



**WEBER BASIN WATER CONSERVANCY DISTRICT
LAYTON, UTAH**

**DAVIS NORTH WATER TREATMENT PLANT
SOLIDS DEWATERING IMPROVEMENT PROJECT**

ENGINEER PROJECT NO. 203356

CONTRACT/TECHNICAL SPECIFICATIONS

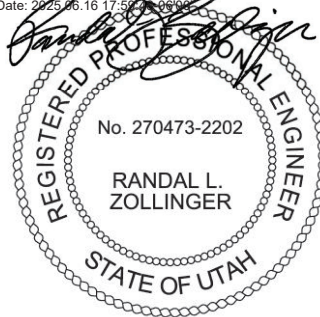
BID SUBMITTAL

VOLUME 1 OF 3

DIVISIONS 00 – 22

JUNE 2025

Digitally signed by Randal L. Zollinger
Contact Info: Carollo Engineers, Inc.
Date: 2025.06.16 17:50:00 -0600



WEBER BASIN WATER CONSERVANCY DISTRICT

DAVIS NORTH SOLIDS DEWATERING UPGRADE

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ADVERTISEMENT FOR BIDS

**WEBER BASIN WATER CONSERVANCY DISTRICT
LAYTON, UTAH
SOLIDS DEWATERING UPGRADE PROJECT**

GENERAL NOTICE

Weber Basin Water Conservancy District (WBWCD or Owner) is requesting Bids for the construction of the following Project:

Davis North Water Treatment Plant (DNWTP)
Solids Dewatering Improvement Project
Engineer Project No: 203356

Bids for the construction of the Project will be received at the Weber Basin Water Conservancy District located at 2837 E Highway 193, Layton, Utah, 84040 until July 22, 2025, by 3:00 p.m. local time. At that time the Bids received will be publicly opened and read.

The Project includes the following Work:

The Solids Dewatering Improvement Project will construct the following two new sludge handling facilities:

Sludge Pump Station: A cast-in-place concrete structure below grade with an electrical room constructed of CMU above grade. Stairs will lead from the above-grade electrical room down to the below grade pump room. New sludge pumps and in-line grinder are located in the pump room and include: (1) Sludge Transfer Pumps used to move thickened sludge from existing Gravity Thickeners to the new Sludge Day Tank; and (2) new Sludge Feed Pumps used to move homogenized thickened sludge from the new Sludge Day Tank to existing dewatering centrifuge equipment located inside the existing Dewatering Building. The above-grade electrical room will match existing Davis North WTP architecture (i.e., brick veneer and metal roof) and house new MCC and PLC equipment.

Sludge Day Tank: An all cast-in-place concrete structure partially buried below existing grade and which is enclosed with a cast-in-place concrete deck and is bifurcated into 2 cells with a center/common wall. Each cell slopes to a center sump where stored sludge is withdrawn. A common overflow box is provided at the end of the center wall. One new mixer is suspended from the concrete deck, centered above the sump for each cell. Access openings are provided in each deck along with ladder and railing to access deck-mounted mixers.

After existing thickened sludge feed pumps are removed, new sludge manifold piping will be added inside the existing Dewatering Building. The Work also includes related demolition, earthwork, civil yard piping and civil site improvements, HVAC/Building conditioning systems, process mechanical work, electrical power and lighting and instrumentation, control and integration work.

Several work items will require close coordination with the Owner to maintain the existing sludge dewatering process in service during construction.

Bids are requested for the following Contract: DNWTP Solids Dewatering Improvement Project. Owner anticipates that the Project's total bid price will be approximately \$6,500,000. The Project has an expected duration of 600 days.

OBTAINING THE BIDDING DOCUMENTS

Bidding documents will be provided in electronic portable document format (PDF) to invited Bidders. Only those General Contractors who have been previously prequalified by the Owner may bid this work. The Bidding Documents will be provided via email or other large file transfer service. Printed copies will not be provided.

PRE-BID CONFERENCE

A mandatory pre-bid conference for the Project will be held on June 24, 2025, at 2:00 p.m. at the Davis North Water Treatment Plant, 2837 E Highway 193, Layton, Utah, 84040. Attendance at the pre-bid conference is required to bid this project.

PREQUALIFICATION OF BIDDERS

Bids will be accepted only from Bidders prequalified by the Owner which include General Contractors, electricians and system integrators. Contact Matthew Meier to obtain a list of prequalification contractors. Due to the specialized nature of the construction, the experience and qualifications of Bidders will be evaluated by the Owner prior to the opening of Bids. Only those Bids submitted by Bidders determined by the Owner to be qualified will be considered. Bids received from Bidders who are not prequalified will be returned.

INSTRUCTIONS TO BIDDERS

For all further requirements regarding Bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

This Advertisement is issued by:

Owner: Weber Basin Water Conservancy District
By: Brad Nelson, PE
Title: Assistant General Manager
Date: June 17, 2025

END OF DOCUMENT

DOCUMENT 00_21_13

INSTRUCTIONS TO BIDDERS

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ARTICLE 1 — DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. Issuing Office—The office from which the Bidding Documents are to be issued, and which registers plan holders.
 - B. Invitation to Bid—In accordance with Utah Procurement Code, Section 63G-6-103, “Invitation for bids” shall mean all documents, whether attached or incorporated by reference, utilized for soliciting bids.
 - C. Owner—Weber Basin Water Conservancy District.
 - D. Engineer—Carollo Engineers, Inc.

ARTICLE 2 — BIDDING DOCUMENTS

- 2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder’s responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.
- 2.03 Bidders may rely that sets of Bidding Documents are complete unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.04 Bidder may register as a plan holder with the Issuing Office and obtain complete sets of Bidding Documents.
- 2.05 Electronic documents:
- A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.
 - 1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader, latest version. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents, or the Contractor’s means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

- B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3 — QUALIFICATIONS OF BIDDERS

- 3.01 Only prequalified Bidders shall be allowed to bid this project. Bids will only be accepted from approved general contractors. Bids will only be accepted from approved general contractors, electricians and system integrators.
- 3.02 Qualification requirements with Bid:
 - A. Owner requires the following information from Bidders to demonstrate Bidder's qualifications to perform the Work:
 - 1. Bidder's Subcontractors listed on Document 00_43_36 - Proposed Subcontractor Form shall be submitted with the Bid.
 - 2. Bidder's Suppliers listed on Document 00_43_35 - List of Equipment Manufacturers.
 - 3. Any special bid preferences listed on Document 00_45_38 - Bid Preferences.
- 3.03 No requirement to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4 — PRE-BID CONFERENCE

- 4.01 A mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or Invitation to Bid where representatives of Owner and Engineer will be present to discuss the Project.
 - A. Bidders are required to attend and participate in the conference to submit a Bid.
 - B. Information presented at the pre-bid conference does not alter the Contract Documents.
 - 1. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-bid conference.
 - 2. Information presented and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5 — SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 5.01 Site and other areas:
 - A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 Site visit and testing by Bidders:

- A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.
- B. A Site visit is scheduled as part of the non-mandatory pre-bid conference. Maps to the Site will be made available.
- C. Bidders visiting the Site are required to arrange their own transportation to the Site.
- D. Access to the Site other than during a regularly scheduled Site visit must be coordinated through the following Owner or Engineer contact before visiting the Site: Matthew Meier WBWCD Project Manager: mmeier@weberbasin.com.
 - 1. Bidder must conduct the required Site visit during normal working hours.
- E. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- F. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.
- G. Bidder must comply with applicable Laws and Regulations regarding excavation and location of utilities, obtain permits, and comply with terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- H. Bidder must fill holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.03 Owner's safety program:

- A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in Document 00_73_00 - Supplementary Conditions.

5.04 Other work at the Site:

- A. Reference is made to Document 00_73_00 - Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents.
 - 1. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6 — BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

6.01 Express representations and certifications in Bid Form, agreement:

- A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder’s examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.
- B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7 — INTERPRETATIONS AND ADDENDA

- 7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- 7.02 Submit questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:
 - A. Submit questions to Matthew Meier, PE: mmeier@weberbasin.gov.
- 7.03 Interpretations or clarifications considered necessary by Owner or Engineer in response to such questions will be issued by Addenda delivered to registered plan holders.
 - A. Questions received less than 7 days prior to the date for opening of Bids may not be answered.
- 7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8 — BID SECURITY

- 8.01 A Bid must be accompanied by Bid security.
 - A. Amount:
 - 1. Percent of Bidder’s maximum Bid price (determined by adding the base Bid and all alternates): 5 percent.
 - B. Format:
 - 1. Bid Bond.
- 8.02 Bidder must submit Document 00_43_30 - Bid Bond that is included in the Bidding Documents.
- 8.03 The Bid security of the apparent Successful Bidder will be retained until Owner awards the Contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released.
 - A. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole.
 - 1. Such forfeiture will be Owner’s exclusive remedy if Bidder defaults.

- 8.04 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.05 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9 — CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in Document 00_52_00 - Agreement Between Owner and Contractor.
- 9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in Document 00_52_00 - Agreement Between Owner and Contractor.

ARTICLE 10 — SUBSTITUTE AND “OR EQUAL” ITEMS

- 10.01 Prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda.
- A. Any assumptions regarding the possibility of post-bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.
- B. No item of material or equipment will be considered by Engineer as an “or-equal or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer within 10 days of the issuance of the Advertisement for Bids or invitation to Bidders.

