link assembly.
 - a. Manufacturer: Model "T" Link Seal as manufactured by PSI-Thunderline Corporation, Houston, TX or approved equivalent.

2.3 PUMPED CONDENSATE (PC)

- A. Comply with the requirements of ASME B31.1.
- B. Piping (150 psig pressure class): ASTM A53, Grade B, Seamless Carbon Steel.
 - 1. Wall thickness:
 - a. All pipe sizes: Schedule 80.
- C. Joints:
 - 1. Pipe sizes 2" and below: Socket-welded.
 - 2. Pipe sizes 2 ½" and above: Butt welded with end preparation in accordance with ASME B16.25.
- D. Fittings:
 - 1. Welded joints:
 - a. Pipe sizes 2 ½" and above: ASTM A234, Grade B, ASME B16.9, seamless, same schedule as adjoining pipe.
 - b. Pipe size 2" and below: ASTM A105, 3000 psig pressure class.
 - 2. All elbows shall be long radius type unless indicated as short radius on Drawings.
- E. Unions and Flanges:
 - 1. Unions: ASTM A105, Class 2000 forged steel, threaded.
 - 2. Flanges: ASTM A105, ANSI B16.5, Weldneck, 150#, forged steel.
 - 3. Gaskets: Class 150, Spiral wound, Style CG or CGI, 304 SS/Industrial Grade.
 - a. Manufacturer: Flexicarb as manufactured by Flexitallic Group, Houston, Texas or approved equivalent.
 - 4. Bolting: ASTM A193, Grade B7, Alloy Steel, Stud Bolts with Heavy Hex nuts, ASTM A194, Grade 2H.
 - 5. Link Assembly: Seal annular space for piping passing through walls with interlocking synthetic rubber link assembly.
 - a. Manufacturer: Model "T" Link Seal as manufactured by PSI-Thunderline Corporation, Houston, TX or approved equivalent.

2.4 DIELECTRIC FITTINGS

- A. Provide threaded dielectric unions for pipe sizes 2" and under. For 2 ½" and above, provide copper and steel flanges electrically isolated at gasket and by sleeves at bolts. Fittings on steam, condensate, chilled water, condenser water, or hot water lines shall be rated at same pressure class as adjoining piping.
- B. Screwed joints shall be made with insulating unions and couplings.
- C. Flanged joints shall be made up of flange insulation kits consisting of a suitable gasket, bolt sleeves, and washers.

2.5 PIPE SLEEVES

- A. Service: For pipes passing through floors, walls, and partitions.
- B. Construction: Steel pipe, Schedule 40 minimum.
- C. Size: Size pipe sleeve based upon the size of the utility piping and requirements of modular seal manufacturer's recommendations for the type of modular seal specified.
- D. Pipe sleeves shall extend a minimum of 6" above finished floor for penetrations through floors.
- E. Pipe sleeves shall have square cut ends with anchoring lugs welded on. Horizontal sleeves through walls and partitions shall be grouted in place and flush with finished wall faces.
- F. Size sleeves such that internal diameter is a minimum of 2" larger than the outside diameter of bare pipe for uninsulated lines and 2" larger than the outside diameter of insulation and jacket for insulated lines. Center pipes in sleeves.

- G. Lines entering buildings through sleeves shall be sealed with a high temperature link assembly placed on the outside of the insulation jacketing.
- H. Valve vault walls cannot be used as anchor points.
- I. Do not install pipe penetrations through beams, ribs, webs, etc.

2.6 MODULAR SEALS FOR PIPE PENETRATIONS

- A. For pipes penetrating the vault walls, ceiling, or floor, provide modular seals per details on Drawings.
- B. Type: Modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object (utility piping) and sleeve. Modular seal shall be connected with bolts and steel zinc dichromate pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- C. Temperature rating: -67°F to 400°F.
- D. Bolts: Steel with zinc dichromate with corrosion inhibiting coating.
- E. Size modular seals per modular seal manufacturer's recommendations for type specified.
- F. Manufacturer: Model "T" Link-Seal Modular Seal, PSI-Thunderline Corporation.

2.7 THREAD SEALANTS

- A. As recommended by the sealant manufacturer for the service.

2.8 PIPING AND EQUIPMENT INSULATION

Service	Insulation Symbol	Design Temp, °F	Pipe Size	Thickness
Steam	MPS	450	2" and below	1.5"
Steam	MPS	450	2-1/2" to 3"	2"
Steam	MPS	450	4"	2.5"
Steam	MPS	450	6" to 12"	3.0"
Steam	MPS	450	14" and above	3.5"
Condensate	PC	200	1-1/2" and below	1"
Condensate	PC	200	2" and above	1.5"

- A. In walk tunnels and steam manholes, piping insulation may need to be thicker than listed above. Surface temperatures of the aluminum jacket shall be no more than 132°F, assuming steam temperatures of 400°F, an airflow of 1 mph, and an ambient temperature of 80°F.
- B. Steam and Condensate pipe insulation:
 - 1. Type: E-glass layered insulation as manufactured in accordance with ASTM C552.
 - 2. Thickness: See insulation thickness table above.
 - 3. Insulation banding: Stainless steel bands and clips at least 1/2" wide, ASTM A167 (Type 304 stainless steel), maximum spacing 18". A minimum of two (2) bands is required for each 4-foot section of insulation.
 - 4. Manufacturer: "Eslin" E-Glass as manufactured by Visionary Industrial Insulation, Kapolei, HI, or approved equivalent.

2.9 PIPING INSULATION JACKET AND ACCESSORIES:

- A. Aluminum pipe jacket:
 - 1. Service: All piping insulation in manholes, trenches, and tunnels.
 - 2. Aluminum alloy sheet in accordance with ASTM B209 with H-14 temper, 1/8" diameter holes on 21/64" staggered corners, minimum thickness of 0.024".
 - 3. Finish: Stucco embossed.

4. Perforated aluminum jacket. Fittings shall be covered with 0.016" perforated aluminum jackets.
 5. Manufacturer: Insul-Mate as manufactured by RPR Products, Inc., Houston, TX, or approved equivalent.
- B. Removable Insulation Covers:
1. Covers shall be used on flanged valves, expansion joints, and steam meters.
 2. Type: Removable and reusable one (1) piece thermal insulation cover consisting of high-density insulation (fiberglass, mineral wool, ceramic fiber).
 3. Interior cover: Stainless steel wire mesh.
 4. Exterior cover: Teflon-impregnated Nomex or coated glass fabric.
 5. Thickness: 1-1/2" minimum.
 6. Secured with heavy adjustable straps with buckles.
 7. Suitable for temperatures up to 500°F.
 8. Install Velcro sealed "inspection window" for expansion covers to allow maintenance personnel the ability to inspect for proper movement of the expansion joint slip.
- C. Pipe insulation accessories:
1. Sealants necessary for proper insulation system installation shall be compatible with the insulation and jacketing materials used and shall be capable of withstanding the system operating temperature conditions.

2.10 STEAM ENERGY SYSTEM VALVES:

- A. Comply with MSS SP-45, MSS SP-80, and ASME B31.1. Design valves for the service fluids and conditions. Pressure-temperature ratings listed are minimum requirements. Packing and gaskets shall not contain asbestos.
- B. Valve manufacturers are listed for purposes of clarification. Equivalent valves produced by an approved manufacturer may be used.
- C. All steam valves 6" and larger shall have a warm-up line to facilitate safe start-up of the steam line.
- D. Check Valves:
1. Size: 2" and below.
 2. End connection: threaded.
 3. Pressure class: Class 300 (ASME/ANSI B16.34).
 4. Type: Bolted flanged cap, stainless steel body swing check.
 5. Manufacturer #2341 as manufactured by Powell Valves, Cincinnati, OH or approved equivalent.
- E. Butterfly Valves:
1. Size: 16" and below.
 2. End connection: Lugged
 3. Pressure Class: Class 150.
 4. Type: Lug Style.
 5. ISO face to face.
 6. Body: Carbon Steel.
 7. Disc: Stainless Steel.
 8. Seal: Laminated graphite and stainless steel.
 9. Manual gear operator with handwheel and open/close.
 10. Manufacturer: Adams MAK, Bray Trilok, Velan Torqseal, Zwick Tri-Con, or approved equivalent.
- F. Gate Valves-Threaded:
1. Size: 2" and below.
 2. Pressure Class: Class 800.
 3. Type: Forged Steel, Outside stem and yoke.
 4. Manufacturer: Hancock 950 S, Vogt 12111, or approved equivalent.
- G. Gate Valves-Socket weld:

1. Size: 2" and below.
 2. Pressure Class: Class 800.
 3. Type: Forged Steel, Outside stem and yoke.
 4. Manufacturer: Hancock 950 W, Vogt SW 12111, or approved equivalent.
- H. Globe Valves-Threaded:
1. Size: 2" and below.
 2. Pressure Class: Class 800.
 3. Type: Forged Steel, Outside stem and yoke.
 4. Manufacturer: Hancock 5500S, Vogt 12141, or approved equivalent.
- I. Globe Valves-Socket weld:
1. Size: 2" and below.
 2. Pressure Class: Class 800.
 3. Type: Forged Steel, Outside stem and yoke.
 4. Manufacturer: Hancock 5500W, Vogt SW 12141, or approved equivalent.
- J. Ball Valves-Threaded:
1. Size: 2" and below.
 2. Pressure Class: Steam Working Pressure: 150, Cold Working Pressure: 600.
 3. Type: Stainless Steel, Full Port, 2-piece.
 4. Body: Lead Free Bronze.
 5. Trim and handle.
 6. Seats and Seals: MTFE.
 7. Manufacturer: Apollo 77CLF 140-10 or approved equivalent.

2.11 STEAM TRAP

- A. Type: Inverted bucket trap.
- B. Pressure Class: Class 300 with 250 psig pressure rating at 450°F.
- C. Construction: Inverted bucket traps shall be ASTM A278, cast iron. Lever arms and bucket shall be stainless steel.
- D. Side inlet and outlet.
- E. Connection: ¾".
- F. Minimum of 1/8" orifice.
- G. Minimum trap capacity shall be 400 lb./hr. at 10 psi differential with the capability to operate with 80 psig differential.
- H. Manufacturer: Armstrong International, model 800 or approved equivalent.

2.12 EXPANSION JOINTS:

- A. Service: Medium-pressure steam or pumped condensate piping systems, rated as follows:
 1. Medium-pressure steam (MPS): 75 psig steam at 450°F.
 2. Pumped Condensate (PC): 75 psig steam at 200°F.
- B. Type: Single without base.
- C. Expansion joint shall be externally pressurized bellows type as shown on Drawings.
- D. Joint shall be internally and externally guided, have integral heavy cover and sleeve, and drain and vent connections. The external housing shall be designed for max system pressure.
- E. End preparation: Weld ends, same schedule as adjoining pipe.
- F. Bellows Type: Externally pressurized, 150 psig design.

- G. Bellows material: 304 Stainless Steel or Inconel.
- H. Covers: Integral.
- I. Sleeve: Integral.
- J. Cycles: 1000.
- K. Joints shall be pre-compressed at the factory for the design travel and shipped with suitable restraining devices to permit proper installation of joint in cold line. Provide for possible joint extension of at least 10% of rated travel. Joints shall include integral flow restrictor.
- L. Joints and guides shall be properly cleaned and painted with manufacturer's standard finish.
- M. Install per manufacturer's Specifications.
- N. Manufacturer: Adscos Manufacturing, Hyspan 3502, or Senior Flexonics Pathway.

2.13 STRAINERS: Y-TYPE

- A. Strainer shall be Y-pattern with stainless steel screen having 0.045" openings.
- B. Strainer shall have blowdown gate valve and associated piping of size matching blow down connection.
- C. Construction: Threaded, Class 600, Cast steel ASTM A216 Grade WCB.
- D. Manufacturer: Armstrong International, model B1SC or approved equivalent.

2.14 VENT CAP

- A. Furnish and install vent caps in steam chases entering buildings next to the building.
- B. Type: Mushroom cap.
- C. Body: Cast Aluminum.
- D. Screen: Brass Mesh.
- E. Connection: 4" NPT.
- F. Manufacturer: Catalog number 11740 by Preferred Utilities, Danbury, CT, or approved equivalent.

2.15 PRESSURE GAUGES

- A. Pressure gauges shall be installed as before every main line steam valve. Coordinate gauge locations with Owner.
- B. Pressure gauges shall be 1% accuracy with stainless steel movement, black phenolic or aluminum alloy case, 4-1/2" diameter dial and 1/2" NPT connection. Gauges shall be by Ashcroft, Palmer, Terrice, Weiss or Weksler.
- C. Bourdon tube shall be stainless steel.
- D. All gauges shall have 1/2" carbon steel bar stock needle valve suitable for steam service.
- E. Gauges used on steam service shall be protected with pigtail siphons.
- F. Gauge scale range shall be as follows:
 - 1. Steam: 0 – 150 psig.

2. Condensate: 0 – 100 psig.

PART 3 EXECUTION

3.1 GENERAL

- A. Connecting to existing work: Connect new work to existing work in a neat and workmanlike manner. Where an existing structure must be cut or existing utilities interfere, such obstruction shall be bypassed, removed, replaced or relocated, patched, and repaired. Work disturbed or damaged shall be replaced to its prior condition.
- B. Grading: As shown on Drawings.

3.2 DEMOLITION

- A. Perform work in accordance with requirements for phasing.
- B. Completely remove all pipe, valves, fittings, insulation, and hangers including the connection to the structure and any fastenings and as shown on the Drawings.
- C. Seal all openings in valve vaults after removal of piping through wall penetrations.
- D. All material and equipment removed shall become the property of the Contractor.

3.3 SCHEDULING

- A. Site utility tie-ins shall be coordinated with the Owner's Representative. Contractor shall notify Owner's Representative two (2) weeks in advance of desired tie-in time. Owner's Representative will give Contractor 72 hours advance notice of actual time for tie-ins. Outages are to be kept to a minimum.
- B. Tie-ins to utility systems shall be made on weekends or nights, and work shall be done around-the-clock until the tie-in is completed.

3.4 PIPING – GENERAL

- A. Carefully inspect all pipe, fittings, valves, equipment, and accessories prior to installation. Any items which are unsuitable, cracked, or otherwise defective shall be rejected and removed from the job immediately.
- B. Pipe lines shall be run straight and true with a minimum use of joints and with only such offsets as may be required to clear interferences, to provide necessary clearance or headroom, or provide the necessary flexibility in the piping system.
- C. Changes in direction of pipe lines shall be made with approved fittings or pipe bends only. Miter joints in welded pipe assemblies shall not be used except where approved by Project Manager.
- D. Backing rings shall not be used on butt welded joints.
- E. All prefabricated piping shall be arranged with extra tangent, loose flanges, field joints, or other provisions to permit field adjustment to suit construction tolerances and to avoid interferences.
- F. Provide flanges or unions at all final connections to equipment, traps, and valves to facilitate dismantling. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.
- G. Pipe shall be cut to exact measurement and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces, or strains on valves, equipment, or structural elements with piping connections or piping supports.

- H. All threaded pipe work is to be assembled with full threads, including all fittings, valves, unions, and specialties. Threads shall be full and clean cut and the pipe shall be reamed and filed, removing all burrs from the interior. Threaded work shall be made up with a suitable pipe joint compound.
- I. All pipe shall be erected and supported in such a manner as to provide for expansion and contraction without harmful strain to structural members, pipe, and pipe supports.
- J. Consideration shall be given to insulation thickness when routing piping such that adequate clearance is provided to avoid interfering with insulation.
- K. All piping in pipe chases shall be welded regardless of size.
- L. Install valves with stems horizontal or extending vertically upward. All valves shall be installed in accessible locations for operation as well as for removal, repair, or replacement.
- M. Install valves with stems horizontal or extending vertically upward. All valves shall be installed in accessible locations for operation as well as for removal, repair, or replacement.
- N. Draining and Venting:
 - 1. Maintain constant slope so lines are pitched for venting and drainage. No lines shall have pockets due to changes in elevation unless proper provisions for draining and venting are provided.
 - 2. Provide 1/2" drain valves fitted with 3/4" hose thread adapter at all low points of steam or condensate piping systems to permit complete or sectionalized draining.
 - 3. Provide manual air vents at the high points of condensate piping systems.

3.5 PIPING JOINTS AND FITTINGS

- A. Welded joints:
 - 1. Branch connections shall be made with either welding tees or welding outlet fittings. Welding outlet fittings shall be forged, integrally reinforced to provide 100% pipe strength, beveled for full penetration welding, and funneled at inlet for full fluid flow.
 - 2. Clean pipe and fittings before welding and installation in system.
- B. Threaded joints:
 - 1. Pipe threads shall be cut to give proper engagement in threaded fittings. Threaded pipe shall have clean-cut threads; dull or damaged pipe dies shall not be used.
 - 2. Clean pipe and fittings before installation and ream pipe after cutting threads. Joints shall be made with oil and graphite pipe joint compound applied to male threads only.
- C. Branch connections:
 - 1. Branch connections shall be made with standard tees and 45° laterals of the type required for the service.
 - 2. In place of standard tees and 45° laterals in black steel piping systems, integrally reinforced weld-on fittings may be used providing branch line is at least two (2) pipe sizes under run pipe size.

3.6 PIPING SPECIALTIES

- A. Traps shall be located in an easily accessible area.
- B. Do not install pumps until manholes are cleaned of all dirt and debris.
- C. Pressure gages should be installed so as to be visible and accessible.
- D. Steam drip legs and traps shall be installed at all low points in the system. Drip legs shall be full pipe size for 4" pipe and smaller and a minimum of 4", but not less than half the pipe diameter for lines larger than 4". Length of drip legs shall be 1-1/2 times the main diameter but not less than 10". All traps and related valves shall be easily accessible from floors.

- E. To ensure proper expansion joint alignment, the piping shall be made up "solid" and anchored and then a section of pipe shall be cut out and joint welded into the pipeline.
- F. Pressure, temperature, maximum overall length, and travel of expansion joints shall be as needed.
- G. Steam and condensate pipe penetrations entering through a concrete building foundation shall be installed with a Link-Seal Modular seal assembly.
- H. Pipe joints connecting copper tubing to steel or iron valves and piping shall be insulating, dielectric connections. Such joint, including dielectric material, shall be rated to withstand the temperature, pressure, and other characteristics of the service for which it is to be used, including testing pressure.
- I. Screwed joints shall be made with insulating unions and couplings.
- J. Dissimilar metals flanged joints shall be made up with flange insulation kits consisting of a suitable gasket, bolt sleeves, and washers.
- K. Individual steam traps shall not serve more than one (1) drain point.

3.7 CLEANING OF PIPING

- A. Clean pipe and fittings inside and outside before and after assembly. Remove all dirt, scale, oil, and other foreign matter from inside the piping by use of a pipe swab or pipe "pig" before connecting pipe sections, valves, equipment, or fittings.
- B. Chips and burrs from thread cutting operations shall be blown out of pipe before assembly. Cutting oil shall be removed from the internal and external surfaces.
- C. Slag and weld splatter shall be removed from pipe joints by peening, chipping, and wire brushing.