ARTICLE 11 — SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 Requirement to retain specific Subcontractors and Suppliers:
- A. A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications.
- B. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 11.02 Submit list of the Subcontractors or Suppliers:
- A. Submit Document 00_43_36 - Proposed Subcontractors Form to Owner with a list of the Subcontractors or Suppliers proposed.
1. List prequalified electrician, system integrator and other Subcontractors or Suppliers proposed who will perform work or labor or render services in an amount in excess of 1 percent of Contractor’s total Bid:
- a. With the Bid.
- B. Submit Document 00_43_35 - List of Equipment Manufacturers with Bid.

11.03 Request to submit an acceptable substitute:

- A. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- B. If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers.
 - 1. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder.
- C. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Document 00_72_00 - General Conditions.

ARTICLE 12 — PREPARATION OF BID

12.01 Document 00_41_00 - Bid Form is included with the Bidding Documents.

- A. Complete blanks on the Bid Form in ink.
- B. Sign the Bid Form signed in ink with names printed in ink below the signatures.
- C. Erasures or alterations must be initialed in ink by the person signing the Bid Form.
- D. Indicate a Bid price for each section, Bid item, alternate, adjustment unit price item, and unit price item listed.
- E. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."
- F. Unauthorized conditions, limitations, or modifications attached to the Bid will render it informal and may cause its rejection as being non-responsive.

12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents.

- A. The printed copy of the Bid Form must be clearly legible, printed on 8-1/2-inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical.
- B. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that required information and submittals are included with the Bid.

12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign.

- A. The corporate address and state of incorporation must be shown.

- 12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign.
- A. The official address of the partnership must be shown.
- 12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign.
- A. The state of formation of the firm and the official address of the firm must be shown.
- 12.06 A Bid by an individual must show the Bidder's name and official address.
- 12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form.
- A. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.08 The Bid must contain an acknowledgment of receipt of Addenda, the numbers of which must be filled in on the Bid Form.
- 12.09 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.
- 12.10 Bidder's state contractor license number must be shown on the Bid Form.
- 12.11 Postal and email addresses and telephone number for communications regarding the Bid must be shown.
- 12.12 Bid preferences:
- A. Submit with Bid Document 00_45_38 - Bid Preferences to certify the preferences to which the Bidder may be entitled in accordance with Utah Procurement Code, Section 63G-6-404.
- B. In accordance with Utah Code, Section 34-30-1, in employing workmen in the construction of public works by the state of Utah or any county or municipality, or by persons contracting with the state of Utah or any county or municipality, preference shall be given citizens of the United States, or those having declared their intention of becoming citizens.
- C. In accordance with Utah Code, Section 34-30-1, if the provisions are not complied with, this Agreement shall be void.

ARTICLE 13 — BASIS OF BID

- 13.01 Lump sum:
- A. Bidders must submit a Bid on a lump sum basis as set forth in the Bid Form.
- 13.02 Base Bid with alternates:
- A. Bidders must submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form.
1. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.

- B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.

13.03 Unit price:

- A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The “Bid Price” (sometimes referred to as the extended price) for each unit price Bid item will be the product of the “Estimated Quantity”, which Owner or its representative has set forth in the Bid Form, for the item and the corresponding “Bid Unit Price” offered by the Bidder.
 - 1. The total of unit price Bid items will be the sum of these “Bid Prices”; such total will be used by Owner for Bid comparison purposes.
 - 2. The final quantities and Contract Price will be determined in accordance with the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

13.04 Allowances:

- A. For cash allowances the Bid price must include such amounts as the Bidder deems proper for Contractor’s overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Document 01_21_00 - Allowances.

ARTICLE 14 — SUBMITTAL OF BID

14.01 Submit Bids and required Bid documents under the terms of the Bid Form.

- A. Hardcopy:
 - 1. Unbound documents.
 - 2. Bid must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, and the name and address of Bidder.
 - a. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation “BID ENCLOSED”.
 - b. A mailed Bid must be addressed to the location designated in the Advertisement.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or Invitation to Bid.

14.03 Bids received after the date and time prescribed for the opening of Bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 15 — MODIFICATION AND WITHDRAWAL OF BID

- 15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.
- A. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified and submit a new Bid prior to the date and time for the opening of Bids.
- 15.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned.
- A. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16 — OPENING OF BIDS

- 16.01 Bids will be opened at the time and place indicated in the Advertisement or Invitation to Bid and, unless obviously non-responsive, read aloud publicly.
- A. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17 — BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 17.01 Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18 — EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids.
- A. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.
- 18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.
- 18.03 If Owner awards the Contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.
- 18.04 Evaluation of Bids:
- A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.
1. To determine the Bid prices for purposes of comparison, Owner will announce to Bidders a "Base Bid plus alternates" budget after receiving Bids, but prior to opening them.

2. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded.
 3. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.
- C. For the determination of the apparent low Bidder when unit price Bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
 - D. If the Contract is to be awarded, Owner will award the Contract to the Bidder whose Bid is in the best interests of the Project.
 - E. After determining the designated Low Bidder for the Project, Owner may award on the amount of the Low Bidder's Base Bid alone or on any combination of alternates.
 1. The combination of alternates may include substituting any of the alternates that were included in the designated Low Bidder's Bid, provided:
 - a. It is in the best interest of the Owner.
 - b. Funds are available at the time of the award.
- 18.05 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 18.06 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors.

ARTICLE 19 — BONDS AND INSURANCE

- 19.01 Document 00_72_00 - General Conditions sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance.
- A. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.
- 19.02 Bid Security, requirements of providing Bid bonds as part of the bidding process are specified in this document.

ARTICLE 20 — SIGNING OF AGREEMENT

- 20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement.
- A. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner.
 - B. Within 10 days thereafter, Owner will deliver 1 fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated the General Conditions.

ARTICLE 21 — SALES AND USE TAXES

21.01 The Bidder agrees that all sales and use taxes are included in the stated Bid prices for the Work.

ARTICLE 22 — CONTRACTS TO BE ASSIGNED (NOT USED)

ARTICLE 23 — PREVAILING WAGES (NOT USED)

ARTICLE 24 — LAWS AND REGULATIONS (NOT USED)

END OF DOCUMENT

DOCUMENT 00_41_00

BID FORM

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, Document 00_72_00 - General Conditions, and Document 00_73_00 - Supplementary Conditions.

ARTICLE 1 — OWNER AND BIDDER

1.01 This Bid is submitted to:

Weber Basin Water Conservancy District
2837 E Highway 193
Layton, UT 84040

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 — ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

- A. Required Bid security in the form of cash, a certified or cashier's check, or a Bid Bond as specified in Document 00_43_30 - Bid Bond (Penal Sum).
- B. Document 00_43_36 - Proposed Subcontractors Form.
- C. Document 00_43_35 - List of Equipment Manufacturers.
- D. Document 00_45_38 - Bid Preferences

ARTICLE 3 — BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 Lump Sum Bids.

- A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum (stipulated) price(s), together with any Unit Prices:
 - 1. Lump Sum Price (Base Bid and Alternates).

Lump Sum Bid Price for Base Bid which includes the construction of a new Sludge Pump Station, new Sludge Day Tank, modifications to the existing Dewatering Building, equipment, mechanical piping, temporary piping, yard piping, civil site improvements, electrical, system integration and all excavation shoring and any unit price bid amounts (if required)	\$
Allowances as specified in Section 01_21_00 - Allowances	\$
Total Lump Sum Bid (Sum of Base Bid Price and Allowances)	\$

ARTICLE 4 — TIME OF COMPLETION

4.01 Bidder agrees that the Work will be substantially complete and will be completed and

ready for final payment in accordance with the Document 00_72_00 - General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5 — BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 Bid acceptance period.

- A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

5.02 Instructions to Bidders.

- A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 Receipt of Addenda.

- A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6 — BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 Bidder's Representations.

- A. In submitting this Bid, Bidder represents the following:
1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Document 00_73_00 - Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Document 00_73_00 - Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Document 00_73_00 - Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 Bidder's Certifications.

- A. The Bidder certifies the following:
 1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
 2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
 3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
 4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract as defined below:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 - c. Collusive practice means a scheme or arrangement between 2 or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

- d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.
- 5. In accordance with the Utah Code, Bidder certifies that Bidder has paid Utah state and local taxes for 5 successive years before submitting this Bid to Owner.
- 6. Bidder has read and complies with Utah Procurement Code, Title 63G, Chapter 6 et seq. as amended, and bidding and contractual amendments.

BIDDER hereby submits this Bid as set forth above:

Bidder:

Address:

(typed or printed name of organization)

Bidder's Contractor License No.:

Bidder's Contact:

Name:

Title:

Phone:

Email:

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

(individual's signature)

(typed or printed)

(typed or printed)

(typed or printed)

Address for giving notices:

A Limited Liability Corporation

Limited Liability Corporation Name: _____

By: _____

(Signature of managing member -- attach evidence of authority to sign)

Name (typed or printed): _____

Business address: _____

END OF DOCUMENT

DOCUMENT 00_43_30

BID BOND (PENAL SUM FORM)

Bidder Name: _____ Address <i>(principal place of business)</i> : _____ 	Surety Name: _____ Address <i>(principal place of business)</i> : _____
Owner Name: _____ Address <i>(principal place of business)</i> : _____ 	Bid Project <i>(name and location)</i> : _____ Bid Due Date: _____
Bond Penal Sum: _____ Date of Bond: _____	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
_____ <i>(Full formal name of Bidder)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<u>Notes:</u> (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner.
 - 3.3. Or Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
5. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than 1 year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF DOCUMENT

DOCUMENT 00_43_35

LIST OF EQUIPMENT MANUFACTURERS

ARTICLE 1 — SELECTED MANUFACTURER/SUPPLIER

- 1.01 Bidder shall edit Table 1. List of Selected Equipment Manufacturers by circling the manufacturer or supplier that will furnish the respective item of equipment for the Work.
- 1.02 If Bidder fails to circle a manufacturer or supplier for each piece of equipment identified,
- A. the Bidder shall provide the first listed (“A”) manufacturer or supplier for its Bid at no increase in the Contract amount or
 - B. may be cause for rejection of the Bid.
- 1.03 Acceptance of a manufacturer or supplier listed by the Bidder shall not constitute a waiver of any provision of the Contract Documents.

Table 1. List of Selected Equipment Manufacturers:

Section	Equipment	Manufacturer/Supplier
26_24_20	Low Voltage Motor Control Centers	A. ABB B. Allen-Bradley C. Eaton D. Schneider Electric
43_23_57.10	Progressing Cavity Pumps	A. Seepex; BN Series B. Moyno Industrial Products, Model Series 2000 C. Netzsch, Inc., Model NM
46_41_34.01	Vertical Shaft Flocculator Units	A. SPX: 1. Philadelphia Mixing Solutions, LLC; Series 3800 2. Lightnin; Series 70 B. Chemineer, Series HT C. Mix-Tec; Model Type 1000

BIDDER

(Signature)

(Date)

END OF DOCUMENT

DOCUMENT 00_43_36
PROPOSED SUBCONTRACTORS FORM

The listing of more than one subcontractor for each item of Work to be performed with the words "and/or" will not be permitted.

Bidder certifies that all Subcontractors listed are eligible to perform the Work.

Add additional sheets, if necessary, to list all Subcontractors.

If no Subcontractors are listed, it will be assumed that no Subcontractors are to be employed meeting the above conditions.

BIDDER

(Signature)

(Date)

Work to be Performed	Contractor Name	License Type/Number	Percent of Total Contract
1. Prime Contractor			
2. Earthwork/Excavation			
3. Shoring			
4. Electrician	Select one of the following prequalified Electricians:		
a.	Cache Valley Electric		
b.	Freedom Electric		
c.	S&S Electric		
d.	Skyline Electric		
e.	Turner Electric		
f.	Wood Electric		
5. Concrete Structure			
6. Masonry			
7. System Integrator			
a.	M8 Automation		
b.	SKM Engineering		
8.			
9.			
10.			

END OF DOCUMENT

DOCUMENT 00_45_38

BID PREFERENCES

- 1.01 Do you claim a bid preference in accordance with Utah Procurement Code 63g-6-404 — Preference for Providers of State Products?

☐ Yes ☐ No

- A. If so, are you submitting proof of qualification for bid preference?

☐ Yes ☐ No

- 1.02 Do you claim a bid preference in accordance with Utah Procurement Code 63g-6-405 — Preference for Resident Contractors?

☐ Yes ☐ No

- A. If so, are you submitting proof of qualification for bid preference?

☐ Yes ☐ No

- 1.03 Did you claim a bid preference in accordance with Utah Procurement Code 63g-6-406 — Preference for Recycled Paper and Paper Products?

☐ Yes ☐ No

- A. If so, are you submitting proof of qualification for bid preference?

☐ Yes ☐ No

END OF DOCUMENT

DOCUMENT 00_51_00

NOTICE OF AWARD

Date of
Issuance:

Owner: Weber Basin Water Conservancy District Owner's Project No.:
Engineer: Carollo Engineers Engineer's Project No.: 203356
Project: Davis North Water Treatment Plant Solids Dewatering Upgrade Project
Contract Name:
Bidder:
Bidder's
Address:

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

Davis North Water Treatment Plant Solids Dewatering Upgrade Project

The Contract Price of the awarded Contract is \$_____. Contract Price is subject to adjustment based on the provisions of the Contract.

☐ unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically.

☐ Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner 2 counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in the General Conditions.

Owner: Weber Basin Water Conservancy District

By *(signature)*: _____

Name
(printed): _____

Title: _____

Copy: Engineer

END OF DOCUMENT

DOCUMENT 00_52_00

AGREEMENT BETWEEN OWNER AND CONTRACTOR

Terms used in this Agreement have the meanings stated in the General Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1 — WORK

- 1.01 Contractor shall complete Work as specified or indicated in the Contract Documents. the Work is generally described as follows: Davis North Water Treatment Plant Solids Dewatering Upgrade Project.

ARTICLE 2 — THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Construction of a new Sludge Pump Station and new Sludge Day Tank, modifications to existing Dewatering Building and related demolition, excavation, shoring, yard piping, civil sitework, electrical and instrumentation and control work .

ARTICLE 3 — ENGINEER

- 3.01 The part of the Project that pertains to the Work has been designed by Carollo Engineers, Inc.
- 3.02 The Owner has retained Carollo Engineers, Inc (“Engineer”) to act as Owner’s representative, assume duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the contract.

ARTICLE 4 — CONTRACT TIMES

- 4.01 Time is of the essence:
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- 4.02 Contract times: Days:
- A. The Work will be substantially complete within 600 days after the date when the Contract Times commence to run as provided in the General Conditions, and completed and ready for final payment in accordance with the General Conditions within 600 days after the date when the Contract Times commence to run.
- 4.03 Liquidated damages:
- A. Contractor and Owner recognize that time is of the essence as stated above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not

completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
4. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

4.04 Special damages:

- A. The special damages imposed in this paragraph are supplemental to any liquidated damages for delayed completion established in this Agreement.
- B. Contractor shall reimburse Owner for:
 1. Any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and
 2. The actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.
- C. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

ARTICLE 5 — CONTRACT PRICE

5.01 Owner will pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

- A. For Work other than Unit Price Work, a lump sum of \$_____.
 1. All specific cash allowances are included in the above price in accordance with the General Conditions.

ARTICLE 6 — PAYMENT PROCEDURES

6.01 Submittal and processing of Payments:

- A. Contractor shall submit Applications for Payment in accordance with the General Conditions.

6.02 Progress Payments; Retainage:

- A. Owner will make progress payments on the basis of Contractor's Applications for Payment on or about the _____ day of each month during performance of the Work as provided in below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. If 50 percent or more of the Work has been completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
- B. In accordance with Utah Procurement Code, Section 13-8-5, 95 percent of the value of the Work completed (with the balance being retainage).
- C. In accordance with Utah Procurement Code, Section 13-8-5, 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- D. In accordance with Utah Procurement Code, Section 13-8-5, upon Substantial Completion, Owner will pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner in accordance with the General Conditions, and less 125 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.
- E. Upon Substantial Completion, Owner will pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner pursuant to the General Conditions, and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 Final payment:

- A. Upon final completion and acceptance of the Work, Owner will pay the remainder of the Contract Price in accordance with the General Conditions.

6.04 Consent of surety:

- A. Owner will not make final payment or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 Interest:

- A. All amounts not paid when due will bear interest at the rate of 4 percent per annum.

ARTICLE 7 — CONTRACT DOCUMENTS

7.01 Contents:

- A. The Contract Documents consist of the following:
 - 1. This Agreement.
 - 2. Bonds:
 - a. Document 00_61_10 - Performance Bond (together with power of attorney).
 - b. Document 00_61_15 - Payment Bond (together with power of attorney).
 - 3. Document 00_72_00 - General Conditions.
 - 4. Document 00_73_00 - Supplementary Conditions.
 - 5. Specifications as listed in the table of contents of the project manual.
 - 6. Drawings listed on the sheet index.
 - 7. Addenda (numbers _____ to _____, inclusive).
 - 8. Exhibits to this Agreement (enumerated as follows):
 - a. Document 00_43_36 - Proposed Subcontractors Form.
 - b. Document 00_43_35 - List of Equipment Manufacturers.
 - c. Document 00_45_38 - Bid Preferences.
 - 9. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Document 00_55_00 - Notice to Proceed.
 - b. Document 00_94_22 - Field Orders.
 - c. Document 00_94_20 - Work Change Directives.
 - d. Document 00_94_21 - Change Orders.
 - 10. The Contract Documents listed above are attached to this Agreement (except as expressly noted otherwise above).
- B. There are no Contract Documents other than those listed above.
- C. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.
- D. In accordance with Utah Procurement Code, Section 63G-6-817, the statute of limitations for actions with respect to the contract are set forth.

ARTICLE 8 — REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's representations:

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 - 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 - 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - 3. Contractor is familiar with Laws and Regulations that may affect cost, progress, and performance of the Work.
 - 4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the General Conditions.

5. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the General Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on:
 - a. the cost, progress, and performance of the Work;
 - b. the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and
 - c. Contractor's safety precautions and programs.
6. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
7. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
8. Contractor has given Engineer written notice of conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
9. The Contract Documents are generally sufficient to indicate and convey understanding of terms and conditions for performance and furnishing of the Work.
10. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 Contractor's certifications:

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this paragraph:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between 2 or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

Owner:

(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Phone: _____

Email: _____

(If [Type of Entity] is a corporation, attach evidence of authority to sign. If [Type of Entity] is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

Contractor:

(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

(If [Type of Entity] is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Phone: _____

Email: _____

License No.: _____
(where applicable)

State: _____

END OF DOCUMENT

EXHIBIT A - Successful Bidder's Bid Form

DOCUMENT 00_55_00

NOTICE TO PROCEED

Owner: Weber Basin Water Conservancy District Owner's Project No.: _____

Engineer: Carollo Engineers Engineer's Project No.: 203356

Contractor: _____ Contractor's Project No.: _____

Project: Davis North Water Treatment Plant - Solids Dewatering Improvement Project

Contract Name: _____

Effective Date of Contract: _____

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on _____, 2025 pursuant to the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

The number of days to achieve Substantial Completion is 600 days from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of _____; and the number of days to achieve readiness for final payment is 700 days from the commencement date of the Contract Times, resulting in a date for readiness for final payment of _____.