3.8 WELDING

- A. The Contractor is entirely responsible for the quality of the welding and shall:
 - 1. Conduct tests of the welding procedures used by its organization, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.
 - 2. Comply with ASME B31.1 and AWS B2.1.
 - 3. Perform all welding operations required for construction and installation.
- B. Qualification of welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1 and AWS B2.1 and also as outlined below.
- C. Examining welder: Examine each welder at job site in the presence of the Owner's Representative to determine the ability of the welder to meet the qualifications required.
- D. Beveling: Field bevels and shop bevels shall be done by mechanical means.
- E. Defective welds: Replace and re-inspect defective welds. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds must be requalified.
- F. Electrodes: Electrodes shall be stored in a dry, heated area and be kept free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.
- G. Non-destructive examination of piping welds:
 - 1. On any given construction Project, the Owner will Contract with an independent testing firm to complete ultrasonic shearwave weld inspections on Owner selected

field welds. If the results of these tests indicate poor quality welds, those “failed” welds shall be replaced at no additional cost to the Project. If further ultrasonic inspection is required to assure quality weld workmanship, these tests shall be at the expense of the Contractor, and any and all defective welds shall be replaced at no additional cost to the Project.

3.9 PIPE AND EQUIPMENT INSULATION

- A. All required tests on piping must be completed and satisfactory test reports must be completed prior to application of insulation covering joints.
- B. All surfaces to be insulated shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of insulation.
- C. All surfaces to be insulated shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of insulation.
- D. All insulation and accessory materials shall be stored in an area that is dry and protected from the weather before and during insulation application.
- E. Insulation shall be installed to accept cyclic thermal growth and contraction of piping without damage and loss of insulating value.
- F. Insulation systems shall be installed in strict accordance with manufacturer's recommendations and as detailed on Drawings “Construction Standard - Expansion Joint Insulation Detail” and “Construction Standard - Pipe Guide Insulation.”
- G. Reinsulate any existing steam and condensate piping that are to remain that had insulation removed as part of asbestos abatement work or to make tie-ins.
- H. Insulation shall be applied to pipe, fittings, flanges, and valves. Unions shall not be insulated. Trap installations to include traps, stop valves, check valve, and hand-blow valve shall not be insulated. Piping on trap installations shall be insulated. Drip leg and piping up to first stop valve shall be insulated.
- I. Insulation shall be installed in a smooth, clean, workmanlike manner. Joints shall be tight and finished smooth. Stagger longitudinal joints and tightly butt sections.
- J. Insulation shall fit tightly against the surface to which it is applied.
- K. Apply insulation to permit expansion or contraction of pipelines without causing damage to insulation.
- L. Preformed pipe covering shall be terminated at a sufficient distance from flanges to permit removal of bolts.
- M. Insulation on flanges and flanged fittings shall overlap adjacent pipe covering at least 2".
- N. Pipe insulation at expansion joints shall be held back a sufficient distance to permit the specified travel into the joint.
- O. Valves shall be insulated up to the gland only so as to permit replacement of packing without disturbing insulation.
- P. Insulation shall be continuous through pipe covering protection saddles, guides and sleeves, or openings in walls and floors. Aluminum jacket shall not be run through pipe saddles and guides.
- Q. Lap jacket 2" and fasten with 1/2" stainless steel bands on 12" centers.
- R. Provide band 1-1/2" back from all discontinuous ends of jacket.

- S. All insulation shall be marked non asbestos.

3.10 PIPE SUPPORT INSTALLATION (IN CHASES, TUNNELS, AND VAULTS)

- A. Coordinate support locations with structure prior to erection of piping. Arrangement of supports shall facilitate operating, servicing and removal of valves, strainers, and piping specialties.

3.11 EXPOSED STEEL SURFACES IN VAULTS AND CHASES

- A. All structural steel components in vaults and chases are to be hot dipped galvanized.

3.12 TESTS

- A. Demonstrate leak-tightness of all piping systems by performing hydrostatic and operational tests. All labor, material, and test instruments must be furnished by the Contractor.
- B. Conduct hydrostatic pressure test direct-buried systems in accordance with ASME B31.1 and this section. Tests shall be completed for all piping.
- C. Hydrostatic and operational tests of piping: Steam and condensate piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1 ½ times distribution supply pressure for a period no less than two (2) hours with no pressure decay.
 1. Tests shall be performed prior to cleaning, insulating, or concealing pipe. Notify Owner’s Representative 48 hours in advance of testing.
 2. Test piping located in concrete trenches prior to installing trench covers. Test direct-buried systems prior to backfilling.
 3. Remove or isolate any elements of the system such as expansion joints, which are not designed for test pressure.
 4. Prior to acceptance of installation, Contractor shall subject system to operating tests to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than six (6) hours for each portion of system tested. Conduct tests at times as the Owner may direct.
 5. Provide calibrated instruments, equipment, facilities, and labor at no additional cost to Owner. Test gauge shall read in increments not exceeding 0.1 psig.
 6. Repeat tests when failures occur. After completion of satisfactory test, replace all elements that have been removed prior to testing.
- D. Prepare and keep records of each system or section of system tested. Test reports shall include, but not necessarily be limited to, the following:
 1. Identification of piping system or section tested.
 2. Date of test and date of Project Manager’s approval signature.
 3. Testing medium and method or description of test procedure.
 4. Test pressure, duration of test, and recorded pressure drop.
- E. Pressure tests shall apply to piping only with all equipment, traps, relief valves, and instruments blocked off or disconnected. In no case shall piping or any component be subjected to pressures exceeding 90% of their published rating. All system valves within section being tested shall be open. Provide temporary restraints on expansion joints and flexible connections during pressure testing.
- F. Blanks shall be furnished and installed wherever necessary to prevent cold test water from coming in contact with hot valves. Remove blanks after testing.
- G. Leakage Test Schedule:

Service	Operating Pressure (psig)	Hydrostatic Test Pressure (psig)	Minimum Time (hrs.)
Steam (MPS)	To 75	150	1
Pump Condensate (PC)	To 100	150	1

- H. All new piping not specifically listed above shall receive an initial service leak test by gradually bringing the system up to normal operating pressure and examining for leaks.
- I. On any given construction Project, the Owner reserves the right to Contract with an independent testing firm to complete ultrasonic shearwave weld inspections on randomly selected field welds. If the results of these tests indicate poor quality welds, those “failed” welds shall be replaced at no additional cost to the Project. If further ultrasonic inspection is required to assure quality weld workmanship, these tests shall be at the expense of the Contractor, and any and all defective welds shall be replaced at no additional cost to the Project.
- J. Deficiencies discovered shall be corrected at the Contractor's expense to satisfaction of Owner's Representative. Major deficiencies or failure to correct deficiencies to the satisfaction of the Owner's Representative may be considered cause for rejecting the entire installation.
- K. After each installation is completed, tested for leaks, cleaned, and approved by Owner's Representative, it shall be filled with the fluid it is to carry. Each system shall be tested in actual operation. All valves, safety devices, and equipment shall be operated and final adjustments made to place the system in operation. Such operation shall be demonstrated to the satisfaction of the Owner's Representative.

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SECTION 33 63 19
PIPE SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. The scope of this document is to provide instruction for the installation of pipe supports for exterior underground steam and condensate distribution piping.

PART 2 DESIGN GUIDELINES

2.1 MATERIALS

- A. Support Tees and Slides:
1. Hot piping shall have pipe tee and slides at all support points. Tees and Slides shall be hot-dipped galvanized Figures 257, type as shown on the Drawings, as manufactured by Anvil International, North Kingstown, RI or approved equivalent. Unless otherwise noted, slide depth shall be equal to or slightly greater than insulation thickness.
- B. Pipe Guides:
1. Steam and condensate piping runs shall include hot dip galvanized pipe guides where indicated on Drawings. Guides shall be Figure 257, type as shown on the Drawings, as manufactured by Anvil International, North Kingstown, RI or approved equivalent.
- C. Copper Pipe:
1. Sump pump discharge piping shall be supported from manhole wall using copper finished extension split tubing clamp Figure CT-138R as manufactured by Anvil International, North Kingstown, RI or approved equivalent with 3/8" stainless steel expansion anchor.
- D. U-Bolts:
1. U-bolts shall be galvanized carbon steel furnished with four (4) finished hex nuts. U-bolts shall be Figure 137 as manufactured by Anvil International, North Kingstown RI or approved equivalent.
- E. Hanger Rods:
1. Hanger rods shall be machine threaded rods ASTM A36 or ASTM A575 with threads conforming to ANSI B1.1., Figure 140.253 as manufactured by Anvil International, Hot Dipped Galvanized North Kingstown, RI or approved equivalent. Minimum rod size shall be as follows:

<u>Pipe Size Hanger</u>	<u>Rod Diameter</u>
2" and under	3/8"
2-1/2", 3"	1/2"
4"	5/8"
6", 8"	3/4"
10", 12"	7/8"
14" thru 18"	1"

- F. Unless otherwise shown or specified, upper attachments for concrete ceilings shall be as follows:
1. Concrete single lug plate shall be Hot Dipped Galvanized Figure 47 or clevis plate Figure 49 all as manufactured by Anvil International, North Kingstown, RI or approved equivalent or equivalent. Expansion anchors shall be stainless steel.
2. For pipe 4" and under (optional): Hot Dip Galvanized, drop-in type female expansion anchor.
- G. Hangers:
1. Hangers required for horizontal piping in manholes shall be as follows and all as manufactured by Anvil International, North Kingstown, RI or approved equivalent:

- a. Uninsulated pipe: Adjustable clevis, Figure 260, Hot Dipped Galvanized.
- b. Insulated Pipe: Adjustable clevis, Figure 260, Hot Dipped Galvanized.
- c. Copper Pipe: Adjustable tubing ring, plastic coated, Figure CT-99C or equivalent.

H. Structural Steel:

- 1. Miscellaneous structural steel, plates, etc. for pipe supports and anchors in trenches and manholes shall be ASTM A36 of sizes and shapes needed, no tubular members.
- 2. All structural steel members and end plates shall be hot dipped galvanized ASTM, A123.
- 3. Repairs to galvanizing shall be with hot melt stick. Spray galvanizing repairs are not allowed.
- 4. Welding of structural steel supports and anchors shall be completed with E70XX electrodes.

I. Expansion Bolts:

- 1. Expansion bolts and nuts used in connection with pipe support structures shall be Hot Dipped Galvanized "Kwik Bolt III" as manufactured by Hilti Inc., Tulsa, OK, or approved equivalent installed per manufacturer's recommendations. Minimum embedment shall be as follows:

<u>Bolt Diameter</u>	<u>Rod Diameter</u>
1/2"	3-1/2"
5/8"	4"
3/4"	4-3/4"
1"	4-1/2"

2.2 INSTALLATION

A. General:

- 1. All piping shall be supported to prevent excessive stress, swaying, sagging, or vibration. Piping shall not be so restrained, however, as to cause it to snake or buckle between supports or anchors or to prevent movement due to expansion and contraction.
- 2. Supports shall be complete, including lock nuts, clamps, rods, bolts, couplings, swivels, inserts, required accessory items, and secondary structural steel members.

B. Spacing:

- 1. The maximum support spacing for horizontal piping shall be as follows:

<u>Steel Pipe (MPS, MPC, PC)</u>	<u>Steam and Liquids</u>
2" and under	6'
6", 8"	12'
10", 12", 14", 16", 24"	24'
<u>Copper Tube</u>	
1/2", 3/4"	5'
1"	6'
1-1/4"	7'
1-1/2", 2"	8'
2-1/2"	9'
3" and above	10'

- 2. Supports in chase shall be installed off the floor of chase a minimum of 1".

2.3 COMMISSIONING

- A. All piping must have needed supports installed and properly adjusted prior to turning the system on.

END OF SECTION

SECTION 33 63 41
MANHOLE AND STRUCTURES-ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manhole lids.

1.2 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.1 MANHOLE LIDS

- A. Fibrelite F95, 36-inch diameter composite cover with gasket and frame, Grey Color.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions.

3.2 CLEANING AND PROTECTION

- A. Delivery, Storage, and Handling:
 - 1. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations, and material safety data sheets.
- B. Sequence deliveries to avoid delays and minimize on-site storage.

END OF SECTION

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SECTION 33 63 50
STEAM STRUCTURE RELATED CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete for tunnel walls, roof, and slabs; manholes, manhole anchors/supports/equipment and pedestals, retaining walls, exterior stairs and ramps, power plant floor slabs on grade and other miscellaneous structures; control, expansion and contraction joint devices associated with concrete work.

1.2 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 302 - Concrete Floor and Slab Construction.
- C. ACI 304R - Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305R - Hot Weather Concreting.
- E. ACI 306.1 - Cold Weather Concreting.
- F. ACI 308 - Curing Concrete.
- G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- H. ASTM C 33 - Concrete Aggregates.
- I. ASTM C 94 - Ready-Mixed Concrete.
- J. ASTM C 150 - Portland Cement.
- K. ASTM C157 – Change of Hardened Hydraulic-Cement Mortar and Concrete
- L. ASTM C 260 - Air Entraining Admixtures for Concrete.
- M. ASTM C 295 – Guide for Petrographic Examination of Aggregates for Concrete.
- N. ASTM C457 – Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete.
- O. ASTM C 494 - Chemicals Admixtures for Concrete.
- P. ASTM C 595M - Blended Hydraulic Cements (Metric).
- Q. ASTM C 618 - Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- R. ASTM C 989 – Ground Granulated Blast-Furnace Slag for use in Concrete and Mortar
- S. ASTM D 994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- T. ASTM C 1017 - Chemical Admixtures for Use in Producing Flowing Concrete.
- U. ASTM C 1107 - Packaged Dry, Hydraulic Cement Grout (Nonshrink).
- V. ASTM C 1202 – Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration.
- W. ASTM C 1240 – Silica Fume Used in Cementitious Mixtures.

- X. ASTM C 1260 – Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
- Y. ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- Z. ASTM C 1567 – Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method).
- AA. ASTM D 6690 - Concrete Joint Sealer, Hot-Poured Elastic Type.

1.3

SUBMITTALS

- A. Product Data: Submit data for bonding agent, joint devices, and attachment accessories.
- B. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent work.
- C. Material Certificates: Submit mill certificates for the cement, supplementary cementitious materials, and admixtures intended for inclusion in the concrete mixtures.
 - 1. Cement: Submit certification of compliance with ASTM C 150 for cement manufactured within three (3) months of submittal date.
 - 2. Fly Ash and Pozzolan: Submit certification of compliance with ASTM C 618 performed within six (6) months of submittal date.
 - 3. Ground Granulated Blast-Furnace Slag: Submit certification of compliance with ASTM C 989 performed within six (6) months of submittal date.
 - 4. Silica Fume: Submit certification of compliance with ASTM C 1240 performed within six (6) months of submittal date.
 - 5. Chemical Admixtures: Submit certificate of compliance with ASTM C 494 Level 1 or Level 2, performed within one year of the submittal date. If a chemical admixture does not fit into a defined C 494 type, admixture certificate shall provide documentation that the admixture has no detrimental effect on strength development, time of setting, shrinkage, air entrainment, scaling, and freeze-thaw resistance (ASTM C 666 Procedure A).
 - 6. Form materials and form-release agents.
 - 7. Steel reinforcement and accessories.
 - 8. Water stops.
 - 9. Curing compounds.
 - 10. Vapor retarders.
 - 11. Joint-filler strips.
 - 12. Repair materials.
- D. Project Record Documents:
 - 1. Accurately record actual locations of embedded utilities and components that are concealed from view.
 - 2. Submit upon request for record copies of all concrete delivery tickets.
 - 3. Submit upon request for record copy of plan with locations and dates for concrete placements shown on Drawing.
- E. Aggregates: Submit test results for each aggregate intended for use in the concrete mixtures, showing conformance to ASTM C 33 and additional requirements as follows:
 - 1. Aggregate source and identification.
 - 2. Maximum nominal aggregate size, or gradation size number.
 - 3. Gradation analysis, including percentage retained and passing each sieve, and a graph of individual percentage retained versus sieve size.
 - 4. Quantity and identification of deleterious substances in the aggregates.
 - a. The limits for deleterious materials contained in coarse aggregate as defined in ASTM C 33 – Table 3 Class 4S.
 - 5. ASTM C 1260 test report performed within six (6) months of the submittal date with the following modifications.
 - a. Expansion limit shall be 0.1% at 28 days in 1 N NaOH soak solution.
 - b. Measure mortar bar expansion at 3-4 day intervals.