Before starting any Work at the Site, Contractor must comply with the following:

Provide safety plan, including security procedures for plant access.

Owner: Weber Basin Water Conservancy District

By (signature): _____

Name: _____

Title: _____

Date Issued: _____

Copy: Engineer

END OF DOCUMENT

DOCUMENT 00_61_10

PERFORMANCE BOND

Contractor Name: _____ Address <i>(principal place of business)</i> : _____	Surety Name: _____ Address <i>(principal place of business)</i> : _____
Owner Name: Weber Basin Water Conservancy District Mailing address <i>(principal place of business)</i> : 2837 E Highway 193, Layton, Utah, 84040	Contract Description <i>(name and location)</i> : Davis North Water Treatment Plant Solids Dewatering Improvement Project Contract Price: _____ Effective Date of Contract: _____
Bond Bond Amount: _____ Date of Bond: _____ <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
Bv: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated in this Document by reference.
2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
 - 3.1. Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within 5 business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within 10 business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
 - 3.2. Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
 - 3.3. Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
5. When Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
 - 5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
 - 5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
 - 5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

- 5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
 - 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond 7 days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within 2 years after a declaration of Contractor Default or within 2 years after the Contractor ceased working or within 2 years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated in this Document. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
14. Now, therefore, the condition of this obligation is such, that if the Principal faithfully performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of the Agreement during the original term of the Agreement and any extension of the Agreement, with or without notice to the Surety, and during the life of any guaranty required under the Agreement, and also performs and fulfills all of the undertakings, covenants, terms, conditions and agreements of all duly authorized modifications of the Agreement that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise it remains in full force and effect.
15. Provided, however, that this bond is executed in accordance with Utah Code, Section 14-1-18 and Utah Code, Section 63G-6-505, as amended, and all liabilities on this bond shall be determined in accordance with Utah Code, Section 14-1-18 and Utah Code, Section 63G-6-505, as amended, to the extent as if it were copied at length in this Agreement.
16. Definitions:
 - 16.1. Balance of the Contract Price—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 16.2. Construction Contract—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 16.3. Contractor Default—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
 - 16.4. Owner Default—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 16.5. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: None.

END OF DOCUMENT

DOCUMENT 00_61_15

PAYMENT BOND

Contractor Name: Address (<i>principal place of business</i>):	Surety Name: Address (<i>principal place of business</i>):
Owner Name: Weber Basin Water Conservancy District Mailing address (<i>principal place of business</i>): 2837 E Highway 193, Layton, UT 84040	Contract Description (<i>name and location</i>): Davis North Water Treatment Plant Solids Improvement Project Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
 - 5.1. Claimants who do not have a direct contract with the Contractor
 - 5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within 90 days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1. Send an answer to the Claimant, with a copy to the Owner, within 60 days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2. Pay or arrange for payment of any undisputed amounts.
 - 7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. Definitions
 - 16.1. *Claim*—A written statement by the Claimant including at a minimum:
 - 16.1.1. The name of the Claimant;
 - 16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;
 - 16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 16.1.4. A brief description of the labor, materials, or equipment furnished;

- 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
- 16.1.7. The total amount of previous payments received by the Claimant; and
- 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
- 17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
- 18. Modifications to this Bond are as follows: None.
- 19. This Bond is in accordance with Utah Code, Section 14-1-18, Section 14-1-19, and Utah Code, Section 63G-6-505.

END OF DOCUMENT

Document 00_62_77
Contractor's Application for Payment

Owner: Weber Basin Water Conservancy District Owner's Contract No.: Contractor: Project Name: Davis North Water Treatment Plant - Solids Dewatering Improvement Project Contract Name: [Engineer] [Construction Manager]: [Engineer's] [Construction Manager's] Project No:	Contractor's Application for Payment No. Application Period: Application Date:

Application for Payment

Change Order Summary		
Approved Change Orders		
Number	Additions	Deductions
TOTALS	\$0.00	\$0.00
NET CHANGE BY CHANGE ORDERS	\$0.00	

1. ORIGINAL CONTRACT PRICE.....	\$	
2. Net change by Change Orders.....	\$	\$0.00
3. Current Contract Price (Line 1 ± 2).....	\$	\$0.00
4. TOTAL COMPLETED AND STORED TO DATE (Column F total on Progress Estimates).....	\$	\$0.00
5. RETAINAGE:		
a. X \$0.00 Work Completed.....	\$	\$0.00
b. 0% X \$0.00 Stored Material.....	\$	\$0.00
c. Total Retainage (Line 5.a + Line 5.b).....	\$	\$0.00
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c).....	\$	\$0.00
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application).....	\$	
8. AMOUNT DUE THIS APPLICATION.....	\$	\$0.00
9. BALANCE TO FINISH, PLUS RETAINAGE	\$	
(Column G total on Progress Estimates + Line 5.c above).....	\$	\$0.00

Contractor's Certification The undersigned Contractor certifies, to the best of its knowledge, the following: (1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment; (2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and (3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.	
Contractor Signature By: Date:	

Payment of:	\$	
		(Line 8 or other - attach explanation of the other amount)
is recommended by:		
		([Engineer] [Construction Manager]) (Date)
Payment of:	\$	
		(Line 8 or other - attach explanation of the other amount)
is approved by:		
		(Owner) (Date)
Approved by:		
		Funding or Financing Entity (if applicable) (Date)

Document 00_62_77
Contractor's Application for Payment

Owner:	Weber Basin Water Conservancy District	Contractor's Application for Payment No. Application Period: Application Date:
Owner's Contract No.:		
Contractor:	Contractor's Project No.:	
Project Name:	Davis North Water Treatment Plant - Solids Dewatering Improvement Project	
Contract Name:		
Engineer:	Engineer's Project No:	

Progress Estimate - Lump Sum Work

			Work Completed		E	F		G
A		B	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
Specification Section No.	Description	Scheduled Value (\$)	From Previous Application (C+D)	This Period				
			\$0.00			\$0.00		\$0.00
						\$0.00		\$0.00
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Document 00_62_77
Contractor's Application for Payment

Owner:	Weber Basin Water Conservancy District	Contractor's Application for Payment No. Application Period: Application Date:
Owner's Contract No.:		
Contractor:	Contractor's Project No.:	
Project Name:	Davis North Water Treatment Plant - Solids Dewatering Improvement Project	
Contract Name:		
Engineer:	Engineer's Project No:	

Progress Estimate - Unit Price Work

[illegible]

Document 00_62_77
Contractor's Application for Payment

Owner: Weber Basin Water Conservancy District		Contractor's Application for Payment No. Application Period: Application Date:
Owner's Contract No.:		
Contractor:	Contractor's Project No.:	
Project Davis North Water Treatment Plant - Solids Dewatering Improvement Project		
Contract Name:		
Engineer:	Engineer's Project No.:	

Progress Estimate - Stored Material Summary

[illegible]

DOCUMENT 00_63_13

REQUEST FOR INFORMATION OR INTERPRETATION (RFI)

Owner: Click here to enter text. **Date:** XX/XX/XXXX

Contractor: Click here to enter text. **Project No.:** 00000.00

Project Name: Click here to enter text. **RFI No.:** 000

RFI Title: Click here to enter text. **Spec/Dwg. Reference:** 00000

Information or Interpretation and Reason Requested	
<u>Click here to enter text.</u>	
Authored By: <u>Click here to enter text.</u>	Date Submitted: <u>XX/XX/XXXX</u>

Response to Request:	
<u>Click here to enter text.</u>	
In the event, Contractor believes the RFI response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.	
Firm Name: <u>Click here to enter text.</u>	Date Returned: <u>XX/XX/XXXX</u>
Signature: _____	Printed Name: _____

END OF DOCUMENT

DOCUMENT 00_65_16

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:

Engineer:

Contractor:

Project:

Contract

Name:

Owner's Project No.:

Engineer's Project No.:

Contractor's Project

No.:

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By (*signature*):

Name

(*printed*):

Title:

END OF DOCUMENT

DOCUMENT 00_72_00

GENERAL CONDITIONS

Prepared By



Endorsed By



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DOCUMENT 00_72_00

GENERAL CONDITIONS

ARTICLE 1 — DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.
11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
15. *Contract Times*—The number of days or the dates by which Contractor shall:
(a) achieve Milestones, if any; (b) achieve Substantial Completion; and
(c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.
22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
- The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.
43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. *Technical Data*
 - a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

- b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or

any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

- C. *Day*: The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective*: The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents;
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 — PRELIMINARY MATTERS

2.01 Delivery of Performance and Payment Bonds; Evidence of Insurance

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by

Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

- C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed *counterpart* of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 Before Starting Construction

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 Preconstruction Conference; Designation of Authorized Representatives

- A. Before any *Work* at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 Acceptance of Schedules

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be

held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.
4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 Electronic Transmittals

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3 — CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 Intent

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part

thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 Reference Standards

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 Reporting and Resolving Discrepancies

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by

Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Requirements of the Contract Documents

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 Reuse of Documents

- A. Contractor and its Subcontractors and Suppliers shall not:
 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 — COMMENCEMENT AND PROGRESS OF THE WORK

4.01 Commencement of Contract Times; Notice to Proceed

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 Starting the Work

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 Reference Points

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 Progress Schedule

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 Delays in Contractor's Progress

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. Abnormal weather conditions;
 - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.
- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
 - 1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 - 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 - 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
 - 1. The circumstances that form the basis for the requested adjustment;
 - 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 - 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 - 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5 — SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 Availability of Lands

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 Use of Site and Other Areas

- A. *Limitation on Use of Site and Other Areas*
 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
 - D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 Subsurface and Physical Conditions

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
 2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
 3. Technical Data contained in such reports and drawings.
- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.
- D. *Limitations of Other Data and Documents:* Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
 3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
 4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 Differing Subsurface or Physical Conditions

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions:* Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04

are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 Underground Facilities

- A. *Contractor's Responsibilities:* Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;
 3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

- E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 Hazardous Environmental Conditions at Site

- A. *Reports and Drawings*: The Supplementary Conditions identify:
1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
 2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers,

directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or

Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 — BONDS AND INSURANCE

6.01 Performance, Payment, and Other Bonds

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a

prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 Insurance—General Provisions

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.
- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.
- H. Contractor shall require:
1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may

impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.
- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 Contractor's Insurance

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required;
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;
 - 4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and
 - 5. include all necessary endorsements to support the stated requirements.

- C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);
 4. not seek contribution from insurance maintained by the additional insured; and
 5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 Builder's Risk and Other Property Insurance

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible

for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 Property Losses; Subrogation

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.
 - 1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
 - 2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
 - 1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the

Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 Receipt and Application of Property Insurance Proceeds

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7 — CONTRACTOR'S RESPONSIBILITIES

7.01 Contractor's Means And Methods Of Construction

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 Supervision and Superintendence

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 Labor; Working Hours

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.
- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 Services, Materials, and Equipment

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 "Or Equals"

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and

sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

- a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
 - b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 Substitutes

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is

functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design;
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor

shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 Concerning Subcontractors and Suppliers

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 Patent Fees and Royalties

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out

of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 Permits

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 Taxes

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 Laws and Regulations

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 Record Documents

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field

Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.13 Safety and Protection

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 Hazard Communication Programs

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 Emergencies

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 Submittals

- A. *Shop Drawing and Sample Requirements*
 - 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
 - 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the

- Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.
3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
 6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
 7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
 8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.
- D. *Resubmittal Procedures for Shop Drawings and Samples*
1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
 2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
 3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.
- E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*
1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.
 - d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.

- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
 - 1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 - 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
 - 1. Observations by Engineer;
 - 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. Use or occupancy of the Work or any part thereof by Owner;
 - 5. Any review and approval of a Shop Drawing or Sample submittal;
 - 6. The issuance of a notice of acceptability by Engineer;
 - 7. The end of the correction period established in Paragraph 15.08;
 - 8. Any inspection, test, or approval by others; or
 - 9. Any correction of defective Work by Owner.
- E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 Delegation of Professional Design Services

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.
- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8 — OTHER WORK AT THE SITE

8.01 Other Work

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is

performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 Coordination

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. An itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. The extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 Legal Relationships

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
 - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work,

and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 — OWNER'S RESPONSIBILITIES

9.01 Communications to Contractor

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 Replacement of Engineer

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 Furnish Data

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 Pay When Due

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 Lands and Easements; Reports, Tests, and Drawings

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

- 9.06 Insurance
- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.
- 9.07 Change Orders
- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.
- 9.08 Inspections, Tests, and Approvals
- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.
- 9.09 Limitations on Owner's Responsibilities
- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- 9.10 Undisclosed Hazardous Environmental Condition
- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.
- 9.11 Evidence of Financial Arrangements
- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).
- 9.12 Safety Programs
- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 — ENGINEER'S STATUS DURING CONSTRUCTION

- 10.01 Owner's Representative
- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.
- 10.02 Visits to Site
- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's

efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 Resident Project Representative

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 Engineer's Authority

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.
- E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 Determinations for Unit Price Work

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 Decisions on Requirements of Contract Documents and Acceptability of Work

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 Limitations on Engineer's Authority and Responsibilities

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 Compliance with Safety Program

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11 — CHANGES TO THE CONTRACT

11.01 Amending and Supplementing the Contract

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 Work Change Directives

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.
- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 Field Orders

- A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 Owner-Authorized Changes in the Work

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 Unauthorized Changes in the Work

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 Change of Contract Price

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 - 1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
 - 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
 - 3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 Change of Contract Times

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 Change Proposals

- A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or

relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice

will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 Notification to Surety

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 — CLAIMS

12.01 Claims

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation*
1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 — COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees

include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.
 - c. *Construction Equipment Rental*
 - 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and

removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

- 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.
- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by

Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.
3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
6. Expenses incurred in preparing and advancing Claims.
7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. Contractor's Fee

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. Documentation and Audit:** Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 Allowances

- A.** It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be

performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.
- E. *Adjustments in Unit Price*
 - 1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
 - 2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to

perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14 — TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 Tests, Inspections, and Approvals

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 Defective Work

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 Acceptance of Defective Work

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 Uncovering Work

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 Owner May Stop the Work

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 — PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 - 3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 - 4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications*
 - 1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend

- payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
 3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. The Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. The Contract Price has been reduced by Change Orders;
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 Substantial Completion

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 Partial Use or Occupancy

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
 - 2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 Final Inspection

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 Final Payment

- A. Application for Payment
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
 3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to 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 for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments.

Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 Waiver of Claims

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 Correction Period

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 — SUSPENSION OF WORK AND TERMINATION

16.01 Owner May Suspend Work

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 Owner May Terminate for Cause

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 Owner May Terminate for Convenience

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 Contractor May Stop Work or Terminate

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is

submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 — FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 — MISCELLANEOUS

18.01 Giving Notice

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
 - 1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 - 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 - 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 Computation of Times

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 Cumulative Remedies

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions

of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 Limitation of Damages

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 No Waiver

- A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 Survival of Obligations

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 Controlling Law

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 Assignment of Contract

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 Successors and Assigns

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 Headings

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

END OF DOCUMENT

DOCUMENT 00_73_00

SUPPLEMENTARY CONDITIONS

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These Supplementary Conditions amend or supplement Document 00_72_00 - General Conditions. The General Conditions remain in full force and effect, except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, "Paragraph SC-4.05."

ARTICLE 1 — DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

SC-1.01 Add to Paragraph 1.01.A by inserting the following as new numbered items in their proper alphabetical positions:

Construction Manager—Person or entity designated by the Owner to provide construction management services for the Project with duties, responsibilities, and limitations of the Engineer, unless stipulated otherwise. The authorized representative of Owner who may be assigned to the Site or any part thereof. The individual or entity will be responsible for administration of the Contract as a representative of the Owner. Owner has designated Engineer to provide construction management services with duties, responsibilities, and limitations therein as required by Contract.

Final Completion - The Work is complete when it is ready for final payment as established by the Engineer's written recommendation of final payment as set forth in Paragraph 15.06.

"Or Equal": Alternate product that does not affect Contract Time, Contract Price, or Contract Scope.

Substitution: Alternate product that requires a Change Order to adjust the Contract Time, Contract Price, or Contract Scope.

Technical Sections: Project Specifications in CSI MasterFormat® Division 02 and higher.

ARTICLE 2 — PRELIMINARY MATTERS

2.01 Delivery of Performance and Payment Bonds; Evidence of Insurance

SC-2.01 Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:

- B. Evidence of Contractor's Insurance: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- C. Evidence of Owner's Insurance: After receipt from Contractor of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner in this Contract (if any). Owner may block out

(redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

2.02 Copies of Documents

SC-2.02 Amend the first sentence of Paragraph 2.02.A. to read as follows:

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following in its place:

- A. Owner shall furnish to Contractor 1 printed copies of conformed documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including 1 fully signed counterpart of the Agreement), and 1 copy in electronic portable document format (PDF). Additional printed copies of the conformed documents will be furnished upon request at the cost of reproduction.

2.06 Electronic Transmittals

SC-2.06 Delete Paragraphs 2.06.B and 2.06.C in their entirety and insert the following in their place:

- B. Electronic Documents Protocol: The parties shall conform to the following provisions in Paragraphs 2.06.B and 2.06.C, together referred to as the Electronic Documents Protocol ("EDP" or "Protocol") for exchange of electronic transmittals.

1. Basic Requirements:

- a. To the fullest extent practical, the parties agree to and will transmit and accept Electronic Documents in an electronic or digital format using the procedures described in this Protocol. Use of the Electronic Documents and any information contained therein is subject to the requirements of this Protocol and other provisions of the Contract.
- b. The contents of the information in any Electronic Document will be the responsibility of the transmitting party.
- c. Electronic Documents as exchanged by this Protocol may be used in the same manner as the printed versions of the same documents that are exchanged using non-electronic format and methods, subject to the same governing requirements, limitations, and restrictions, set forth in the Contract Documents.
- d. Except as otherwise explicitly stated in this Document, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any third party for any portion of the Work on the Project, or any project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.
- e. When transmitting Electronic Documents, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the receiving party's use of software application packages, operating systems, or computer hardware differing from those established in this Protocol.
- f. Nothing herein negates any obligation (1) in the Contract to create, provide, or maintain an original printed record version of Drawings and Specifications, signed and sealed according to applicable Laws and Regulations; (2) to comply with any applicable Law or Regulation governing

the signing and sealing of design documents or the signing and electronic transmission of any other documents; or (3) to comply with the notice requirements of General Conditions, Paragraph 18.01.