- c. Aggregates that exceed the 0.1% expansion limit may be used with ASR mitigation. ASR mitigation options include cement replacement with fly ash/slag/silica fume or addition of lithium nitrate admixture. The combination of reactive aggregate and cementitious materials and/or lithium nitrate admixture must be tested in accordance with ASTM C1567 and have an expansion not exceeding 0.1% at 28 days.
- Note:
It is recommended to prepare ASTM C 1567 tests over a range of supplementary cementitious material replacement levels to identify the appropriate combination for mitigation.
- 1) If 30% lithium nitrate admixture is used to mitigate ASR expansion, the minimum lithium admixture dose shall be determined by ASTM C 1567 tests performed at three (3) or more dose levels, one of which will be a 100% dose. The 100% dose is defined as 0.55 gallons of admixture per pound of sodium equivalent in the Portland cement. For cement with 1% sodium equivalent, the 100% dose of 30% lithium nitrate admixture is 0.0455 mL/gram of cement.
 - 2) If 30% lithium nitrate admixture is used to mitigate ASR expansion, the ASTM C 1567 soak solution shall be 1 N NaOH containing lithium nitrate admixture in proportion to the dose added to the mortar. For the 100% dose of 30% lithium nitrate admixture, use 71 mL of admixture per liter of soak solution.
6. Submit complete data regarding concrete aggregates prior to any change in aggregate source.
- F. Concrete Mixture Submittal: At least 30 days minimum prior to concrete placement, submit mixture proportions and prequalification test data for each type of concrete along with material certifications. Submit complete list of ingredients including type, brand, source and amount of: cement, fly ash, silica fume, ground-granulated blast-furnace slag, aggregates, and admixtures.
- G. Prequalification of Concrete Mixtures: Provide test data for each class of concrete meeting the performance requirements for each class of concrete required in Section 3.9.
1. Laboratory Qualifications: Prequalification testing shall be performed by a laboratory selected or approved by the Owner's Representative.
 2. Submit copies of testing reports showing the concrete mixture has been successfully tested to produce the properties specified and that the mix will be suitable for the job conditions. The laboratory tests shall include mill certificates and other test data for all cementitious materials, aggregates, and admixtures required by this Specification. Materials used in the trial mixtures shall have the same source as proposed for use on the Project. If source material changes, resubmit mixture data using revised source material, unless approved in writing by the Owner's Representative.
 3. No concrete shall be placed unless proven by trial mix studies to meet the requirements of this Specification, unless otherwise approved in writing by the Owner's Representative.
 4. The submittal shall clearly indicate the concrete producer's mixture identification name or code, the class of concrete, and intended use.
 5. Prequalification criteria are as follows. Specification limit values for each class of concrete are listed in Table 1.
 - a. Report trial mixture proportions, slump, air content, unit weight, and mixture temperature.
 - b. ASTM C 39 – Submit compressive strength development of the trial mixture from at least two cylinders tested at 3, 7, 28, and 56 days age. Tests may be performed on either 6-inch diameter or 4-inch diameter standard concrete cylinders.
 - c. ASTM C 39 - Provide documentation for establishing the required average strength, f'_{cr} .
 - 1) If available, submit test data for 30 individual batches of production concrete tested at 28 days age. Determine the mean and standard deviation, s . Calculate the required average strength of concrete

from the specified strength, f'_c , and standard deviation, s , as follows.

$$f'_{cr} = f'_c + 1.34s \text{ [psi]}$$

- 2) In the absence of historical data, calculate the required average strength as follows

$$f'_{cr} = f'_c + 1200 \text{ [psi]}$$

- d. ASTM C1152 – Acid-soluble chloride ion content of the concrete mixture shall not exceed 0.20 percent of the mass of cement. Report the average of two tests taken from the trial concrete mixture. Obtain a representative sample of concrete by cutting and pulverizing a disk from the center of a cylinder that is at least as thick as the maximum aggregate size.
- e. ASTM C 457 – Submit test report for the hardened air content and air-void system parameters of the trial concrete mixture when required in Table 1. The minimum acceptable hardened air content shall be identified in Table 1. The maximum acceptable air-void spacing factor shall be 0.008 inches. The minimum acceptable specific surface shall be 600 in²/in³.
- f. ASTM C 1202 – Submit test results for three cylinders tested at 28 days when required in Table 1. Moist cure test cylinders in a water bath held at 73 (± 3) degrees Fahrenheit for seven (7) days followed by 100 (± 3) degrees Fahrenheit for 21 days prior to test.
- g. ASTM C 157 – Submit test results for 28 day drying shrinkage as the average of three specimens in accordance with ASTM C 157 and the following modifications when required in Table 1.
- 1) Record and report the initial length upon removal from the mold as described in ASTM C 157, then cure test specimens in 73 (± 3) degree F lime water for seven (7) days followed by air storage in standard conditions. (73 ± 3 F and 50% ± 4% RH)
 - 2) Record and report drying shrinkage measurements weekly.
 - 3) Calculate the drying shrinkage as the difference between the length of the specimen upon removal from curing and the length measured in air storage expressed as a percentage of the length measured upon removal from curing at eight (8) days age.
 - 4) For maximum coarse aggregate size ≤ 1 inch, specimens shall be 3-in by 3-in by 11.25-in prisms with a 10-inch gage length. For larger aggregate, use a minimum specimen dimension that is at least three (3) times the maximum aggregate size.
 - 5) If the concrete mixture drying shrinkage at 28 days exceeds the limit listed in Table 1, mixture proportions shall be adjusted, or a shrinkage reducing admixture shall be incorporated into the mixture.
- H. Silica Fume Manufacturer's Representative: Submit statement that silica fume manufacturer's representative will be present at mix plant to ensure proper mix, including high range water reducer, superplasticizer, and batching methods during the first three (3) days of concrete mix preparation and placement. After which, manufacturer's representative will designate representative at concrete producer's plant to ensure concrete mix procedures meet silica fume manufacturer's recommendations. Silica fume manufacturer's representative shall attend and advise at placement and finishing of initial phases of tunnel construction.
- I. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- B. Maintain one (1) copy of each document on site.
- C. Conform to ACI 305R when concreting during hot weather.
- D. Conform to ACI 306.1 when concreting during cold weather.
- E. A preconstruction meeting shall be held with concrete supplier, Contractor, finisher, admixture supplier(s) and Owner's Representative. A sample pour shall be performed with each of the proposed concrete mixes to verify methods of placing, finishing and curing to ensure concrete quality. Test cylinders may be cast for the sample pour at the discretion of the Owners Representative.
- F. 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.

1.5 COORDINATION

- A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type II
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

- A. Air Entrainment: ASTM C 260.
- B. Chemical: ASTM C 494, Type A - Water Reducing, Type B – Retarding, Type C – Accelerating, Type F - Water Reducing, High Range.
- C. Fly Ash and Calcined Pozzolan: ASTM C 618.
- D. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 80, 100 or 120
- E. Plasticizing: ASTM C 1017.
- F. Silica Fume: ASTM C 1240

2.3 ACCESSORIES

- A. Bonding Agent: Polymer resin emulsion or Latex emulsion.
- B. Non-Shrink Grout: ASTM C 1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive

strength of 2,400 pounds per square inch in 48 hours and 5,000 pounds per square inch in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler: ASTM D 1752; closed cell molded vinyl foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.

2.5 CONCRETE MIX

- A. Mix concrete in accordance with ACI 301. Deliver concrete in accordance with ASTM C 94.
- B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.
- C. Optimize the combined aggregate gradation to minimize the paste content required to make workable concrete.
- D. Use accelerating admixtures in cold weather only when approved by Owner's Representative. Use of admixtures will not relax cold weather placement requirements.
- E. Admixtures containing ingredients corrosive to reinforcing steel such as chloride ion, bromide ion, or thiocyanate are not permitted.
- F. Use set retarding admixtures during hot weather only when approved by the Owner's Representative.
- G. Add air entraining agent to normal weight concrete mix for work exposed to exterior.

2.6 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4-inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.7 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 1035 (MMFX steel), 100ksi yield grade deformed, unfinished.

2.8 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- B. Tie wire shall be plastic coated 16-gauge black annealed wire.
- C. Water: ASTM C 94/C 94M and potable.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Available Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edoco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company (The); EucoBar.
 - g. Kaufman Products, Inc.; Vapor Aid.
 - h. Lambert Corporation; Lambco Skin.
 - i. L&M Construction Chemicals, Inc.; E-Con.
 - j. MBT Protection and Repair, Div. of ChemRex; Confilm.
 - k. Meadows, W. R., Inc.; Sealtight Evapre.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
 - p. Unitex; Pro-Film.
 - q. US Mix Products Company; US Spec Monofilm ER.
 - r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Available Products:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. Burke by Edoco; Aqua Resin Cure.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - f. Euclid Chemical Company (The); Kurez DR VOX.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; Aqua Kure-Clear.
 - i. L&M Construction Chemicals, Inc.; L&M Cure R.
 - j. Meadows, W. R., Inc.; 1100 Clear.
 - k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
 - l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
 - m. Tamms Industries, Inc.; Hornocure WB 30.
 - n. Unitex; Hydro Cure 309.
 - o. US Mix Products Company; US Spec Maxcure Resin Clear.
 - p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.10 RELATED MATERIALS

- A. Related Materials:
1. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
 2. Joint Sealants:
 - a. Vertical Joints: Non-sag, polyurethane sealant complying with Fed. Spec. TT-S-00230C, Type II, Class A, Sonneborn Sonolastic NP1 as manufactured by BASF Building Systems, Shakopee MN or approved equivalent.
 - b. Horizontal Joints: One (1) part (Fed Spec. TT-S-00230C, Type I, Class A) polyurethane sealant, pour grade, Sonneborn Sonolastic SL1 as manufactured by BASF Building Systems, Shakopee MN or approved equivalent.
 - c. Miscellaneous sealing materials shall be as follows:
 - 1) Joint Filler: 1/2" thick polyethylene closed cell foam. Filler shall be "Ceramar" as manufactured by W. R. Meadows, Hampshire, IL, or approved equivalent.
 - 2) Sealant Backer Rod: Compressible rod stock of closed cell polyethylene foam, for back-up of and compatibility with sealant.
 3. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 4. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - a. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 5. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

PART 3 - EXECUTION

3.1 FORMWORK

- A. 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.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- 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 one (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. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one (1) mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.4 WATERSTOPS

- A. Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.5 EXAMINATION

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

3.6 PREPARATION

- A. Prepare previously placed concrete surfaces by abrasive blast cleaning, to remove debris and laitance and expose aggregate. Thoroughly wet the substrate prior to placement of fresh concrete against prepared surface.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels in an approved epoxy or adhesive.

3.7 PLACING CONCRETE

- A. Place and consolidate concrete in accordance with ACI 301 and ACI 318.
- B. Notify Owner's Representative and testing agency minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, and formed expansion and contraction joints are not disturbed during concrete placement.

- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Place concrete continuously between predetermined expansion, control, and construction joints.
- F. Do not interrupt successive placement; do not permit cold joints to occur.
- G. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- H. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- I. 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.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least six (6) inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- J. 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.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- K. 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°F for three (3) 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.
- L. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90°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.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one (1) day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one (1) part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one (1) part Portland cement and one (1) part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one (1) direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated, to receive trowel.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

3. Specified overall values 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; for slabs-on-grade.
 4. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- long straightedge resting on two (2) high spots and placed anywhere on the surface does not exceed 1/4 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel finished floor surfaces
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated
- G. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.11 CURING AND PROTECTION

- A. General: 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.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one (1) or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

- c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- F. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- G. Remove any curing materials containing waxes or other products that may interfere with adhesion of waterproofing membrane installed under Section 07132 and 07140.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one (1) part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than one (1) inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that

- penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes one (1) inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes one (1) inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.14 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 by ACI certified technicians.
- B. Provide free access to Work and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- D. Concrete for casting test specimens and fresh concrete properties shall be sampled at the end of the chute in accordance with ASTM C 172.
- E. No water other than the incidental water used to prewet the delivery chute and fins shall be added to the concrete after the truck leaves the batch plant, unless directed in writing by the Owners Representative.
- F. Adjustment of slump on site shall only be accomplished by the addition of water reducing or plasticizing admixture. Admixture shall be placed directly onto the concrete and the revolving drum mixer shall mix at high speed for five (5) minutes, or 100 revolutions, before discharge.
- G. Obtain concrete for casting test samples after slump adjustment.
- H. Tests for fresh concrete properties (slump ASTM C 143, air content ASTM C 231, temperature ASTM C 1064, and unit weight ASTM C 138) shall be performed whenever casting test cylinders.

- I. One (1) additional slump test will be taken at the point of pump discharge for each set of test cylinders taken.
- J. Additional fresh concrete property tests shall be performed when requested by the Owners Representative.
- K. Six (6) concrete test cylinders (6-in dia. x 12-in) will be cast for each placement, or for every 75 cubic yards, whichever is greater, for each class of concrete placed. Compressive strength of test cylinders shall be determined as follows:
 - 1. One (1) cylinder shall be tested at three (3) days.
 - 2. One (1) cylinder shall be tested at seven (7) days.
 - 3. Two (2) cylinders shall be tested at 28 days.
 - 4. One (1) cylinder shall be tested at 56 days.
 - 5. One (1) extra cylinder will be cast for discretionary use.
- L. Two (2) additional test cylinders shall be cast during cold weather concreting and shall be cured on the job site under the same conditions as the concrete it represents. Compressive strength of field cured cylinders shall be determined prior to form removal, and at 56 days age.
- M. Two (2) concrete test cylinders (preferably 4-in dia. x 8-in) will be cast for ASTM C 1202 quality assurance testing for every 500 cubic yards, or portion thereof. ASTM C 1202 cylinders shall be cured in the same manner as the prequalification test cylinders.

3.15 SCHEDULE - CONCRETE TYPES AND TEST REQUIREMENTS

- A. Class A concrete shall include concrete for tunnels, chases, vaults, manholes and other tunnel system components:
- B. Class B concrete shall include concrete for retaining walls, power plant slabs on grade, exterior stairs, ramps, and other miscellaneous structures:
- C. Class C concrete shall include concrete for flowable fill for backfill at over-excavation in rock:

Table 1 – Concrete Proportioning and Testing Requirements

Concrete Class	A	B	C
Materials and Proportions			
Cement, ASTM C 150	Type I/II	Type I/II	Type I/II
Supplementary Cementitious Materials, <i>cm</i>	50% max [†]	50% max [†]	No limit
Maximum Aggregate Size	1 inch	1 inch	3/8-inch
Water-cementitious materials ratio, <i>w/cm</i>	0.40 max	0.40 max	No limit
Prequalification Requirements			
Aggregates	ASTM C 1260	ASTM C 1260	
Slump - ASTM C 143	6 to 8 in.	>6 in.	>8 in.
Chloride Content – ASTM C 1152	< 0.20% wt of cement	< 0.20% wt of cement	Not required
Air Content - ASTM C 231	Not required	5.5% to 7.5%	Not required
Hardened Air Content - ASTM C457	Not required	> 5%	Not required
28-day Strength - ASTM C 39	$f'_c = 5000$ psi	$f'_c = 4500$ psi	$f'_c = 700$ psi
Drying Shrinkage - ASTM C 157	≤ 0.04%	Not required	Not required
28-day Permeability – ASTM C 1202	≤1500 Coulomb	Not required	Not required
Permeability			> 0.4 cm/sec
Field Testing for Process Control			
Slump - ASTM C 143	6 to 8 in. at point of placement	>6 in. at point of placement	>8 in. at point of placement
Air Content - ASTM C 231	Not required	5.5% to 7.5%	Not required
28-day Strength - ASTM C 39	$f'_c = 5000$ psi	$f'_c = 4500$ psi	$f'_c = 700$ psi
28-day Permeability – ASTM C 1202	≤1500 Coulomb	Not required	Not required

† Maximum combined supplementary materials content of ternary or quaternary blends. Limitations on supplementary materials shall include quantities contained in blended cement. Fly ash content shall not exceed 25%. Ground granulated blast-furnace slag content shall not exceed 45%. Silica fume content shall not exceed 10%.

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SECTION 33 63 51
STEAM STRUCTURE RELATED CONCRETE REPAIR

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The work shall consist of removal of unsuitable concrete; surface and face preparation; forming; and furnishing, placing, finishing, and curing concrete repair material as required to repair structures designated in this specification.

1.2 SUMMARY

- A. Section Includes:
 - 1. Removal of deteriorated concrete and subsequent replacement and patching.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete repair including, but not limited to, the following:
 - a. Materials, material application, sequencing, tolerances, and required clearances.
 - b. Quality-control program.

1.4 MATERIALS

- A. Proprietary concrete repair materials shall be subject to review and approval of the Engineer prior to use. The material shall meet all specified salient features for repair materials and not react detrimentally with the existing concrete or associated member of the structure being repaired.
- B. Replacement concrete repair materials shall be a material that consists essentially of a binding medium of Portland cement and water that will meet all the specified salient features for repair materials and not react detrimentally with the existing concrete or associated members of the structure being repaired. This may be, but is not limited to, a conventional concrete mix with or without admixtures, shotcrete, pre-placed aggregate concrete, or grout.

1.5 PREPARATION OF AREAS TO BE REPAIRED

- A. All loose, cracked or otherwise unsuitable or defective concrete shall be removed from the existing structure as shown on the drawings. The final extent of removal shall be determined by the Engineer after inspection of prepared surfaces.
- B. Feathered edges at the surface will not be permitted. The surface edge of the repaired area shall be cut with a saw, drilled, or chipped to leave a sharp edge with a minimum of a 5/8-inch depth face perpendicular to the face of the wall.
- C. The top-side of the repair hole shall be shaped to a uniform fairly straight face which is sloped upward on a one (1) inch rise for each three (3) inches of depth of cut toward the face from which the repair material will be placed. The repair hole shall be conical in shape with the large end at the surface from which repair material will be placed.

- D. The bottom and vertical or near vertical sides of the hole shall be cut sharply and approximately perpendicular to the face of the wall. All interior corners shall be rounded to a minimum radius of one (1) inch.
- E. Test areas where concrete has been removed by tapping with hammer and remove additional concrete until unsound and debonded concrete is completely removed.
- F. Where reinforcement is encountered, the concrete directly in contact with the sides of the reinforcement shall be removed to provide at least 1-inch clear distance between the reinforcement and the in-place concrete. Remove loose and flaking rust from exposed reinforcing bars by abrasive blast cleaning, or wire brushing until only tightly adhered light rust remains. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace.
- G. Prior to placement of concrete repair material, all oil and/or grease shall be steam or solvent cleaned from all reinforcement and surfaces to which the repair materials are required to bond. If solvent cleaning is used, solvents and solvent residues shall not impair the repair material or its bonding strengths.
- H. After removal of all oil and grease, the reinforcement shall be cleaned to remove any loose, flaky rust, mill scale, and other coatings or foreign substances that would impair bonding of the repair material to the reinforcement. The prepared faces of the repair hole shall be cleaned by high pressure water jets or compressed air jetting with water to remove all loose particles and dust. The repair hole shall be free of chips, sawdust, debris, free water, ice, snow, or other harmful substances or coatings.

1.6 DISPOSAL

- A. Unless otherwise specified, all concrete and other debris resulting from the repair works shall be removed from the site and disposed of at location(s) of the Contractor's selection. The Contractor is responsible for complying with all local, state, and federal regulations pertaining to the disposal of such waste.

PART 2 PRODUCTS

2.1 SELECTION OF CONCRETE REPAIR MATERIAL

- A. Only one brand of proprietary concrete repair material shall be used in any single repair operation unless compatibility between brands can be proven with actual test or performance data.
- B. The Contractor will be responsible for the selection and correct application of the concrete repair material. At least 14 days prior to installation, the Contractor shall provide the Engineer for approval all technical data for the repair material. The technical data shall include the design mix and test results to verify satisfactory conformance to the salient feature requirements. If a proprietary material is used, the manufacturer's recommended preparation, use, and installation specifications shall also be submitted 14 days prior to installation. Concrete repair materials shall not be placed prior to approval.
- C. Concrete repair material shall have the following features:
 - 1. Be a cementitious material that after hardening will remain stable in wet and moist environments and will not dissolve in water.
 - 2. A 28-day compressive strength of 4000 psi or greater when tested according to ASTM C 39, unless otherwise specified.

3. Bond strength of the repair material shall have been tested in accordance with ASTM C 882 procedures for Type V material and shall have the minimum strength of 1100 psi at 28-days unless otherwise specified.
 4. Shall be suitable for application at the minimum temperature of 55 degrees Fahrenheit.
 5. Shall not contain chlorides, added gypsum, added lime, or high alumina cements. Shall be non-combustible, both before and after cure.
 6. Color shall be concrete gray unless otherwise specified.
 7. Shall not produce a vapor barrier material and shall be thermally compatible with concrete.
 8. Shall have a freeze-thaw resistance equal to or greater than 4000 psi, air-entrained concrete designed for severe exposure conditions according to ACI Standard Practice 211.1, unless otherwise specified.
- D. Corrosion-inhibiting materials:
1. Corrosion-Inhibiting Treatment: Waterborne solution of alkaline corrosion-inhibiting chemicals for concrete-surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.
- E. Bonding agents:
1. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.
 2. Epoxy Bonding Agent: ASTM C 881/C 881M, bonding system and free of VOCs.
 3. Latex Bonding Agent, Non-Redispersible: ASTM C 1059/C 1059M, Type II for use at structural and exterior locations and where indicated.

PART 3 EXECUTION

3.1 HANDLING AND MEASUREMENT OF MATERIAL

- A. For all types of repair materials, the cementitious components shall be kept dry and protected from contamination until incorporated in the mix. Broken containers or bags of pre-measured and pre-mixed components will not be accepted.
- B. Handling and measurement of conventional concrete mix repair material shall conform to ASTM C 94.
- C. Handling and measurement of pre-packaged proprietary materials shall follow the manufacturer's recommendations and requirements. Handling and measurement of components which are not pre-packaged or pre-measured shall be in accordance with the requirements listed below and the manufacturer's requirements. A copy of the manufacturer's written requirements will be provided to the Engineer 5-days prior to installation.

3.2 FORMS

- A. Forming material shall be wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated false-work shall be substantial and unyielding and shall be constructed so that the finished repair will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities.
- B. To prevent bonding of the repair materials to the forms, prior to setting the forms into place, the surface of the form shall be lined with plastic sheeting or coated with a non-staining form

release agent compatible with the repair material being used. If the forms are lined with plastic, the plastic shall be stretched taut removing all wrinkles and folds and maintain a smooth condition during the placement and curing of the repair material.

- C. Metal ties or anchorage within the forms shall be equipped with cones, she-Bolts or other devices that permit their removal to a minimum depth of one (1) inch without injury to the concrete or repair material. Ties designed to break-off below the surface of the concrete shall not be used without cones.
- D. All visible edges and corners included in the repair location shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.
- E. Forms shall be constructed to facilitate consolidation and complete filling of the repair void, and when all surfaces are formed, to facilitate applying pressure to the repair material immediately after placement.

3.3 MIXING, CONVEYING, AND PLACING

- A. Proprietary repair material shall be mixed and conveyed to the forms according to manufacturer's written recommendations. Material that cannot be placed within the manufacturer's time requirements shall not be placed in the forms and shall be discarded off-site at locations selected by the Contractor.
- B. Concrete repair material shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved by the testing agency.
- C. The Contractor shall have all equipment and materials required for curing available at the site ready for use before placement of repair material begins.
- D. No concrete repair material shall be placed except in the presence of the Engineer. The Contractor shall give reasonable notice to the testing agency each time concrete repair material is scheduled for placement. Such notice shall be adequate to allow the testing agency sufficient time to review and approve the subgrade, forms, steel reinforcement and other preparations for compliance with the specifications. Other preparations include, but are not limited to, the mixing and delivery equipment and system, placing and finishing equipment and system, schedule of work, work force, and heating and cooling facilities as applicable. All deficiencies are to be corrected before concrete repair material is mixed for placement.
- E. The concrete repair material shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The depositing of repair material shall be regulated so that the material can be consolidated with a minimum of lateral movement.
- F. Unless otherwise approved, concrete repair material shall not be dropped from a height greater than recommended by the manufacturer or five (5) feet whichever is less.
- G. Unless otherwise specified, all concrete repair material required for each repair location shall be placed in one continuous operation. Successive layers or batches shall be placed at a rate sufficient to prevent setting of material between successive layers.
- H. At the time of placement of repair material, existing concrete surfaces shall be damp, without free water, unless otherwise specified or required by manufacturer of the proprietary repair material being used.

3.4 CONSOLIDATING

- A. Concrete repair materials shall be consolidated to ensure positive contact of repair material with all repair surfaces and reinforcing steel, to remove entrapped air pockets and voids, and to maximize the density of the repair material.
- B. Vibration shall not be applied directly to the reinforcing steel or other embedded items, the forms, or to concrete repair material that has hardened to the degree that it is no longer plastic.
- C. The use of vibrators to transport concrete repair material in the forms or conveying equipment will not be allowed.
- D. Proprietary repair material shall be consolidated in accordance with the manufacturer's recommendations.

3.5 REMOVAL OF FORMS

- A. Unless otherwise approved, forms shall not be removed sooner than the minimum time recommended by the manufacturer of the repair material or 48 hours, whichever is greater.
- B. Forms shall be removed in a manner to prevent damage to the concrete repair material. Supports shall be removed in a manner that will permit the repair material to take the stresses due to its own weight uniformly and gradually.

3.6 FINISHING FORMED SURFACES

- A. All repaired surfaces shall be true and even, and shall be free of open or rough spaces, depressions or projections.
- B. Immediately after the removal of forms:
 - 1. All bulges, fins, form marks or other irregularities which in the judgment of the Engineer will adversely affect the appearance or function of the structure shall be removed. All form bolts and ties shall be removed to a minimum depth of one (1) inch below the surface of the repair. The cavities produced by form ties and all other holes of similar size and depth shall be thoroughly cleaned and, after the interior surfaces have been kept continuously wet for at least three (3) hours, shall be carefully repaired with a compatible patching mortar or packed with a dry patching mortar mixed not richer than one (1) part cement and three (3) parts sand. Dry patching mortar shall be mixed in advance and allowed to stand without addition of water until it has reached the stiffest consistency that will permit placing. Manipulation of the mortar with a trowel during this period shall be performed as required to insure the proper consistency.
 - 2. Holes resulting from form bolts or straps which pass through the wall shall be entirely filled with mortar to form a dense, well-bonded unit. The mortar shall be tamped into place with a rod slightly smaller than the hole being filled. The hardened mortar shall be sound and free from shrinkage cracks.
 - 3. All repaired areas shall be cured as specified in Section 13.

3.7 FINISHING UNFORMED SURFACES

- A. All exposed surfaces of the concrete repair material shall be accurately screeded to grade and finished to match adjacent surfaces, unless otherwise specified. Water shall not be sprinkled or in any manner added to the surface of conventional concrete mix repair material during finishing operations.

- B. Proprietary repair materials shall be finished in accordance with the manufacturer's recommendations.
- C. Joints and edges on unformed surfaces shall be shaped the same as adjacent or similar edges or corners of the structure being repaired.

3.8 CURING

- A. The repair material shall be protected against premature surface drying, rainfall, and freezing for a minimum of 72-hours. For proprietary repair materials, the manufacturer's recommendations for curing shall be followed. Replacement concrete repair material shall be protected from drying and freezing for seven (7) days after placement.
- B. If curing compound is used, it shall be non-solvent type and shall conform to ASTM C 309, Type 1-D, Class B, non-pigmented with a fugitive dye, unless otherwise specified. Curing compounds shall not be used if specifically prohibited by the proprietary repair material user guides.

3.9 REMOVAL OR REPAIR

- A. When the repaired area is honeycombed, damaged or otherwise defective, the Contractor shall remove and replace the defective repair. The Engineer will determine the required extent of removal, replacement and/or repair.

3.10 CONCRETE REPAIR IN HOT WEATHER/ENVIRONMENTS

- A. For proprietary repair materials, the manufacturer's recommendation together with the requirements below shall be followed.
- B. For replacement concrete repair material, the requirements below shall be followed.
- C. For the purpose of this Specification, hot weather is defined as any combination of the following conditions that may impair the quality of the freshly mixed and/or hardened concrete repair material by accelerating the rate of moisture loss and rate of cement hydration, or any other action that could contribute to detrimental results:
 - 1. High ambient temperature.
 - 2. High concrete temperature.
 - 3. Low relative humidity.
 - 4. Wind velocity.
 - 5. Solar radiation.
- D. Whenever the above conditions exist or when climatic conditions are such that the temperature of the concrete repair material may reasonably be expected to exceed 90oF at the time of delivery to the work site or during the placement operations, the following provisions shall apply:
 - 1. The Contractor shall maintain the temperature of the concrete repair material below 90oF during mixing, conveying, and placing.
 - 2. Exposed concrete repair material surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or other suitable means to maintain adequate moisture during the period between placement and finishing and following finishing. Water shall not be sprinkled or added directly to the surface of the concrete repair prior to, or during, finishing.

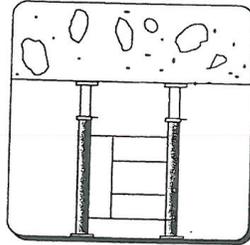
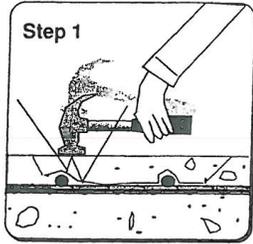
3. Finishing of slabs and other exposed or non-formed surfaces shall be started as soon as the condition of the concrete repair material allows and shall be completed without delay.
4. Formed surfaces shall be kept completely and continuously moist for the duration of the curing period or until the application of the curing compound is completed.
5. Concrete repair material surfaces, especially flat-work placed with large surface areas, shall be covered with wet burlap or other similar material as soon as the concrete repair material has sufficiently hardened and shall be kept continuously moist for a minimum of 24-hours for the initial curing period. This protective method shall be continued for the required curing period or until the application of curing compound is completed.
6. Moist curing may be discontinued before the end of the curing period if white, or other color selected in Section 18, pigmented curing compound is applied immediately.
7. Under extreme conditions of high ambient temperature, high concrete temperature, low relative humidity, wind velocity and exposure to solar radiation, the Engineer may (1) restrict placement to the most favorable time of day, (2) restrict the depth of layers to assure coverage of the previous layer while it will still respond readily to vibration, (3) suspend placement until conditions improve, and (4) require removal of forms, repair, patching and re-application of wet curing by small areas at a time.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 1. Perform the following tests and inspections:
 - a. Evaluate extents of defective concrete removal.
 - b. Evaluate the existing reinforcing for reduced section and removal of rust.
 - c. Review procedures of preparation and patching prior to and during the first placement of repair materials.
 2. Product will be considered defective if it does not pass tests and inspections.

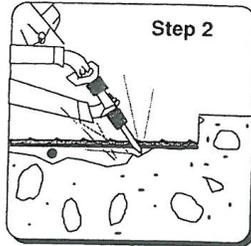
PART 4 SUPPLEMENTAL INFORMATION

General Surface Preparation Procedure



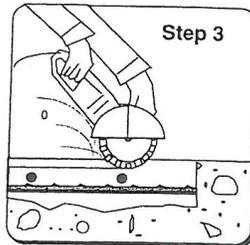
Step 1

Locate area to be repaired (see "Concrete Evaluation"). Hammer sounding or chain drag are used when locating delamination. Design and install temporary support system prior to any concrete removals.



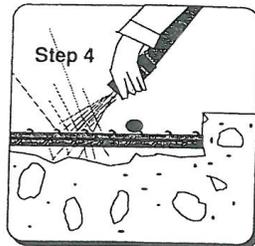
Step 2

Remove deteriorated concrete using acceptable methods. When embedded steel is encountered, follow recommendations on following pages. Undercutting of exposed bars is critical to long term success of surface repairs. Bars which are damaged by the removal operation or have a significant section loss may require repair.



Step 3

Prepare surface repair boundaries to prevent feather edged conditions. Geometry of boundaries should minimize edge length. Shotcrete may require some modifications to squared edges. (ACI 506R-90.)



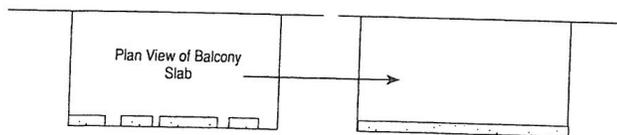
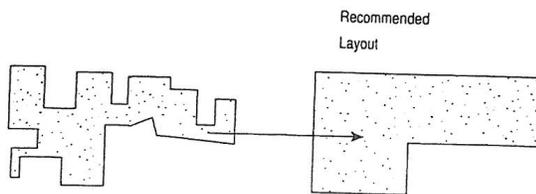
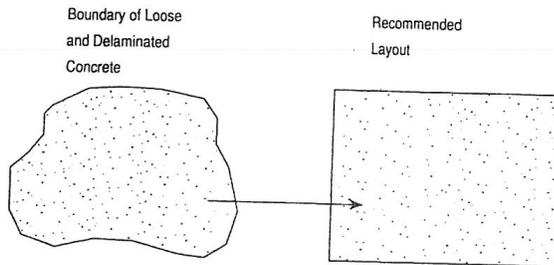
Step 4

Clean the surface of the exposed reinforcing steel and concrete. Surface cleaning is critical to achieve an adequate bond between the repair and the existing concrete. (See "Bonding Repair Materials to Existing Concrete.")

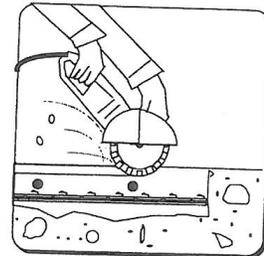
Peter H. Emmons/Concrete Repair and Maintenance

Recommended Layout of Surface Repairs

Layouts should be made as simple as possible.



Deterioration of concrete surfaces generally is not uniform. Areas requiring repair should be modified to provide for simple layouts. The layouts should be designed to reduce boundary edge length. Excessive or complex edge conditions result in shrinkage stress concentrations and cracking. If using sawcutting as a method for edge conditioning, keep in mind that saws cut straight and that, at turns, the saw may be required to overcut.



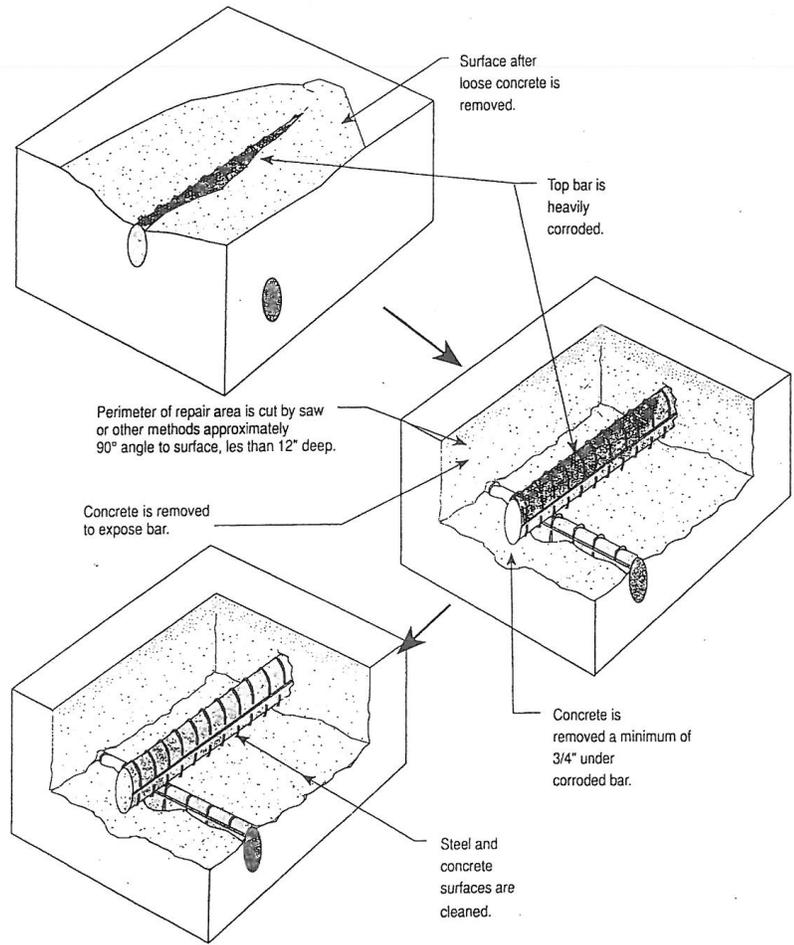
Adapted from IACRS—Surface Preparation Guideline 03730. 31, 32, 34 dated 10/15/89.