2. System Infrastructure for Electronic Document Exchange:

- a. Each party will provide hardware, operating system(s) software, internet, email, and large file transfer functions ("System Infrastructure") at its own cost and sufficient for complying with the EDP requirements. With the exception of minimum standards set forth in this EDP, and any explicit system requirements specified by attachment to this EDP, it is the obligation of each party to determine, for itself, its own System Infrastructure.
 - 1) The maximum size of an email attachment for exchange of Electronic Documents under this EDP is [] MB. Attachments larger than that may be exchanged using large file transfer functions or physical media.
 - 2) Each Party assumes full and complete responsibility for any and all of its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, or otherwise enabling its System Infrastructure, including operating systems and software, for use with respect to this EDP.
- b. Each party is responsible for its own system operations, security, back-up, archiving, audits, printing resources, and other Information Technology ("IT") for maintaining operations of its System Infrastructure during the Project, including coordination with the party's individual(s) or entity responsible for managing its System Infrastructure and capable of addressing routine communications and other IT issues affecting the exchange of Electronic Documents.
- c. Each party will operate and maintain industry-standard, industry-accepted, ISO-standard, commercial-grade security software and systems that are intended to protect the other party from: software viruses and other malicious software like worms, Trojans, adware; data breaches; loss of confidentiality; and other threats in the transmission to or storage of information from the other parties, including transmission of Electronic Documents by physical media such as CD/DVD/flash drive/hard drive. To the extent that a party maintains and operates such security software and systems, it shall not be liable to the other party for any breach of system security.
- d. In the case of disputes, conflicts, or modifications to the EDP required to address issues affecting System Infrastructure, the parties shall cooperatively resolve the issues; but, failing resolution, the Owner is authorized to make and require reasonable and necessary changes to the EDP to effectuate its original intent. If the changes cause additional cost or time to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in price or time under the appropriate process in the Contract.
- e. Each party is responsible for its own back-up and archive of documents sent and received during the term of the contract under this EDP, unless this EDP establishes a Project document archive, either as part of a mandatory Project website or other communications protocol, upon which the parties may rely for document archiving during the specified term of operation of such Project document archive. Further, each party remains solely responsible for its own post-Project back-up and archive of Project

documents after the term of the Contract, or after termination of the Project document archive, if one is established, for as long as required by the Contract and as each party deems necessary for its own purposes.

- f. If a receiving party receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving party will advise the sending party of the incomplete transmission.
- g. The parties will bring any non-conforming Electronic Documents into compliance with the EDP. The parties will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the communication.
- h. The Owner will operate a Project information management system (also referred to in this EDP as "Project Website") for use of Owner, Engineer and Contractor during the Project for exchange and storage of Project-related communications and information. Except as otherwise provided in this EDP or the General Conditions, use of the Project Website by the parties as described in this Paragraph will be mandatory for exchange of Project documents, communications, submittals, and other Project-related information. The following conditions and standards will govern use of the Project Website:
 - 1) Describe the period of time during which the Project Website will be operated and be available for reliance by the parties;
 - 2) Provide any minimum system infrastructure, software licensing and security standards for access to and use of the Project Website;
 - 3) Describe the types and extent of services to be provided at the Project Website (such as large file transfer, email, communication, and document archives, etc.); and
 - 4) Include any other Project Website attributes that may be pertinent to Contractor's use of the facility and pricing of such use.

C. Software Requirements for Electronic Document Exchange; Limitations:

- 1. Each party will acquire the software and software licenses necessary to create and transmit Electronic Documents and to read and to use any Electronic Documents received from the other party (and if relevant from third parties), using the software formats required in this Section of the EDP.
 - a. Prior to using any updated version of the software required in this Section for sending Electronic Documents to the other party, the originating party will first notify and receive concurrence from the other party for use of the updated version or adjust its transmission to comply with this EDP.
- 2. The parties agree not to intentionally edit, reverse engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes any Electronic Document or information contained therein that was transmitted in a software data format, including Portable Document Format (PDF), intended by sender not to be modified, unless the receiving party obtains the permission of the sending party or is citing or quoting excerpts of the Electronic Document for Project purposes.
- 3. Software and data formats for exchange of Electronic Documents will conform to the requirements set forth in Table 1, including software versions, if listed.

Table 1. Software Requirements for Electronic Document Exchange

Item	Electronic Documents	Transmittal Means	Data Format	Note ⁽¹⁾
a.1	General communications, transmittal covers, meeting notices and responses to general information requests for which there is no specific prescribed form.	Email	Email	
a.2	Meeting agendas, meeting minutes, RFIs and responses to RFIs, and Contract forms.	Email	PDF	(2)
a.3	Contractors Submittals (Shop Drawings, "or equal" requests, substitution requests, documentation accompanying Sample submittals and other submittals) to Owner and Engineer, and Owner's and Engineer's responses to Contractor's Submittals, Shop Drawings, correspondence, and Applications for Payment.	Email	PDF	
a.4	Correspondence; milestone and final version Submittals of reports, layouts, Drawings, maps, calculations and spreadsheets, Specifications, Drawings and other Submittals from Contractor to Owner or Engineer and for responses from Engineer and Owner to Contractor regarding Submittals.	Email	PDF	
a.5	Layouts and drawings to be submitted to Owner for future use and modification.	Email	DWG	
a.6	Correspondence, reports, and Specifications to be submitted to Owner for future word processing use and modification.	Email	DOC	
a.7	Spreadsheets and data to be submitted to Owner for future data processing use and modification.	Email	EXC	
a.8	Database files and data to be submitted to Owner for future data processing use and modification.	Email	DB	

Notes:

(1) All exchanges and uses of transmitted data are subject to the appropriate provisions of Contract Documents.

(2) Transmittal of written notices is governed by General Conditions, Paragraph 18.01.

Key:

DB Microsoft® Access .mdb format
DGN Microstation .dgn format
DOC Microsoft® Word .docx format
DWG Autodesk® AutoCAD .dwg format

Item	Electronic Documents	Transmittal Means	Data Format	Note ⁽¹⁾
Email	Standard Email formats (.htm, .rtf, or .txt). Do not use stationery formatting or other features that impair legibility of content on screen or in printed copies			
EXC	Microsoft® Excel .xls or .xml format			
LFE	Agreed upon Large File Exchange method (FTP, CD, DVD, hard drive)			
PDF	Portable Document Format readable by Adobe® Acrobat Reader			

SC-2.06 Add the following new paragraph immediately after Paragraph 2.06.C:

- D. Requests by Contractor for Electronic Documents in Other Formats:
1. Release of any Electronic Document versions of the Project documents in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be at the sole discretion of the Owner.
 2. To extent determined by Owner, in its sole discretion, to be prudent and necessary, release of Electronic Documents versions of Project documents and other Project information requested by Contractor ("Request") in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be subject to the provisions of the Owner's response to the Request, and to the following conditions to which Contractor agrees:
 - a. The content included in the Electronic Documents created by Engineer and covered by the Request was prepared by Engineer as an internal working document for Engineer's purposes solely and is being provided to Contractor on an "AS IS" basis without any warranties of any kind, including, but not limited to, any implied warranties of fitness for any purpose. As such, Contractor is advised and acknowledges that the content may not be suitable for Contractor's application or may require substantial modification and independent verification by Contractor. The content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other devices that may affect subsequent reuse.
 - b. Electronic Documents containing text, graphics, metadata, or other types of data that are provided by Engineer to Contractor under the request are only for convenience of Contractor. Any conclusion or information obtained or derived from such data will be at the Contractor's sole risk and the Contractor waives any claims against Engineer or Owner arising from use of data in Electronic Documents covered by the Request.
 - c. Contractor shall indemnify and hold harmless Owner and Engineer and their subconsultants from all claims, damages, losses, and expenses, including attorneys' fees and defense costs arising out of or resulting from Contractor's use, adaptation, or distribution of any Electronic Documents provided under the Request.
 - d. Contractor agrees not to sell, copy, transfer, forward, give away or otherwise distribute this information (in source or modified file format) to any third party without the direct written authorization of Engineer, unless such distribution is specifically identified in the Request and is limited to Contractor's subcontractors. Contractor warrants that subsequent use by Contractor's subcontractors complies with all terms of the Contract Documents and Owner's response to Request.

ARTICLE 3 — CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 Intent

SC-3.01 Add the following new subparagraph after Paragraph 3.01.A:

1. Requirements stated in the following CSI MasterFormat® divisions apply to the Technical Sections.
 - a. Division 00 - Procurement and Contracting Requirements, from Document 00_50_00 and higher.
 - b. Division 01 - General Requirements.

ARTICLE 4 — COMMENCEMENT AND PROGRESS OF THE WORK

4.05 Delays in Contractor's Progress

SC-4.05 Add the following new subparagraph after Paragraph 4.05.C.4:

5. Weather-Related Delays:
 - a. Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by National Weather Service weather monitoring station at Salt Lake City International Airport.
 - b. The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.
 - c. Atmospheric hazard: Each day that requires worker exposure to outside conditions when the Air Quality Index (AQI) for PM_{2.5} particulate is at a Hazardous (301 or higher) Level may be counted as a bad weather day.

ARTICLE 5 — SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 Availability of Lands

SC-5.01 Add the following language at the end of the last sentence of Paragraph 5.01.A:

Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may request an amendment to the Contract Documents as provided in Article 11.