Peter H. Fennema/Concrete Repair and Maintenance

Part Three: Surface Repair Section 4: Surface Preparation

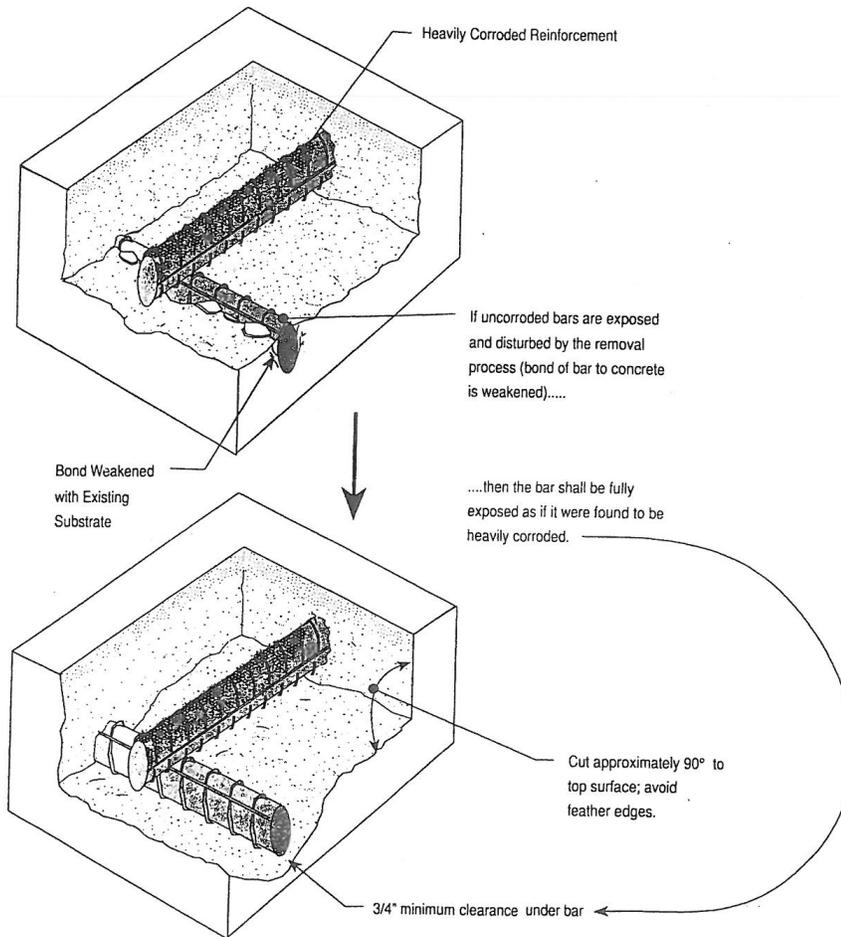
Surface Preparation

When Corroded Reinforcement Is Encountered



Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

When Corroded Reinforcement Is Encountered

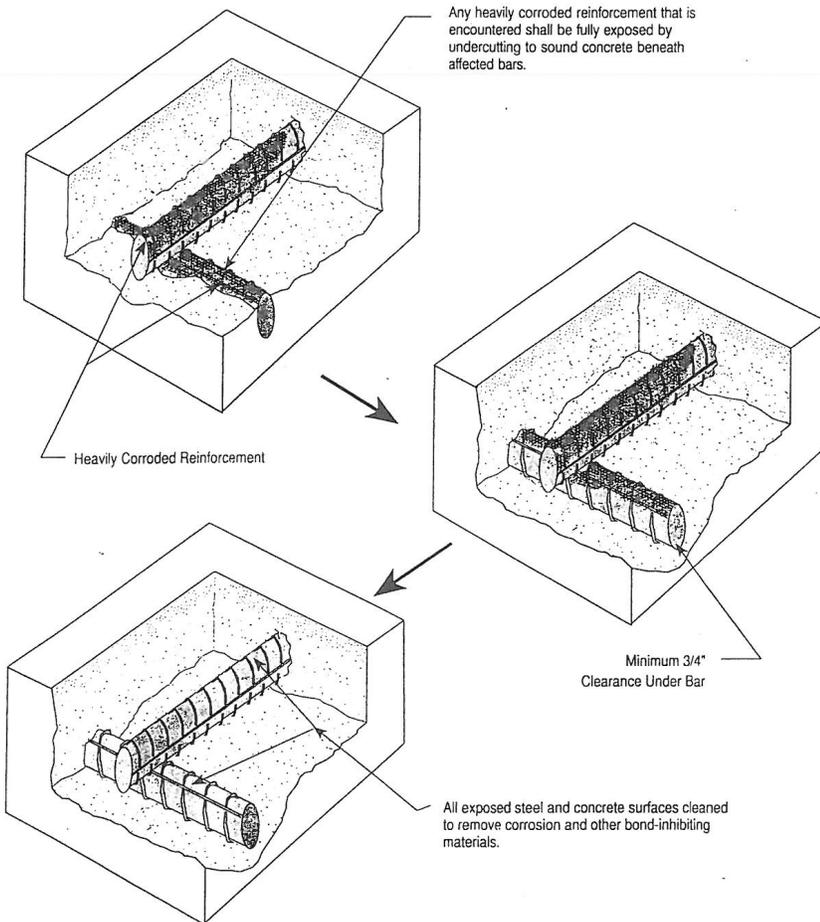


Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

Part Three: Surface Repair Section 4: Surface Preparation

Surface Preparation

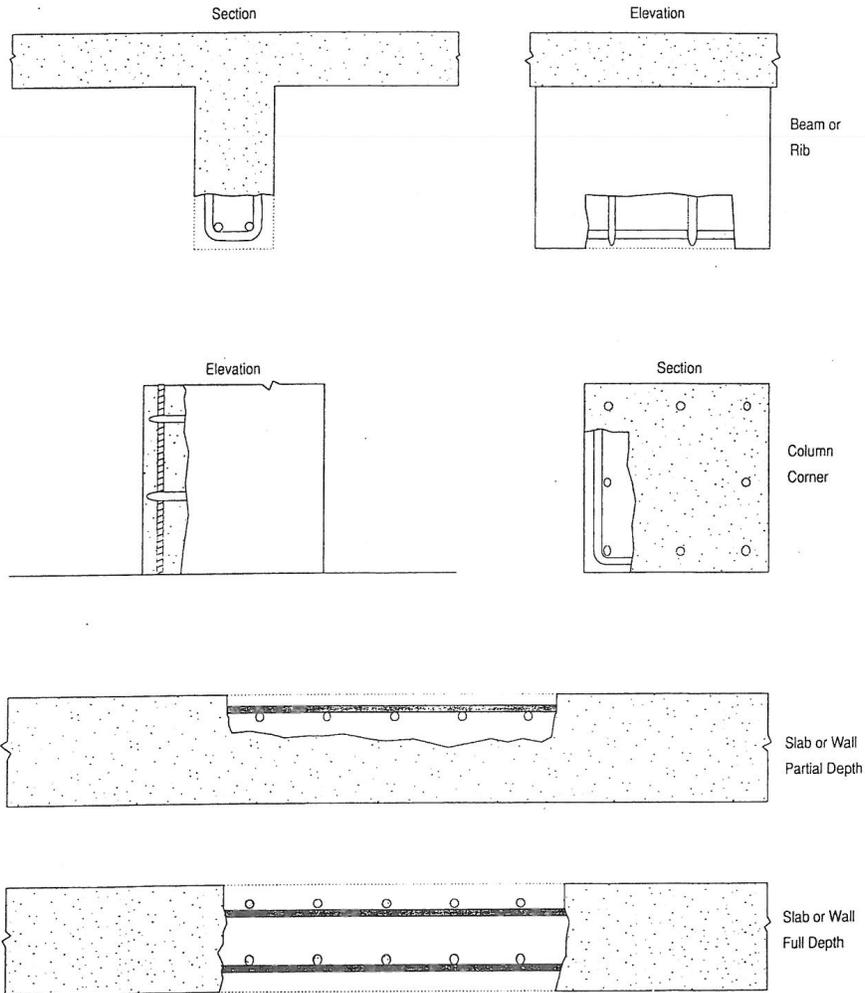
When Corroded Reinforcement Is Encountered



Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

Part Three: Surface Repair Section 4: Surface Preparation

Recommended Removal Geometry



Adapted from IACRS—Surface Preparation Guideline 03730, 31, 32, 34 dated 10/15/89.

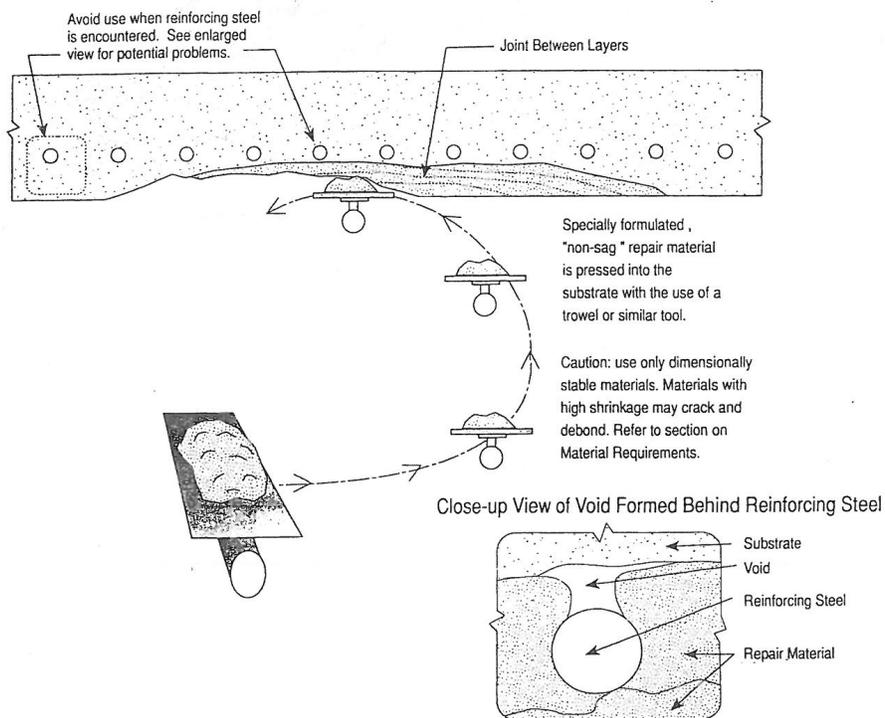
Peter H. Emmens/Concrete Repair and Maintenance

Part Three: Surface Repair Section 7: Placement Methods

Hand-Applied

Hand-applied techniques are used to place non-sag repair materials on vertical and overhead locations. Most hand-applied materials are special blends of cement, finely graded aggregates, non-sag fillers, shrinkage compensating systems, and water. The mixed material is applied to the prepared surface with either a trowel or by hand. The applied pressure drives the repair material into the pore structure of the exposed concrete. The repair material is designed to "hang"

in place until subsequent layers are added. Each layer is roughened to promote bond with the next layer. The best use of this technique is for topical cosmetic repairs not involving reinforcing steel. When reinforcing steel is encountered, it is very difficult to consolidate and provide for complete encapsulation of the reinforcing steel. Problems associated with this technique involve poor bond between layers and voids around embedded reinforcing steel.



END OF SECTION

SECTION 33 63 54
GENERAL CONCRETE REQUIREMENTS - WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete Repair Materials
 - a. As recommended by waterproofing manufacturer.
- B. Waterstops.
- C. Cold Applied Waterproofing.
- D. Waterproofing accessories.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated.
 - 2. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved by manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified with three (3) years' experience in work of the type required by these Construction Standards.
- B. For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer to the extent possible.
- C. Preinstallation Conference: Conduct conference at Project site

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period
 - 1. Warranty Period: Provide written five (5) year material warranty for sheet membrane waterproofing issued by the membrane manufacturer upon completion of the work.
- B. Installer's Special Warranty: Signed by Installer, covering Work of this Section, for warranty period of two (2) years.

PART 2 PRODUCTS

2.1 WATERSTOPS

- A. Waterstops for use in concrete manhole or chase repairs shall utilize Volclay Waterstop-RX.
- B. Waterstops for the precast lid to wall connection shall be Butyl-Rubber sealant. Waterstop to be Conseal CS-102 or approved equal.

2.2 COLD-APPLIED WATERPROOFING

- A. Components and membrane materials must be obtained as a single source from the membrane manufacturer to ensure total system compatibility and integrity. TREMproof® 250GC is a rapid-curing, high solids, VOC compliant modified polyurethane waterproofing membrane or approved equal.
 - 1. Provide a complete fluid applied elastomeric waterproofing membrane system designed for concealed building components subject to hydrostatic head that is polyurethane, coal-tar free and complies with ASTM C 836:

2.3 ACCESSORIES

- A. Primer: As recommended by waterproofing membrane system manufacturer.
- B. Joint backing: Closed-cell, polyethylene rod as recommended by membrane manufacturer
- C. Reinforcing fabric: Woven fiberglass scrim cloth
- D. Elastomeric sheet flashing: 1/16 inch thick by 12-inch-wide uncured neoprene sheeting;
- E. Elastomeric transition flashing to above-grade: polyurethane liquid-applied coating system with ultraviolet protective topcoat.
 - 1. Acceptable product:
 - a. Vulkem 350/351; Tremco Inc.
- F. Joint Treatment:
 - 1. Acceptable product:
 - a. Dymeric 240FC; Tremco Inc.
 - b. TREMproof 201/60T; Tremco Inc.
 - c. TREMproof 250GCT; Tremco Inc.
- G. Protection course: As recommended by waterproofing membrane manufacturer.
 - 1. Acceptable product for walls:
 - a. Protection Mat; Tremco Inc.
- H. Prefabricated Composite Drainage: Two-part prefabricated composite drainage material consisting of a formed polystyrene core covered on one side with filter fabric.
 - 1. For water collection and high profile section for water flow around the perimeter of the structure, a drainage composite with non-woven needle-punched polypropylene filter fabric, a transition section to couple with adjoining drainage mat, high profile flow capacity of 100 gpm and fitted with compatible factory-molded universal tees, universal outlets and 12" corner guards. Acceptable product:
 - a. TREMDrain Total-Drain; Tremco Inc.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
- F. Typical waterproofing installation includes concrete repairs, joint caulking, waterstops, pre-applied sheet waterproofing, waterproofing and protection board. Refer to manufacturer's literature for instructions on installation.
- G. Cast-in-place Concrete Substrates:
 - 1. Do not proceed with installation until concrete has properly cured and dried. If recommended by the manufacturer, special primers may be used to allow priming and installation of hot applied waterproofing sooner than seven (7) days. Priming may begin as soon as the concrete will maintain structural integrity.
 - 2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
 - 3. Repair bugholes over 13 mm (0.5 in.) in length and 6 mm (0.25 in.) deep and finish flush with surrounding surface.
 - 4. Remove scaling to sound, unaffected concrete and repair exposed area.
 - 5. Grind irregular construction joint to suitable flush surface.
 - 6. Treat joints and install flashing as recommended by waterproofing manufacturer.

3.2 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
 - 1. Install 1/4" diameter backer rod into corner of all horizontal-to-vertical junctures subject to movement and cover with 1" detail cant of approved sealant; install 1" detail cants at projections, curbs and other horizontal-to-vertical junctures.
 - 2. Install detail coats, joint and crack treatments, elastomeric flashing and reinforcing fabric in accord with manufacturer's instructions.
 - 3. Allow detail applications to cure in accordance with manufacturer's instructions prior to general application of membrane.

3.3 MEMBRANE APPLICATION

- A. General: Install waterproofing system in accord with manufacturer's recommendations and instructions as applies to the Work except where more stringent requirements are indicated.
 - 1. Grid deck surfaces to assure proper coverage rates and verify membrane wet-film mil thickness with gauges as work progresses.
 - 2. Retain empty product containers during course of work to aid in determining whether completed membrane complies with required average dry-film thickness.

- B. Verify proper dry condition of substrate using method recommended by membrane system manufacturer; perform adhesion checks prior to general application of membrane system using field adhesion test method recommended by manufacturer.
- C. Mask off adjoining surfaces not to receive membrane system.
- D. Wipe clean all detail coats with white rags wetted with Xylene solvent; do not saturate detail coat.
- E. Apply membrane uniformly and allow to cure in accordance with manufacturer's instructions.
- F. Feather terminating edge when entire area cannot be completed in one day; clean area 6" wide along terminating edge of membrane with Xylene solvent on clean white rags prior to startup on next working day; use interlaminary primer per manufacturer's instructions as needed; overlap existing work by 6" with new work.
- G. Flood test: Follow ASTM D 5957. Plug drains on deck surfaces and use sand bags or other means to restrict runoff. Flood deck with water to depth of 2" (50 mm) and allow to stand at least 48 hours.
- H. Install protection course over cured membrane in accord with manufacturer's instructions.
- I. Install drainage material in accord with manufacturer's instructions.

3.4 WATERSTOPS

- A. Waterstops shall be installed in strict accordance with manufacturer's recommendations with particular care being given to properly setting in adhesive and maintaining the required minimum concrete coverage

3.5 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Delivery, Storage, and Handling
 1. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.
 2. Protect primer, mastic and adhesive from moisture and potential sources of ignition.
 3. Store protection board flat and off the ground. Provide cover on top and all sides.
- C. Sequence deliveries to avoid delays and minimize on-site storage.
- D. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work
- E. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer
- F. Butt joint between precast lids shall be sealed immediately after placing lids in order to minimize water infiltration prior to applying waterproofing. Seal with horizontal joint sealant as specified.

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

3.6 FIELD QUALITY CONTROL

- A. All concrete waterproofing shall inspected by the owner prior to proceeding to next step of installation. Owner shall receive 24-hour notice of inspections being required. These inspections for approval include:
 - 1. Substrate conditions ready for waterproofing
 - 2. Flashing installation complete
 - 3. Membrane installation complete
 - 4. Protection and drainage installation complete

END OF SECTION

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**GEOTECHNICAL ENGINEERING REPORT
FOR
UNIVERSITY OF MISSOURI**

**CP253171 GS STEAM, CONDENSATE &
WATER LINE REPLACEMENT
COLUMBIA, MISSOURI**

OCTOBER 1, 2025

Crockett GTL Project Number: G251223

1000 W Nifong Blvd, Bldg 1 • Columbia, MO 65203

Phone: 573-447-0292

www.CrockettEngineering.com

CROCKETT

GEOTECHNICAL - TESTING LAB

1000 W Nifong Blvd. – Building 1
Columbia, Missouri 65203
(573) 447-0292

October 1, 2025

University of Missouri
117 General Services Building
Columbia, MO 65211

Attn: Jennifer Sullivan

Re: Geotechnical Engineering Report
CP253171 GS Steam, Condensate & Water Line Replacement
Columbia, Missouri
Crockett GTL Project Number: G251223

Ms. Sullivan,

Crockett Geotechnical – Testing Lab (Crockett GTL) has completed the geotechnical engineering services for the referenced project. This report should be read in its entirety. This report presents the results of our field explorations, laboratory testing, and recommendations for design and construction of the referenced project.

We appreciate the opportunity to be of service and look forward to working with you during the construction phase of this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,



Collin Walsh, E.I.
Project Manager



Eric H. Lidholm, P.E.
Principal Engineer
Missouri: E-23265



Enclosures

cc: 1 – Client (.PDF)
1 – File

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APPENDIX

- Site Location Map
- Boring Location Plan
- Boring Logs
- Boring Log Legend and Nomenclature

Geotechnical Engineering Report
CP253171 GS Steam, Condensate & Water Line Replacement
Columbia, Missouri
Crockett GTL Project Number: G251223
October 1, 2025

1 INTRODUCTION

Crockett Geotechnical - Testing Lab (Crockett GTL) has conducted a geotechnical exploration for the proposed project. The purpose of our exploration was to:

- Characterize and evaluate the subsurface conditions
- Provide design and construction recommendations for:
 - undocumented fill
 - groundwater control
 - excavation considerations
 - uplift pressures
 - lateral earth pressures
 - special inspection requirements

2 SITE AND PROJECT INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

Item	Description
Location	This project is located immediately west of Schweitzer Hall at 503 S College Avenue in Columbia, Missouri A Site Location Map showing the approximate location of this project is included in the Appendix of this report
Existing topography	Relatively flat in the area of planned construction

2.2 PROJECT DESCRIPTION

Item	Description
Proposed improvements	A new manhole expected to be as deep as 10 feet below existing grade

Item	Description
Below grade areas	Manhole

3 SUBSURFACE CONDITIONS

3.1 FIELD EXPLORATION AND LABORATORY TESTING

At the request of the client, one (1) boring was drilled for this project at the approximate location indicated on the Boring Location Plan included in the Appendix of this report. Additional information follows:

Field Exploration	
Boring Locations ¹	Designated by the University of Missouri and staked by a Crockett GTL project manager
Boring Elevations ¹	The boring elevation was obtained using the terrain feature on Boone County Parcel Viewer The elevation was rounded to the nearest foot
Drill Rig	Mobile B-57 track-mounted drill rig equipped with 6-inch solid stem augers
Sampling Methods	Representative samples were obtained using thin-walled tube sampling procedures
1. The location and elevation of the borings should be considered accurate only to the degree implied by the means and methods used to define them.	

The samples were tagged for identification, sealed to reduce moisture loss and taken to our laboratory for further examination, testing and classification. Information provided on the boring log attached to this report includes material descriptions, consistency evaluations, boring depth, sampling intervals and groundwater conditions. The boring was backfilled prior to the drill crew leaving the site.

The field log was prepared by the drill crew. The final log in this report reflect the engineer's interpretation of the field log, incorporating modifications from laboratory tests and observations of the samples. Detailed information on material encountered, field sampling and laboratory testing results is provided on the boring log in the Appendix of this report. The descriptions of the soil on the final boring log are in general accordance with the Unified Soil Classification System which is included in the Appendix of this report.

3.2 ENCOUNTERED SUBSURFACE CONDITIONS

Detailed descriptions of the encountered materials are listed on the individual boring log included in the Appendix of this report. Strata lines indicate the approximate location of changes in material types. The transition between material types may be gradual. A generalized summary of what was encountered in the boring follows:

From the ground surface the boring encountered about 3-inches of topsoil. The thickness of the topsoil may vary elsewhere on the site.

Underlying the topsoil was undocumented fill consisting primarily of lean clay. Undocumented fill is material that appears to be compacted to a relatively high degree, but for which no compaction test results are available to verify that satisfactory compaction and moisture control was achieved throughout the fill area. The undocumented fill extended to a depth of about 3 feet in the boring.

Underlying the undocumented fill was fat clay. The fat clay extended to a depth of about 8.0 feet in the boring.

Underlying the fat clay was lean to fat clay and clayey sand that was visually identified as glacial drift. The glacial drift extended to the planned boring termination depth of 15.0 feet. Bedrock was not encountered.

3.3 GROUNDWATER

The borehole was observed for the presence and level of groundwater while drilling, after completion of drilling and for the extended duration for which a temporary piezometer was installed. The temporary piezometer was removed one week after installation and the subsurface has been restored. The groundwater levels observed are summarized below:

Groundwater Levels			
Boring Number	Depth to Groundwater (feet)		
	At Time of Drilling	At End of Drilling	After Completion of Drilling
B-1	Not encountered	Not encountered	Not encountered @ 0.25 hrs Not encountered @ 4 days Not encountered @ 6.2 days

Due to the low permeability of the soils encountered in the boring, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole in these

materials. Long term observations in piezometers were performed for this project to define groundwater levels. Groundwater levels depend on seasonal and climatic variations and may be present at different levels in the future.

Pockets, lenses and stringers of sand are sometimes encountered in the glacial soils present in the vicinity of the referenced project. These sand pockets are normally discontinuous, often contain water of variable quality and quantity and may be encountered during excavation.

The boreholes were backfilled prior to departing the project site. Groundwater records are indicated on the boring log included in the Appendix of this report.

4 GEOTECHNICAL RECOMMENDATIONS

4.1 UNDOCUMENTED FILL

Undocumented fill was encountered in the boring to a depth of about 3.0 feet. Undocumented fill is material that appears to be compacted to a relatively high degree but for which no compaction test reports are available to verify satisfactory compaction and moisture control was achieved throughout the fill area.

4.2 GROUNDWATER CONTROL

Groundwater was not encountered in the boring while drilling or for the duration that the temporary piezometer was installed. Based on the groundwater data presented earlier in this report, we anticipate groundwater control will not be necessary for construction of the new manhole. However, due to the limited number of borings and variability of subsurface conditions, this interpretation is not definitive.

Due to the presence of high clay-content soils in the boring, it is unclear if well-point dewatering methods will work satisfactorily should groundwater be encountered. Other appropriate means may be required for groundwater control during construction.

Control of groundwater, if encountered, should be accomplished in a manner that will preserve the strength of the soils, will not cause instability of the excavation, and will not result in damage to existing structures, if any.

4.3 EXCAVATION CONSIDERATIONS

For this project, excavated side slopes or vertical cut excavations are feasible depending on location. For vertical cut excavations greater than 4 feet in depth, excavations will require the

use of a trench box or shoring and bracing to prevent sloughing and caving of the soil into the excavation. The contractor should use a trench box or shoring and bracing as necessary to maintain a safe and clean excavation which meets Occupational Safety and Health Administration (OSHA) requirements. Bracing for vertical excavation walls should be designed to resist the lateral earth pressure as outlined in this report in section 4.5 Lateral Earth Pressures.

In lieu of shoring, bracing or trench boxes for excavations greater than 4 feet, OSHA standards provide recommendations for the design of temporary sloped excavations with a depth less than 20 feet. The surface of slopes should be protected from deterioration and weathering if they are left open for significant periods of time. The OSHA slope standards listed above do not guarantee stable slopes and slope stability analysis was beyond the scope of this geotechnical investigation.

We recommend no equipment should be operated within a horizontal distance equal to the excavation depth from the edge of the excavation and no materials should be stockpiled within this distance unless designed and approved by the contractor's competent person. Excavations should not approach closer than a horizontal distance equivalent to the excavation depth from existing structures or buried utilities without some form of protection for the facilities. Proper berming or ditching should be done to divert any surface runoff away from the excavations.

Excavations should be performed with equipment capable of providing a relatively clean bearing area. Excavating equipment should not disturb the soil beneath the design excavation bottom and should not leave loose soil in the excavation.

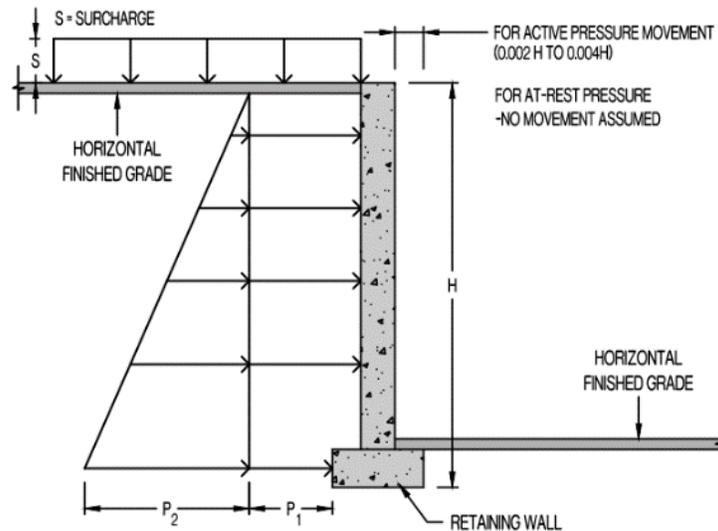
The bearing surface should be protected against disturbance and deterioration by completing the utility line installation and backfilling operations as quickly as possible. The excavation bottom should be properly sloped to allow water infiltrating into the excavation to be collected at a convenient location along the edge of the excavation. Water should not be allowed to stand within the bearing area.

4.4 UPLIFT PRESSURES

Uplift forces on below-grade structures, such as manholes, will be generated by a difference in water level in the soil adjacent to the structure and inside of the structure. Effective dewatering and engineering design must be performed to minimize, or eliminate, uplift forces during construction and post-construction.

4.5 LATERAL EARTH PRESSURES

Below grade walls with unbalanced backfill levels may be utilized on this site. Walls should be designed using the earth pressures indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Earth Pressure Coefficients			
Backfill Type	Active (K_a) ²	At Rest (K_o)	Passive (K_p) ³
Equivalent Fluid Unit Weights			
Cohesive	50 pcf	70 pcf	280 pcf
Granular	40 pcf	60 pcf	360 pcf
Surcharge Pressure, P_1 (psf)			
Cohesive	(0.42)S	(0.58)S	---
Granular	(0.33)S	(0.46)S	---
Earth Pressure, P_2 (psf)			
Cohesive	(50)H	(70)H	---
Granular	(40)H	(60)H	---

Earth Pressure Coefficients	
Sliding Resistance	0.32 (coefficient of friction)
<ul style="list-style-type: none"> • The values are applicable when the surface of the backfill behind the wall is horizontal. Increased values will result with steeper than horizontal slopes • No safety factor included in soil parameters • Does not include loading from heavy compaction equipment • No hydrostatic pressures acting on wall • Backfill compacted to at least 95% standard Proctor dry density, or at least 80% relative density, as appropriate for material type • Soil backfill unit weight a maximum of 120 pcf • No dynamic loading • For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height • For passive earth pressures to develop, the wall must move horizontally • Ignore passive pressure in the frost zone • For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively • Exterior granular backfill should be capped with approximately 2 feet of cohesive soil to reduce the potential for surface water infiltration into the granular backfill • Uniform surcharge, where S is surcharge pressure 	

Where appropriate, we recommend below-grade walls be provided with a drainage system. A minimum 4-inch diameter, perforated drain pipe should be placed at the foundation level. Granular drainage material, consisting of 1-inch clean crushed rock, classified as GP by ASTM D 2487, with less than 5 percent passing the No. 200 sieve, should be placed a minimum of 6 inches in all directions around the drainage pipe. Synthetic filter fabric, such as Mirafi 140N or equivalent, should encapsulate the drainpipe and granular drainage material.

The pipe should be sloped to drain by gravity or through weep holes located on approximately 10-foot centers for above-grade retaining walls, or to a sump with a pump for below-grade walls where positive drainage by gravity cannot be achieved. Any interior sumps must be isolated “watertight” from the interior subgrade to prevent the movement of moisture from the sump into the underlying soils.

4.6 SPECIAL INSPECTION REQUIREMENTS

The following items require special inspections in accordance with Chapter 17 of the International Building Code:

Schedule of Special Inspection Services ^{1,2}			
Material/Activity	Service	Applicable to this Project	
		Y/N	Extent
1705.6 Soil		Y	
<ul style="list-style-type: none"> Verify materials below shallow foundations are adequate to achieve the design bearing capacity 	Field Inspection	Y	Periodic
<ul style="list-style-type: none"> Verify excavations are extended to proper depth and have reached proper material 	Field Inspection	Y	Periodic
<ul style="list-style-type: none"> Perform classification and testing of controlled fill materials 	Field Inspection	Y	Periodic
<ul style="list-style-type: none"> Verify use of proper material, densities, and lift thicknesses during placement and compaction of controlled fill 	Field Inspection	Y	Continuous
<ul style="list-style-type: none"> Prior to placement of controlled fill, observe subgrade and verify site has been prepared properly 	Field Inspection	Y	Periodic
1705.7 Driven Deep Foundations		N	
1705.8 Cast-In-Place Deep Foundations		N	
1705.9 Helical Pile Foundations		N	
1. Testing and inspections services shall be performed by an approved agency in general accordance with section 1703 of the International Building Code 2. This section references 2015 IBC. Other code years may have a differing section number for concrete elements			

The contractor shall request special inspection of the items listed above prior to those items becoming inaccessible and unobservable due to the progression of work.

5 GENERAL COMMENTS

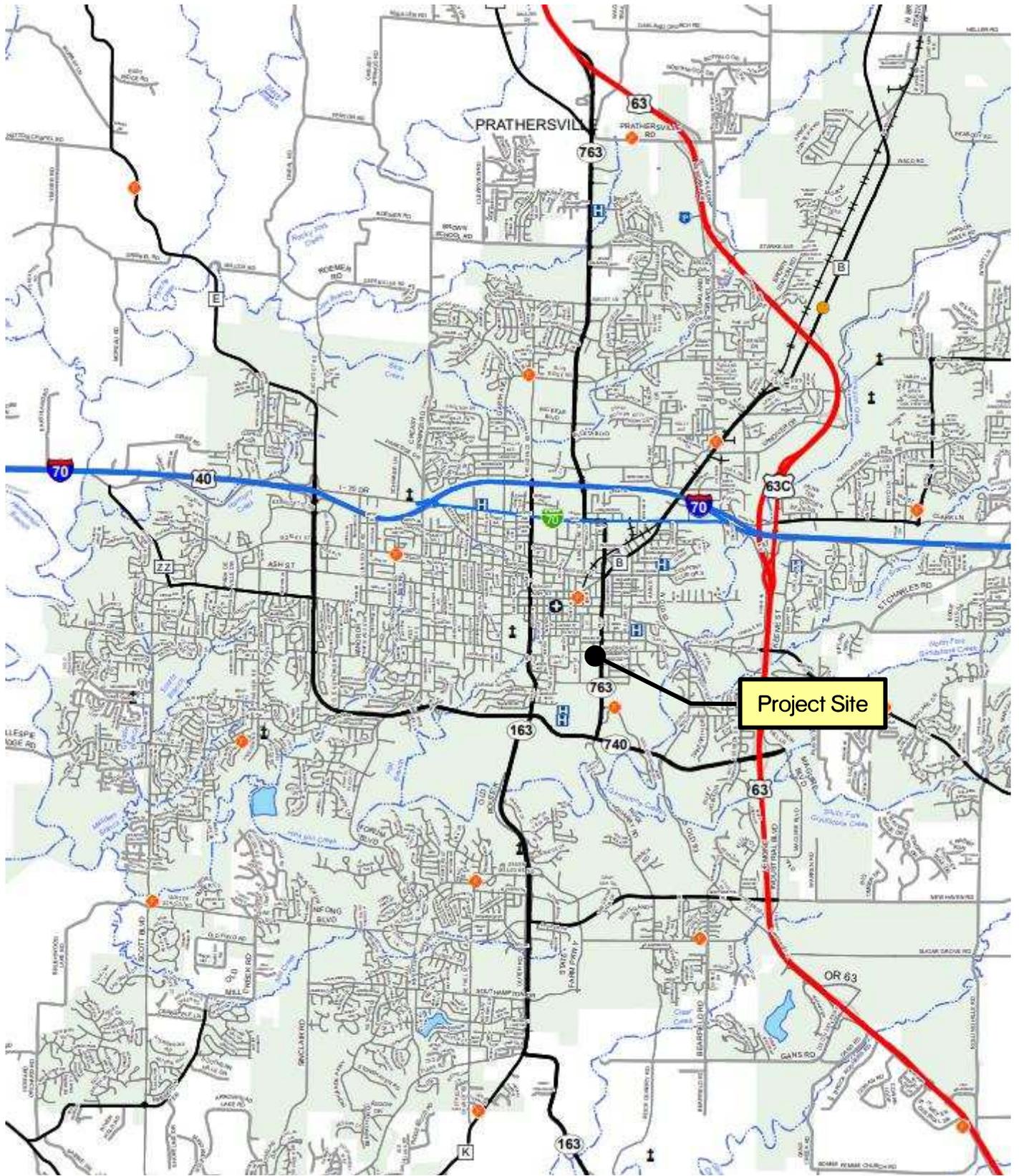
The recommendations provided herein are for the exclusive use of our client. Our recommendations are specific only to the project described herein and are not meant to supersede more stringent requirements of local ordinances or codes. The recommendations are based on subsurface information obtained at our boring locations, sample locations, our understanding of the project as described in this report, and geotechnical engineering practice consistent with the current standard of care. No warranty is expressed or implied. CGTL should be contacted if conditions encountered are not consistent with those described.

CGTL should be provided with a set of final plans and specifications, once they are available, to review whether our recommendations have been understood and applied correctly and to assess the need for additional exploration or analysis. Failure to provide these documents to

CGTL may nullify some or all of the recommendations provide herein. In addition, any changes in the planned project or changes in site conditions may require revised or additional recommendations on our part.

The final part of our geotechnical service should consist of direct observation during construction to observe that conditions actually encountered are consistent with those described in this report and to assess the appropriateness of the analyses and recommendations contained herein. CGTL cannot assume liability or responsibility for the adequacy of recommendations without being retained to observe construction.

APPENDIX



PROJECT NO.: G251223

SITE LOCATION MAP

CP253171 GS STEAM, CONDENSATE & WATER
 LINE REPLACEMENT
 COLUMBIA, MISSOURI

Prepared By:

CROCKETT

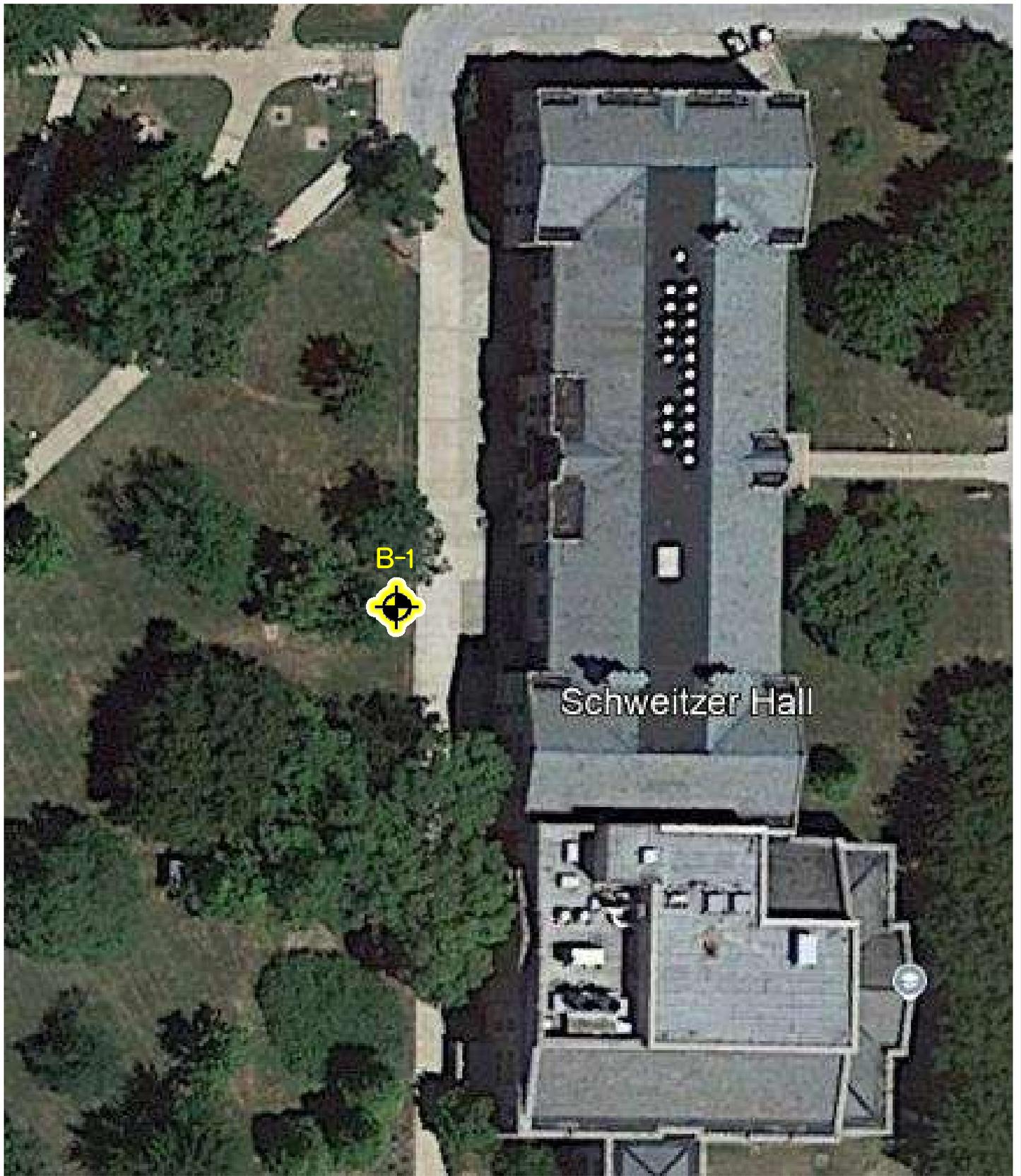
GEOTECHNICAL - TESTING LAB

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Schweitzer Hall

B-1



BORING LOCATION PLAN

CP253171 GS STEAM, CONDENSATE & WATER
LINE REPLACEMENT
COLUMBIA, MISSOURI

PROJECT NO.: G251223

Prepared By:



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 1000 W Nifong Blvd, Bldg 1
 Columbia, MO 65203
 Telephone: 573-447-0292



BORING NUMBER B-1

CLIENT University of Missouri **PROJECT NAME** CP253171 GS Steam, Condensate & Water Line Replacement
PROJECT NUMBER G251223 **PROJECT LOCATION** Columbia, Missouri
DATE STARTED 9/18/25 **COMPLETED** 9/18/25 **GROUND ELEVATION** 774 ft MSL **HOLE SIZE** 6"
DRILL RIG IPES Mobile B-57 (Hammer Efficiency = 91.7%) **GROUND WATER LEVELS:**
DRILLING METHOD 6" SSA **AT TIME OF DRILLING** --- Not encountered
LOGGED BY Walsh **CHECKED BY** Lidholm **AT END OF DRILLING** --- Not encountered
NOTES Borehole backfilled upon completion **149hrs AFTER DRILLING** --- Not encountered

SAMPLE LENGTH REPORT - LAT-LONG TEMPLATE.GDT - 10/1/25 09:18 - V1===PROJECTS===G251223 - CP253171 GS STEAM, CONDENSATE & WATERLINE REPLACEMENT\G251223.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY LENGTH	BLOW COUNTS (N VALUE)	PENETROMETER (psf)	UNC. COMP. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0												
0.3		TOPSOIL (3-inches)										
		UNDOCUMENTED FILL: Lean clay, brown, trace sand and gravel, friable	ST 1	14		7600			10			
3.0		FAT CLAY: Brown, trace gray, trace rust and lignite stains, trace sand	ST 2	11		12000	15704	111	15			
8.0		LEAN TO FAT CLAY: Gray, trace brown, with sand, trace gravel (glacial drift)	ST 3	18		10000	9428	116	12			
13.5		CLAYEY SAND: Brown, trace gravel (glacial drift)	ST 4U	6		12000		114	15			
		-200 wash = 32.6% passing	ST 4L	12		sand			6			
15.0												

No refusal.
 Bottom of borehole at 15.0 feet.