SC-5.01 Add the following new paragraph immediately after Paragraph 5.01.C:

- D. Any Work performed in public rights-of-way, in addition to conforming to the Contract Documents, shall be done in accordance with the requirements of the permit issued by the public agency in whose right-of-way the Work is located.

5.03 Subsurface and Physical Conditions

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D.4:

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that are provided as supplemental information and contain no Technical Data. These are not Contract Documents:

Report Title	Date of Report
Weber Basin Water Conservancy District - Davis North Water Treatment Plant Solids Dewatering Improvement Project prepared by RB&G Engineering	October 2024

- F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that are provided as supplemental information and contain no Technical Data. These are not Contract Documents:

Drawings Title	Date of Drawings
None	

- G. Contractor may examine copies of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents at Davis North Water Treatment Plant at 2837 E Highway 183, Layton, UT 84040 during regular business hours, or may request copies from Engineer.

5.05 Underground Facilities

SC-5.05 Delete Paragraph 5.05.F.4 in its entirety and insert the following in its place:

4. The information and data shown or indicated on the Drawings listed in the following table with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with industry best practices. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph.

Drawings Title	Date of Drawings
WBWCD Water Treatment Plant No. 3 Expansion 2001 - Record Drawings	May 2004

5.06 Hazardous Environmental Conditions at Site

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site and are provided as supplemental information and contain no Technical Data. These are not Contract Documents:

Report Title	Date of Report

Report Title	Date of Report

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, are provided as supplemental information and contain no Technical Data. These are not Contract Documents:

Drawings Title	Date of Drawings

ARTICLE 6 — BONDS AND INSURANCE

6.01 Performance, Payment, and Other Bonds

SC-6.01 Add the following new paragraphs immediately after Paragraph 6.01.A:

1. Required Performance Bond Form: The performance bond that Contractor furnishes will be in the form of Document 00_61_10 - Performance Bond.
2. Required Payment Bond Form: The payment bond that Contractor furnishes will be in the form of Document 00_61_15 - Payment Bond.

6.02 Insurance—General Provisions

SC-6.02 Add the following new paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

SC-6.02 Add the following new paragraph immediately after Paragraph 6.02.B:

6.03 Contractor's Insurance

SC-6.03 Add the following new paragraphs immediately after Paragraph 6.03.C.5:

- D. Other Additional Insureds: As a supplement to the provisions of General Conditions, Paragraph 6.03.C, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: Engineer
- E. Workers' Compensation and Employer's Liability: Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	Policy limits of not less than:
Workers' Compensation	
State	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable.	Statutory
Stop-gap Liability Coverage	
For work performed in monopolistic states, stop-gap liability coverage must be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	\$3,000,000

- F. Commercial General Liability—Claims Covered: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:
1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
 2. damages insured by reasonably available personal injury liability coverage, and
 3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- G. Commercial General Liability—Form and Content: Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage.
 - a. Such insurance must be maintained for 3 years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and 3 years thereafter.
 2. Blanket contractual liability coverage, including, but not limited to, coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
 4. Underground, explosion, and collapse coverage.
 5. Personal injury coverage.
 6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
 7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

- H. Commercial General Liability—Excluded Content: The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:
1. Any modification of the standard definition of “insured contract” (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
 2. Any exclusion for water intrusion or water damage.
 3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
 4. Any exclusion of coverage relating to earth subsidence or movement.
 5. Any exclusion for the insured’s vicarious liability, strict liability, or statutory liability (other than worker’s compensation).
 6. Any limitation or exclusion based on the nature of Contractor’s work.
 7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

- I. Commercial General Liability—Minimum Policy Limits:

Commercial General Liability	Policy limits of not less than:
General Aggregate	\$3,000,000
Products—Completed Operations Aggregate	\$3,000,000
Personal and Advertising Injury	\$1,000,000
Bodily Injury and Property Damage—Each Occurrence	\$2,000,000

- J. Automobile Liability: Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	\$2,000,000
Each Accident	\$2,000,000
Property Damage	
Each Accident	\$2,000,000
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	\$2,000,000

- K. Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements: Contractor may meet the policy limits specified for employer’s liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy’s policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified in this Document. If such umbrella or excess liability policy was required under this

Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of \$3,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.

- L. Contractor's Pollution Liability Insurance: Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than 3 years after final completion.

Contractor's Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	\$1,000,000
General Aggregate	\$3,000,000

- M. Contractor's Professional Liability Insurance: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of 2 years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	Policy limits of not less than:
Each Claim	\$2,000,000
Annual Aggregate	\$4,000,000

6.04 Builder's Risk and Other Property Insurance

SC-6.04 Delete Paragraph 6.04.A in its entirety and insert the following in its place:

- A. Owner shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations).

SC-6.04 Add the following new paragraphs immediately after Paragraph 6.04.E:

- F. Builder's Risk Requirements: The builder's risk insurance must:
1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition

occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

- a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.
 - b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.
2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 3. cover expenses incurred in the repair or replacement of any insured property (including, but not limited to, fees and charges of contractors, engineers, and architects).
 4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of 500,000.
 5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of \$500,000.
 6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.
 7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.
 8. include performance/hot testing and start-up, if applicable.
 9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.
 10. include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:
 - a. Construction Manager.
- G. Coverage for Completion Delays: The builder's risk policy will include, for the benefit of Owner, loss of revenue and soft cost coverage for losses arising from delays in completion that result from covered physical losses or damage. Such coverage will

include, without limitation, fixed expenses, and debt service for a minimum of 12 months with a maximum deductible of 30 days, compensation for loss of net revenues, rental costs, and attorneys' fees and engineering or other consultants' fees, if not otherwise covered.

- H. Builder's Risk and Other Property Insurance Deductibles: The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.
1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount of no more than \$10,000 for direct physical loss in any one occurrence.

ARTICLE 7 — CONTRACTOR'S RESPONSIBILITIES

7.03 Labor; Working Hours

SC-7.03 Amend the first and second sentences of Paragraph 7.03.C to read as follows:

- C. "...all Work at the Site must be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday."

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7:00 a.m. to 7:00 p.m., Monday through Friday.
2. Owner's legal holidays are: MLK Jr, Washington, Memorial, Juneteenth, Independence, Pioneer, Labor, Columbus, Thanksgiving, Christmas, New Years.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

- D. Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular workday. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

7.07 Concerning Subcontractors, Suppliers, and Others

SC-7.07 Add the following new subparagraph immediately after Paragraph 7.07.B:

1. Subcontracting: Contractor shall perform with Contractor's own organization work amounting to not less than 51 percent of the combined value of all items of the Work covered by the Contract.

7.09 Permits

SC-7.09 Add the following new paragraphs immediately after Paragraph 7.09.A:

- B. As Permittee, the Contractor will submit application, but Owner will pay for the following permits:
1. Building Permit issued by Layton City (per Section 01_21_00 - Allowances).

7.11 Laws and Regulations

SC-7.11 Add the following new paragraph immediately after Paragraph 7.11.C:

- D. Contractor's Continuing Obligation: Contractor's obligation to perform services in connection herewith will be in accordance with Utah UCA, Title 70A.
- E. Contract Documents include clauses in accordance with Utah Code, Section 63G-6-601 providing for adjustments in prices, time of performance, or other appropriate contract provisions.
- F. Controlling law:
 - 1. The district court shall have jurisdiction over an action, whether in law or equity, in accordance with Utah Procurement Code, Section 63G-6-815.
 - 2. Actions under Utah Procurement Code, Section 63G-6-815 shall be initiated according to Section 63G-6-817 Statute of Limitations.
 - 3. This contract is to be governed in accordance with Utah Procurement Codes and Rules.

7.17 Contractor's General Warranty and Guarantee

SC-7.17 Delete Paragraph 7.17.B. and subparagraphs in their entirety and insert the following in its place:

- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08.

7.19 Delegation of Professional Design Services

SC-7.19 Add the following new subparagraph immediately after Paragraph 7.19.A.

- 1. Where the technical specs require the Contractor to provide professional design services and to submit signed and sealed documents from a registered professional engineer, such Work is "Delegated Design".

ARTICLE 8 — OTHER WORK AT THE SITE (NOT USED)

ARTICLE 9 — OWNER'S RESPONSIBILITIES

9.01 Communications to Contractor

SC-9.01 Delete Paragraph 9.01.A in its entirety and insert the following in its place:

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Construction Manager.
- B. Construction Manager will establish and implement procedures, including testing, reviewing and processing requests for clarifications and interpretations of the Contract Documents; Shop Drawings, samples, and other submittals; schedule adjustments; Change Order proposals; written proposals for substitutions; payment applications; and maintenance of logs.

ARTICLE 10 — ENGINEER'S STATUS DURING CONSTRUCTION

10.01 Owner's Representative

SC-10.01 Add the following new paragraph immediately after Paragraph 10.01.A:

- 1. Owner will provide a Resident Project Representative to act as the Owner's Representative, who will direct and supervise the Construction Manager and

will confer with the Construction Manager regarding its actions. The Owner's Representative's dealings in matters pertaining to onsite Work shall, in general, be only with the Construction Manager and the Contractor, and dealing with Subcontractors shall only be through or with full knowledge of the Contractor. All written communication between the Owner Representative and the Contractor will be shared with the Construction Manager.

10.03 Resident Project Representative

SC-10.03 Add the following new subparagraph immediately after Paragraph 10.03.A:

1. On this Project, by agreement with the Owner, the Engineer will not furnish a Resident Project Representative to represent Engineer at the Site or assist Engineer in observing the progress and quality of the Work.