BORING LOG LEGEND AND NOMENCLATURE

Sample Type	Description
AU	Auger sample, disturbed, obtained from auger cuttings
NR	No recovery or lost sample
RC	Rock core, diamond core bit, nominal 2-inch diameter rock sample (ASTM D 2113)
ST	Thin walled (Shelby) tube sample, relatively undisturbed (ASTM D 1587)
SPT	Split spoon sample, disturbed (ASTM D 1586)
VA	Shear vane (ASTM D 2753)

Grain Size Terminology	
Boulders	Larger than 12-inches
Cobbles	3-inches to 12-inches
Gravel	Retained on #4 sieve to 3-inches
Sand	Retained on #200 sieve but passes #4 sieve
Silt or Clay	Passes #200 sieve

Descriptor	Relative Proportion of Sand and Gravel	Relative Proportion of Fines
Trace	Less than 15% by dry weight	Less than 5% by dry weight
With	15% to 30% by dry weight	5% to 12% by dry weight
Modifier	More than 30% by dry weight	More than 12% by dry weight

Relative Density of Coarse grained Soils	
Descriptive Term	SPT N-Value, Blows/Foot
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	50+

Consistency of Fine Grained Soils		
Descriptive Term	SPT N-Value, Blows/Foot	Unconfined Compressive Strength, psf
Very Soft	0 - 1	0 - 500
Soft	2 - 3	501 - 1,000
Medium	4 - 9	1,001 - 2,000
Stiff	10 - 29	2,001 - 4,000
Very Stiff	30 - 49	4,001 - 8,000
Hard	50+	> 8,000

USCS Soil Classification System					
Major Divisions			Group Symbol	Group Name	
coarse grained soils more than 50% retained on #200 sieve	gravel >50% of coarse fraction retained on #4 (4.75 mm) sieve	clean gravel <5% small than #200 sieve	GW	well-graded gravel, fine to coarse gravel	
		gravel with >12% fines	GP	poorly graded gravel	
		sand >50% of coarse fraction passes #4 (4.75 mm) sieve	clean sand	GM	silty gravel
			sand with >12% fines	GC	clayey gravel
	fine grained soils more than 50% passes #200 sieve	silt and clay liquid limit < 50	inorganic	SW	well-graded sand, fine to coarse sand
			organic	SP	poorly graded sand
silt and clay liquid limit ≥ 50		inorganic	SM	silty sand	
		organic	SC	clayey sand	
highly organic soils		ML	ML	silt	
		CL	CL	clay	
		MH	MH	silt of high plasticity, elastic silt	
		CH	CH	clay of high plasticity, fat clay	
		OH	OH	organic clay, organic silt	
		PT	PT	peat	

Weathering	Description of Rock Properties
Fresh	No discoloration. Not oxidized.
Slightly weathered	Discoloration or oxidation of most surfaces but or short distance from fractures
Moderately weathered	Discoloration or oxidation extends from fractures, usually throughout. All fractured surfaces are oxidized or discolored.
Severely weathered	Discoloration or oxidation throughout. All fractured surfaces are oxidized or discolored. Surfaces are friable.
Decomposed	Resembles a soil. Partial or complete remnant rock structure may be present.

Rock Quality Designator (RQD)	
RQD, %	Rock Quality
90 - 100	Excellent
75 - 90	Good
50 - 75	Fair
25 - 50	Poor
0 - 25	Very poor

Joint, Bedding, and Foliation Spacing in Rock		
Spacing	Joints	Bedding/Foliation
< 2-inches	Very close	Very thin
2-inches - 1-foot	Close	Thin
1-foot - 3-feet	Moderately Close	Medium
3-feet - 10-feet	Wide	Thick
>10-feet	Very Wide	Very thick

UNIVERSITY *of* MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

Hazardous Building Material Survey

Steam and Water Line Replacement

CP253171

11/5/2025

Introduction

At the request of Larissa Barnes, Assistant Project Manager for Planning, Design, and Construction, MU EHS completed a Hazardous Building Material Survey for steam and water line replacement at Stephens and Lefevre Halls. The survey was made to determine the presence of hazardous materials that will be impacted by planned renovations to this area.

The survey was conducted, in part, to satisfy the requirements of 40 CFR 61, subpart M, which stipulates that all buildings be "thoroughly inspected" for asbestos before the commencement of renovation or demolition activities.

The chases between SMH-100, SMH-104, and SMH-105 have pipe insulation which contain asbestos. The chase from SMH-105 into Schweitzer Hall and from SMH-100 into Stephens Hall has pipe insulation which contains asbestos. SMH-100 is presumed to contain some asbestos piping. Waterproofing tarpaper on the lids of the chases contains asbestos. Mechanical Room 46 in Schweitzer Hall contains PACM piping.

Project Scope

The steam and water line replacement will be completed at Stephens and Lefevre Halls. The areas affected due to the project will be underground utilities, mechanical spaces, etc.

Steam Manholes 100, 104, and 105 will be involved, and the chases that connect them. The pipes in the chase running northeast from Steam Manhole 100 to Stephens Hall will be replaced. A new manhole will be built in the chase running along the west side of Schweitzer Hall. The pipe running from SMH105 to this new manhole will be replaced. Pipe from the new manhole into Schweitzer will be replaced.

The chases will be refurbished and the lids will be replaced.

Field Observations

Asbestos surveys were made of Steam Manholes 100 and 105 in 2012. Analysis for the samples from those surveys are included with this report. Due to the age of the earlier surveys, signed analysis sheets are not available.



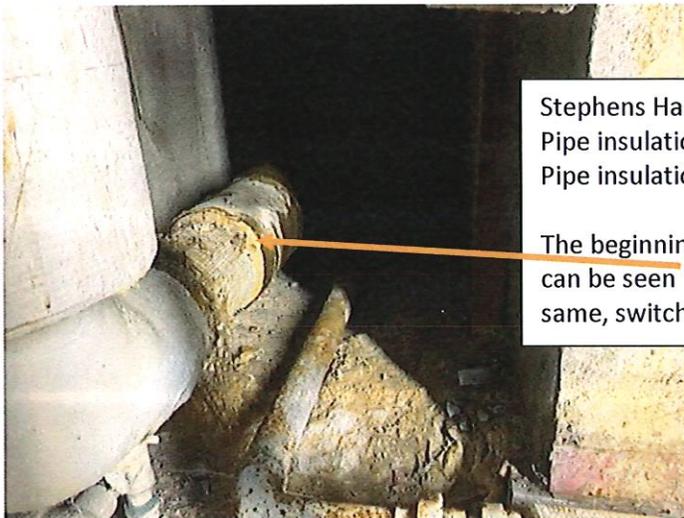
The pipe insulation in SMH105 was found to be negative for asbestos. The pipe insulation in the chase leading out of the manhole was found positive for asbestos. It is presumed that the TSI is positive from SMH105 to SMH100. Also, the pipe insulation leading south out of SMH105, running along the west side of Schweitzer Hall, is presumed positive for asbestos.

The pipe insulation in SMH100 is mostly negative, but one length of steam and one of condensate are positive for asbestos.

After the survey for SMH100 was completed in 2012, an abatement took place in 2013. Not all the asbestos pipe insulation was stripped however, and some positive material remains in SMH100. Any pipe insulation in SMH100 which is not clearly fiberglass or black foam glass, is presumed positive for asbestos.

MU EHS entered SMH104 for this survey. The manhole has fitted, modern jackets on the valves and fittings. These are taken as signs of negative insulation. The straights are jacketed with sheet metal, with pinholes. It is apparent that the straights and 90s are black foam glass, which is negative for asbestos. This manhole is negative. Pipe insulation in the chase leading from SMH104 to SMH105 is presumed positive.

Steam pipes enter Stephens Hall in Mechanical Room 107. Pipe insulation in Room 107 is fiberglass and black neoprene. From the south edge of Room 107, material from the pipe in the chase was sampled and analyzed. The pipe insulation in the tunnel is negative for asbestos. The pipe wrap is positive for asbestos. Therefore, the TSI package is presumed positive for asbestos from SMH100 to Stephens Hall.



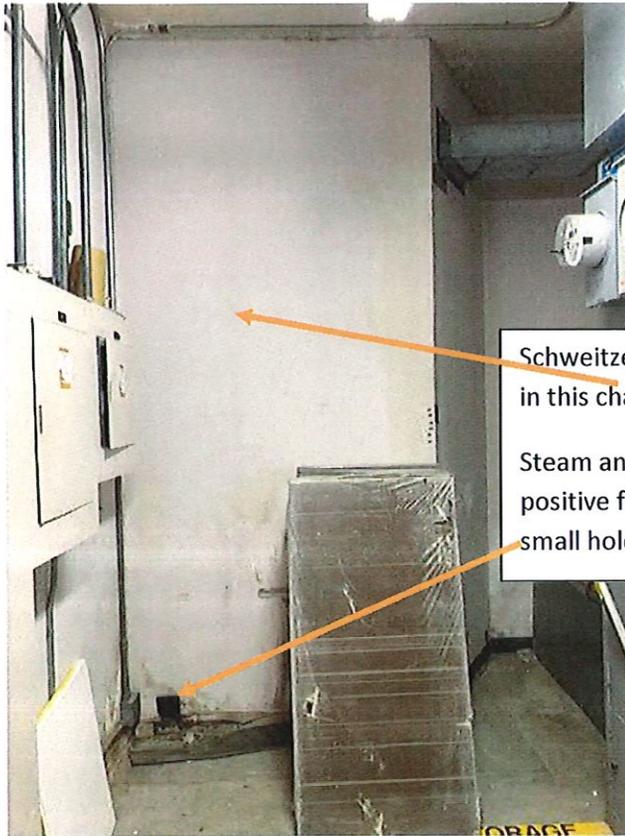
Stephens Hall Room 107 Steam Tunnel –
Pipe insulation in mechanical room is fiberglass.
Pipe insulation in tunnel contains asbestos.

The beginning of the ACM insulation on the steam line can be seen here. It is presumed the condensate is the same, switching over to ACM once inside the tunnel.

Steam pipes enter Schweitzer Hall in Mechanical Room 46. The pipes enter a chase inside the room and are not accessible. The walls of the chase are plaster on the east side and gypsum panels on the north side. Samples of materials were collected from the walls of the chase and analysis shows the walls are negative for asbestos.



Visual inspection from a small hole in the wall of the chase reveals the pipes inside to be presumed positive for asbestos inside this chase.



Schweitzer Hall Room 46 – Steam line enters the building in this chase.

Steam and condensate pipe insulation is presumed positive for asbestos. Visual inspection made through small hole in plaster wall.

The pipes turn 90 degrees to the south and enter Mechanical Room 45. Here the pipe insulation is clearly fiberglass. The rest of this mechanical room is also insulated with fiberglass and black neoprene, which is not suspect material. Some pipes are bare copper. Fire suppression pipes are bare steel. Some drain lines from labs upstairs are glass.

The north wall of Room 45 is brick, covered with material which appears to have been trowelled on or sprayed-on. The suspect surfacing material was sampled and analyzed. It is negative for asbestos.





Schweitzer Hall Room 45, north wall –
Steam line is negative for asbestos. Troweled-on or sprayed-on material is negative for asbestos.



Schweitzer Hall Room 45 –
Trowelled-on or sprayed-on material – negative for asbestos

Using hydro-excavation, a contractor exposed a small square of the top surface of the chase along the west side of Schweitzer. Samples of tar and tarpaper were collected from the concrete. The tar is negative for asbestos. The tarpaper is positive for asbestos. It is presumed that positive waterproofing is present on the lids of the chases.



Asbestos Inspection

Pipe insulation in SMH100 is a mixture of positive and negative material. Any pipe insulation in this manhole which is not clearly fiberglass or black neoprene is presumed positive for asbestos. There are eight (8) linear feet of presumed positive friable material.

Pipe insulation on the steam line and the condensate line in the chase running from SMH104 to SMH105 is presumed positive for asbestos; one hundred ten (110) linear feet of presumed positive friable material.

Pipe insulation on the steam and condensate lines in the chase running from SMH105 to SMH100 is presumed positive for asbestos; thirty four (34) linear feet of presumed positive friable material

Pipe insulation on the steam and condensate lines in the chase running from SMH105 into Schweitzer Hall is presumed positive for asbestos; four hundred fourteen (414) linear feet of presumed positive friable material.

Pipe insulation on the steam and condensate lines in the chase running from SMH100 into Stephens Hall is presumed positive for asbestos; three hundred ten (310) linear feet of presumed positive friable material.

Pipe insulation on steam and condensate lines in Room 46 Schweitzer Hall is presumed positive for asbestos; twenty four (24) linear feet of presumed positive friable material.

Tarpaper waterproofing on the lids of the concrete chases is positive for asbestos; approximately two thousand one hundred seventy five (2,175) square feet of non-friable material.

The pipe insulation and the waterproofing on the chase lids are in fair condition.

Sampling Analysis

All samples were transported under chain-of-custody to EMSL Analytical, Inc., a NVLAP-certified laboratory, for asbestos analysis of bulk materials or of non-friable organic bulk materials via AHERA Method 40 CFR 763 Subpart E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy.

Two samples were analyzed by MU EHS, an AIHA-Certified Proficient laboratory for asbestos analysis via AHERA Method 40 CFR 763 Subpart E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy.

See Sample Table below for a summary of samples analyzed.

Sample Table

Sample Number	Description	Condition*	Analysis Results
250916-01	107 Stephens Hall, TSI - steam line (inside building) 8" straight YELLOW	Fair	98% glass, 2% non-fibrous
250916-02	107 Stephens Hall, TSI – steam line (inside building) 8" straight TAN	Fair	95% glass, 5% non-fibrous



250916-03	107 Stephens, TSI – steam line wrap (inside tunnel) – fabric wrap	Fair	CONTAINS 30% CHRYSOTILE, 20% cellulose, 50% non-fibrous
250919-01^	Steam chase – yard of Schweitzer/Stephens Hall – lid of chase – tarpaper waterproofing	Fair	CONTAINS 2% CHRYSOTILE, 98% non-fibrous
250919-02^	Steam chase – same location as above – lid of chase – tar waterproofing	Fair	100% non-fibrous
251008-01	46 Schweitzer Hall, west wall – wall plaster, at floor	Poor	95% gypsum, 3% cellulose, <1% glass fibers, 2% non-fibrous
251008-02	46 Schweitzer Hall, west wall – sheet rock joint compound	Poor	100% non-fibrous
251008-03	45 Schweitzer Hall, north wall – troweled-on TSI material on brick	Poor	15% quartz, 85% non-fibrous, <1% cellulose
251008-04	45 Schweitzer Hall, west wall – troweled -on TSI material on brick	Poor	10% quartz, 90% non-fibrous

*Condition legend: Good-no issues; Fair- nothing immediate, maintain regular observations; Poor- needs immediate attention by licensed professionals.

^ samples analyzed by MU EHS

Asbestos Summary

Friable Asbestos

Nine hundred (900) linear feet of friable TSI on steam and condensate lines, in fair condition.

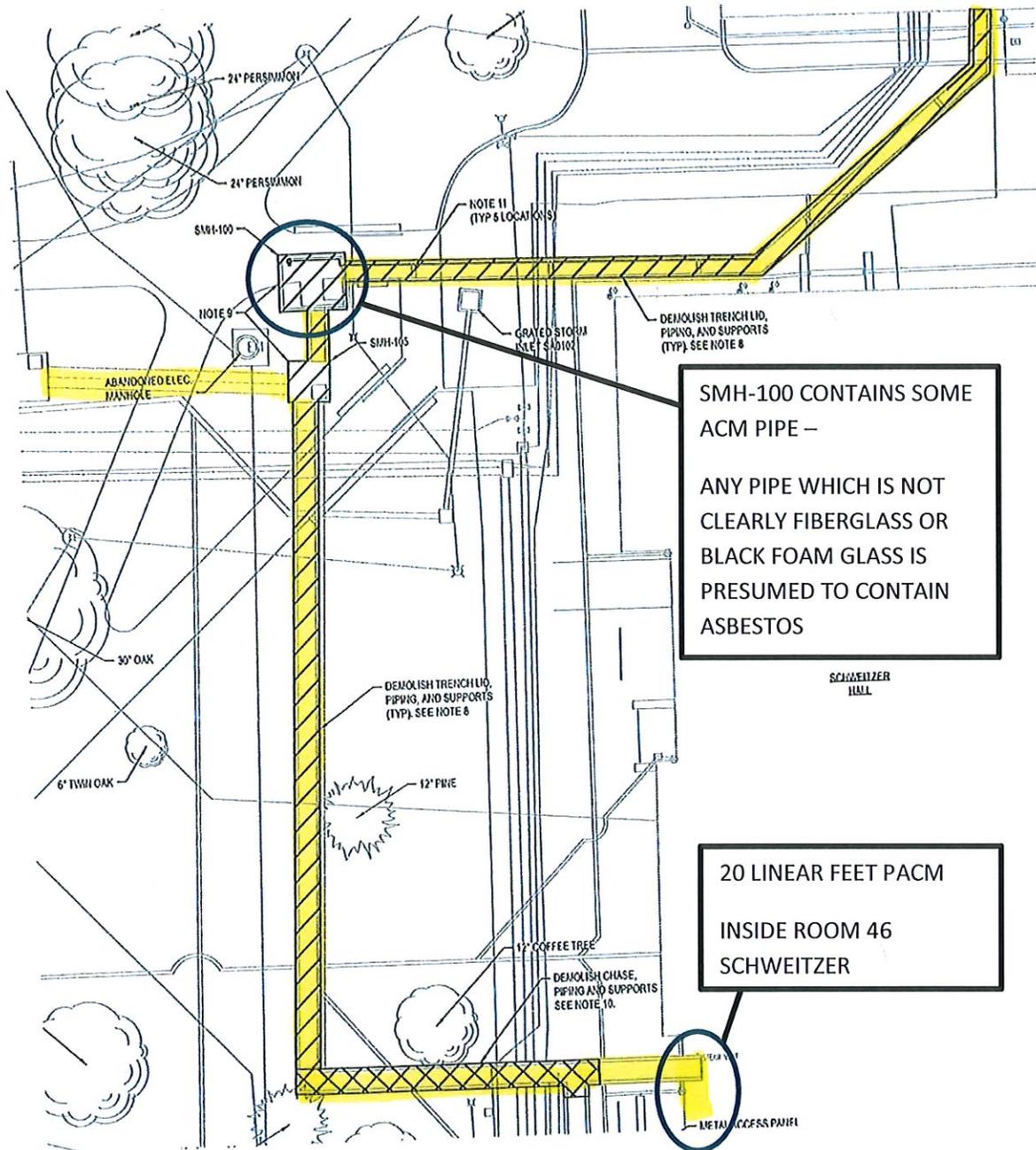
Non-Friable Asbestos

Two thousand one hundred seventy five (2,175) square feet of non-friable tarpaper waterproofing, in fair condition

The plans on the next page identify the chases which contain asbestos pipe insulation, and asbestos-containing waterproofing on the lids.

Please note that SMH-100 still contains some positive TSI. Any pipe insulation found in SMH-100 which is not clearly fiberglass or foam glass is presumed to be positive for asbestos.





SMH-100 CONTAINS SOME ACM PIPE –

ANY PIPE WHICH IS NOT CLEARLY FIBERGLASS OR BLACK FOAM GLASS IS PRESUMED TO CONTAIN ASBESTOS

SCHWEITZER HALL

20 LINEAR FEET PACM

INSIDE ROOM 46

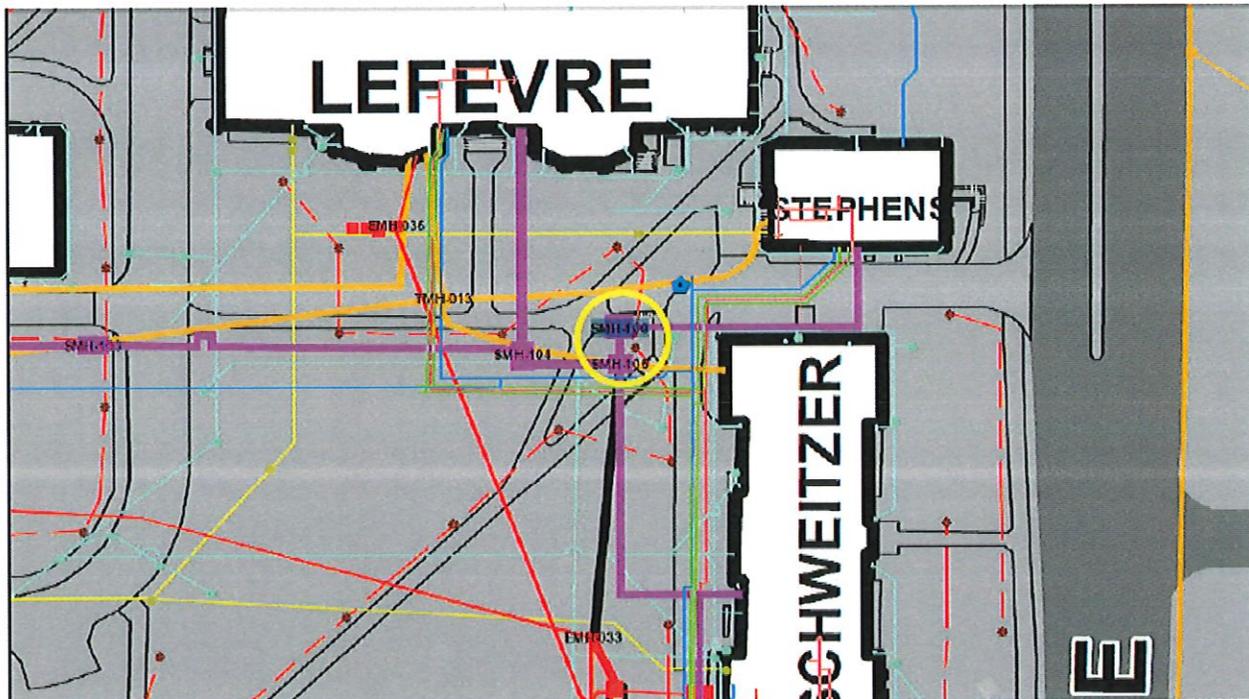
SCHWEITZER

Hazardous Building Material Survey
SMH-100
P# 139204

West of Schweitzer
20' steam, 20' condensate; condensate pipe is very rusty
Loose insulation on pipes
Debris on top of steam pipe

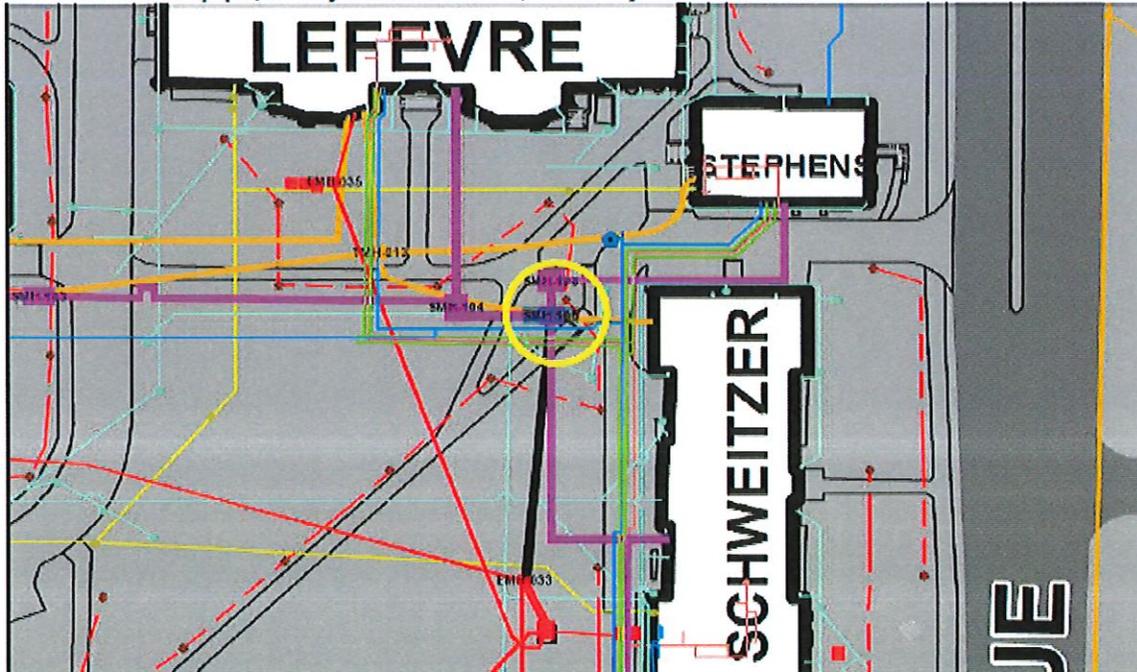
**ASBESTOS SUMMARY: PIPE INSULATION ON THE STEAM LINE CONTAINS ASBESTOS- 20
LINEAR FEET.**

Sample ID #	Location/Description	Analysis
120921-01	SMH 100; Debris on top of steam line	95% Glass, 5% Non-Fibrous
120921-02	SMH 100; TSI 8" straight, steam line	5% CHRYSOTILE, 75% Non-Fibrous, 20% Cellulose,
120921-03	SMH 100; TSI 8" straight, N-S line	20% Glass, 80% Non-Fibrous
120921-04	SMH 100; TSI 6" 90	100% Non-Fibrous
120921-05	SMH 100; TSI 6" straight, condensate	100% Non-Fibrous



Hazardous Building Material Survey
 SMH 105
 P# 139205

West of Schweitzer- In sidewalk
 One bare pipe, new jacket on valve, 1 valve jacket loose on floor



ASBESTOS SUMMARY: No asbestos identified within manhole. TSI ON PIPE IN CHASE CONTAINS ASBESTOS.

Sample ID #	Location/Description	Analysis
120921-01	SMH 105; TSI 6" straight heading south	100% Non-Fibrous
120921-02	SMH 105; TSI 12" tee heading south	100% Non-Fibrous
120921-03	SMH 105; TSI 6" valve on condensate to the north	100% Non-Fibrous
120921-04	SMH 105; TSI 12" straight to the north	100% Non-Fibrous
120921-05	SMH 105; TSI steam line in chase to the north	2% Chrysotile, 98% Non Fibrous

]



Lead Inspection

The chases and manholes are bare concrete, with no painted surfaces. The tunnels into the buildings are bare concrete as well. No lead-based paint is a concern.

Universal Waste

There is no lighting in the manholes. No universal waste will be disturbed by the project.

Summary

This report provides summary findings of a hazardous building materials survey performed by MU EHS staff certified/licensed to perform this work.



Pete Kohler Missouri Asbestos Inspector 7118100225MOIR10883 expires 10/07/2026

CERTIFICATION NUMBER:

7118100225MOIR10883

THIS CERTIFIES

Pete Kohler

HAS COMPLETED THE CERTIFICATION

REQUIREMENTS FOR

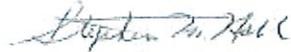
Inspector



APPROVED: **10/07/2025**

TRAINING DATE: **10/02/2025**

EXPIRES: **10/07/2026**



Director of Air Pollution Control Program





EMSL ANALYTICAL, INC.
LABORATORY PRODUCTS TRAINING

Asbestos Bulk Building Materials - Chain of Custody

EMSL Order Number / Lab Use Only

EMSL Analytical, Inc.

Indianapolis, IN 46250
PHONE: (317) 803-2997
EMAIL: indianapolislab@emsl.com

Customer Information	Customer ID:	University of Missouri - Columbia UNMO50	Billing Information	Billing ID:	PO 0000721975
	Company Name:	University of Missouri Columbia		Company Name:	University of Missouri Columbia
	Contact Name:	Pete Kohler		Billing Contact:	University of Missouri Columbia EHS IH
	Street Address:	900 E Stadium blvd		Street Address:	EHS IH General Service Building 900 E Stadium
	City, State, Zip:	Columbia MO 65204		Country:	US
	Phone:	573 884-8829		City, State, Zip:	Columbia MO
Email(s) for Report:	kohlerp@missouri.edu	Phone:	5738827018	Email(s) for Invoice:	

Project Information

Project Name/No:	CP253171, Steam and Water Line - Stephens, Lefevre	Purchase Order:	C0000721975
EMSL LIMS Project ID: <small>(If applicable, EMSL will provide)</small>		US State where samples collected:	MO
		State of Connecticut (CT) must select project location:	<input type="checkbox"/> Commercial (Taxable) <input type="checkbox"/> Residential (Non-Taxable)
Sampled By Name:	Pete Kohler	Sampled By Signature:	
		Date Sampled:	
		No. of Samples in Shipment	3

Turn-Around-Time (TAT)

3 Hour
 6 Hour
 24 Hour
 32 Hour
 48 Hour
 72 Hour
 96 Hour
 1 Week
 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only, samples must be submitted by 11:30am.

Test Selection

<p>PLM - Bulk (reporting limit)</p> <input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%) <input type="checkbox"/> PLM EPA NOB (<1%) <input type="checkbox"/> POINT COUNT <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> POINT COUNT w/ GRAVIMETRIC <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> NIOSH 9002 (<1%) <input type="checkbox"/> NYS 198.1 (Friable - NY) <input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY) <input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)	<p>TEM - Bulk</p> <input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (Non-Friable - NY) <input type="checkbox"/> TEM EPA 600/R-93/116 w Milling Prep (0.1%)
--	---

Other Tests (please specify)

Positive Stop - Clearly Identified Homogeneous Areas (HA)

Sample Number	HA Number	Sample Location	Material Description
250916-01		107 Stephens, TSI steam line, inside building	TSI - 8" straight
250916-02		107 Stephens, TSI steam line, inside tunnel	TSI - 8" straight
250916-03		107 Stephens, TSI steam line wrap, inside tunnel	TSI - pipe wrap

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment:	Sample Condition Upon Receipt:
Relinquished by: Pete Kohler	Date/Time:
Relinquished by:	Date/Time:
Received by:	Date/Time:
Received by:	Date/Time:

Controlled Document - Asbestos Bulk R7 9/14/2021

AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.



EMSL Analytical, Inc.

6340 CastlePlace Dr. Indianapolis, IN 46250
Tel/Fax: (317) 803-2997 / (317) 803-3047
<http://www.EMSL.com / indianapolislaboratory@emsl.com>

EMSL Order: 162512755
Customer ID: UNMO50
Customer PO: C0000721975
Project ID:

Attention: PETE KOHLER
University of Missouri - Columbia
900 E. Stadium Blvd
Suite #180
Columbia, MO 65211
Project: CP253171, STEAM AND WATER LINE - STEPHANS, LEFEVRE

Phone: (573) 884-8829
Fax: (573) 882-7940
Received Date: 10/01/2025 10:27 AM
Analysis Date: 10/02/2025
Collected Date:

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
250916-01 162512755-0001	107 STEPHENS, TSI STEAM LINE, INSIDE BUILDING - TSI - 8" STRAIGHT	Yellow Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
250916-02 162512755-0002	107 STEPHENS, TSI STEAM LINE, INSIDE TUNNEL - TSI - 8" STRAIGHT	Tan Non-Fibrous Homogeneous	5% Glass	95% Non-fibrous (Other)	None Detected
250916-03 162512755-0003	107 STEPHENS, TSI STEAM LINE WRAP, INSIDE TUNNEL - TSI - PIPE WRAP	Black Fibrous Homogeneous	20% Cellulose	50% Non-fibrous (Other)	30% Chrysotile

Analyst(s)
Hilary Jarvis (3)

Asbestos Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN NVLAP Lab Code 200188-0, AZ0939, CA 2575, CO AL-15132, TX 300262, A2LA Accredited - Certificate #2845.25

Initial report from: 10/02/2025 11:01:06



EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Bulk Building Materials - Chain of Custody

EMSL Order Number / Lab Use Only

EMSL Analytical, Inc.

Indianapolis, IN 46250
PHONE: (317) 803-2997
EMAIL: indianapolislab@emsl.com

Customer Information	Customer ID: University of Missouri - Columbia UNMO50	Billing Information	Billing ID: PO 0000721975
	Company Name: University of Missouri Columbia		Company Name: University of Missouri Columbia
	Contact Name: Pete Kohler		Billing Contact: University of Missouri Columbia EHS IH
	Street Address: 900 E Stadium blvd		Street Address: EHS IH General Service Building 900 E Stadium
	City, State, Zip: Columbia MO 65204 Country: US		City, State, Zip: Columbia MO Country: US
	Phone: 573 884-8829		Phone: 5738827018
Email(s) for Report: kohlerp@missouri.edu		Email(s) for Invoice:	

Project Information			
Project Name/No: CP253171, Steam and Water Line - Stephens, Lefevre	Purchase Order: C0000721975		
EMSL LIMS Project ID: (If applicable, EMSL will provide)	US State where samples collected: MO	State of Connecticut (CT) must select project location: <input type="checkbox"/> Commercial (Taxable) <input type="checkbox"/> Residential (Non-Taxable)	
Sampled By Name: Pete Kohler	Sampled By Signature:	Date Sampled:	No. of Samples in Shipment: 3

Turn-Around-Time (TAT)

3 Hour
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 72 Hour
 96 Hour
 1 Week
 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only, samples must be submitted by 11:30am.

PLM - Bulk (reporting limit)	TEM - Bulk
<input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%) <input type="checkbox"/> PLM EPA NOB (<1%) <input type="checkbox"/> POINT COUNT <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> POINT COUNT w/ GRAVIMETRIC <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> NIOSH 9002 (<1%) <input type="checkbox"/> NYS 198.1 (Friable - NY) <input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY) <input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)	<input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (Non-Friable - NY) <input type="checkbox"/> TEM EPA 600/R-93/116 w Milling Prep (0.1%) <p style="text-align: center;"><u>Other Tests (please specify)</u></p> <input type="checkbox"/> Positive Stop - Clearly Identified Homogeneous Areas (HA)

Sample Number	HA Number	Sample Location	Material Description
251008-01		46 Schweitzer, west wall	wall plaster, at floor
251008-02		46 Schweitzer, west wall	sheet rock joint compound
251008-03		45 Schweitzer, north wall	TSI material on brick (trowel-on?)
251008-04		45 Schweitzer, west wall	TSI material on brick (trowel-on?)

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by: Pete Kohler	Date/Time:	Received by:	Date/Time
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - Asbestos Bulk R7 9/14/2021

AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.



EMSL Analytical, Inc.

6340 CastlePlace Dr. Indianapolis, IN 46250
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EMSL Order: 162513167
Customer ID: UNMO50
Customer PO: C0000721975
Project ID:

Attention: PETE KOHLER
University of Missouri - Columbia
900 E. Stadium Blvd
Suite #180
Columbia, MO 65211
Project: CP253171, Steam and Water Line - Stephens, Lefevre

Phone: (573) 884-8829
Fax: (573) 882-7940
Received Date: 10/09/2025 10:22 AM
Analysis Date: 10/10/2025
Collected Date:

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
251008-01 <i>162513167-0001</i>	46 Schweitzer, west wall - Wall plaster, at floor	White Non-Fibrous Homogeneous	3% Cellulose <1% Glass	95% Gypsum 2% Non-fibrous (Other)	None Detected
251008-02 <i>162513167-0002</i>	46 Schweitzer, west wall - Sheet rock joint compound	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
251008-03 <i>162513167-0003</i>	45 Schweitzer, north wall - TSI material on brick (trowel-on)	Gray Non-Fibrous Homogeneous	<1% Cellulose	15% Quartz 85% Non-fibrous (Other)	None Detected
251008-04 <i>162513167-0004</i>	45 Schweitzer, west wall - TSI material on brick (trowel-on)	Brown/Gray Non-Fibrous Homogeneous		10% Quartz 90% Non-fibrous (Other)	None Detected

Analyst(s) _____
Hilary Jarvis (4)

Asbestos Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.
Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN NVLAP Lab Code 200188-0, AZ0939, CA 2575, CO AL-15132, TX 300262, A2LA Accredited - Certificate #2845.25

Initial report from: 10/10/2025 13:59:18

UNIVERSITY of MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

Asbestos Sampling Analysis

PLM EPA 600/R – 93/116

CP253171

Steam Line Replacement – Stephens Hall, Lefevre Hall

09/19/2025

250919-01	West side of Schweitzer Hall, west of sidewalk – Steam Chase exposed by hydro- excavation – Tarpaper waterproofing on lid	2% chrysotile, 98% non-fibrous
250919-02	Same location – tar waterproofing on concrete lid	100% non-fibrous



Pete Kohler