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.B:

- C. The Resident Project Representative (RPR) will be the Owner's Representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
 1. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 2. Safety Compliance: Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
 3. Liaison:
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
 4. Review of Work; Defective Work:
 - a. Conduct on-site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is, in general, proceeding in accordance with the Contract Documents.
 - b. Observe whether any Work in place appears to be defective.
 - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection, or approval.
 5. Inspections and Tests:
 - a. Observe Contractor-arranged inspections required by Laws and Regulations, including, but not limited to, those performed by public or other agencies having jurisdiction over the Work.
 - b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 6. Payment Requests: Review Applications for Payment with Contractor.
 7. Completion:
 - a. Participate in Engineer's visits regarding Substantial Completion.

- b. Assist in the preparation of a punch list of items to be completed or corrected.
 - c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work and prepare a final punch list of items to be completed or corrected by Contractor.
 - d. Observe whether items on the final punch list have been completed or corrected.
- D. The RPR will not:
- 1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 - 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 - 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 - 4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.
 - 5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
 - 6. Participate in specialized field or laboratory tests or inspections conducted off site by others, except as specifically authorized by Engineer.
 - 7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11 — CHANGES TO THE CONTRACT

11.02 Change Orders

SC-11.02 Insert the following new paragraph immediately following Paragraph 11.02.A.3:

- a. Changes in Contract Price are subject to prior written certification that the Change Order is within the determined Project budget in accordance with Utah Procurement Code, Section 63G-6-602.

SC-11.02 Insert the following new subparagraphs immediately following Paragraph 11.02.A.4:

- 5. In signing a Change Order, the Owner and Contractor acknowledge and agree that:
 - a. the stipulated compensation (Contract Price or Contract Times, or both) set forth in the Change Order includes not only all direct costs of Contractor such as labor, material, job overhead, and profit markup, but also includes any costs for modifications or changes in sequence of work to be performed, delays, rescheduling, disruptions, extended direct overhead or general overhead, acceleration, material or other escalation which includes wages and other impact costs. This Document will become a supplement to the Contract and all Contract provisions will apply hereto. It is understood that this Change Order shall be effective on the date approved by the Owner's Representative;
 - b. the Change Order constitutes full mutual accord and satisfaction for the change to the Work;
 - c. no reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and
 - d. no subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

11.08 Change of Contract Times

SC-11.08 Add the following new paragraphs immediately after Paragraph 11.08.B:

C. Use of Float:

1. A request for adjustment of Contract Times (or Milestones), otherwise allowable under the Contract Documents, shall be granted only when the time lost or gained exceeds the float for the activity at the time of the event giving rise to the claim. Float, the amount of time between the early start date and the late start date, or the early finish date and the late finish date, is jointly owned by both Owner and Contractor whether expressly disclosed or implied in any manner.
2. Contractor shall not use float suppression techniques (including, but not limited to, preferential sequencing caused by late starts of follow-up trades, unreasonably small crews, extended durations, or imposed dates) in information provided to Engineer.

D. Weather Days:

1. The Contract Time includes a weather day allowance of 20 working days. No extension in Contract Time will be allowed for the first 20 working days lost due to weather conditions.

ARTICLE 12 — CLAIMS (NOT USED)

ARTICLE 13 — COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

SC-13.01 Adding the following new language at the end of Paragraph 13.01.B.5.c.2:

The equipment rental rate book that governs the included costs for the rental of machinery and equipment owned by Contractor (or a related entity) under the Cost of the Work provisions of this Contract is the most current edition of Rental Rate Blue Book.

SC-13.01 Adding the following new language at the end of Paragraph 13.01.C.2:

- a. Costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. For purposes of this paragraph, "small tools and hand tools" means any tool or equipment whose current price if it were purchased new at retail would be less than \$500.

13.03 Unit Price Work

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. Adjustments in Unit Price:

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the extended price of a particular item of Unit Price Work amounts to 25 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by

- Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and
- b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
 - c. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
 - d. Adjusted unit prices will apply to all units of that item.

ARTICLE 14 — TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK (NOT USED)

ARTICLE 15 — PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.01 Progress Payments

SC-15.01 Delete Paragraph 15.01.B.1 in its entirety and insert the following in its place:

1. At least 30 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - a. Payments for stored materials and equipment shall be based only upon the actual cost of the materials and equipment to Contractor and shall not include any overhead or profit to Contractor. Partial payments will not be made for undelivered materials or equipment, except for payments associated with prepurchase vendor contracts initiated by Owner and assigned to Contractor.

SC-15.01 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

1. 30 days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

SC-15.01 Add the following new paragraph immediately after Paragraph 15.01.D.1:

2. Contractor shall disburse money paid to him, including any interest Contractor receives, to Subcontractors and Suppliers within 15 days after Contractor receives the money, in direct proportion to the Subcontractors' and Suppliers' basis in the total Contract between Contractor and Owner. Any money which is payable to a Subcontractor pursuant to this Section accrues interest at the legal rate. Contractor may withhold a portion of any partial payment as may be set forth in a subcontract. Thereafter Contractor shall pay any additional funds if, in the opinion of Contractor, satisfactory progress is being made in the work under the subcontract, and the payment must be equal to that paid by Owner to Contractor for the Work performed by the Subcontractor.
 - a. The Contractor may retain the amount withheld under the subcontract until the subcontract is satisfactorily completed.
 - b. The amount withheld under the subcontract is due within 15 days after the acceptance of the subcontract work by Contractor.

- c. Whenever Contractor receives a payment of interest earned on the amount withheld from the Contract, Contractor shall within 15 days pay to each Subcontractor that portion of the interest received from the state which is attributable to the amount of money withheld from the Subcontractor.

15.03 Substantial Completion

SC-15.03 Add the following new subparagraphs immediately after Paragraph 15.03.A:

1. The Work shall be Substantially Complete when the Work can use new sludge pump station and day storage facilities can be used to dewater solids in accordance with the Contract Documents. All process and transmission equipment shall be installed and operational, or temporary arrangements satisfactory to Owner shall have been made. Operational testing must be completed prior to the date of Substantial Completion.
1. To be considered substantially complete, the following portions of the Work must be operational and ready for Owner's continuous use as intended:
 - a. Transfer solids from each existing Gravity Thickener to new Sludge Day Tank.
 - b. Feed solids from each cell in the Sludge Day Tank to existing centrifuge dewatering equipment.
2. Portions of the Work not essential to plant operation, which can be completed without interruption of plant operation, may be completed after the Work is accepted as Substantially Complete, and may include the following items:
 - a. Final Grading.
 - b. Punch list items.

SC-15.03 Add the following new subparagraph immediately after Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

15.05 Final Inspection

SC-15.05 Add the following new paragraph immediately after Paragraph 15.05.A:

1. If some or all of the Work has been determined not to be at a point of Final Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

15.08 Correction Period

SC-15.08 Delete Paragraph 15.08.B. in its entirety.

SC-15.08 Delete Paragraph 15.08.C. in its entirety and insert the following in its place:

- B. If, after receipt of a notice of defect Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay

all costs, losses, and damages (including, but not limited to, all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including, but not limited to, all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

15.08 SUSPENSION OF WORK AND TERMINATION (NOT USED)

ARTICLE 16 — SUSPENSION OF WORK AND TERMINATION (NOT USED)

ARTICLE 17 — FINAL RESOLUTION OF DISPUTES

17.02 Arbitration

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

17.02 Arbitration

- A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of \$100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.
- C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.
- D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.
- E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.

- F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.
- G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:
1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration; such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings; such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.
 2. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.
 3. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

17.02 Attorneys' Fees

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

17.02 Attorneys' Fees

- A. For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18 — MISCELLANEOUS

SC-18.11 Add the following new paragraphs immediately after Paragraph 18.10:

18.11 Wages and Labor

- B. The Contractor shall submit copies of any or all payrolls not more than 14 days after the end of each pay period.

END OF DOCUMENT

DOCUMENT 00_94_20
WORK CHANGE DIRECTIVE

Owner: Weber Basin Water Conservancy District
Engineer: Carollo Engineers
Contractor:
Project: Davis North Water Treatment Plant Solids Dewatering Improvement Project
Contract Name:

Owner's Project No.:
Engineer's Project No.: 203356
Contractor's Project No.:

Date Issued: Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):
Description:

Attachments:

Purpose for the Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following:

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: \$ _____ **[increase][decrease][not yet estimated].**

Contract Time: _____ days **[increase][decrease][not yet estimated].**

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

Recommended by Engineer

Authorized by Owner

By: _____

Title: _____

Date: _____

END OF DOCUMENT

DOCUMENT 00_94_21

CHANGE ORDER

Owner:	Weber Basin Water Conservancy District	Owner's Project No.:
Engineer:	Carollo Engineers	Engineer's Project No.: 203356
Contractor:		Contractor's Project No.:
Project:	Davis North Water Treatment Plant Solids Dewatering Improvement Project	
Contract Name:		
Date Issued:	Effective Date of Change Order:	

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments:

In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The Change Order constitutes full mutual accord and satisfaction for the change to the Work. The stipulated compensation (Contract Price or Contract Times, or both) set forth in the Change Order includes not only all direct costs of Contractor such as labor, material, job overhead, and profit markup, but also includes any costs for modifications or changes in sequence of work to be performed, delays rescheduling, disruptions, extended direct overhead or general overhead, acceleration, material, or other escalation which includes wages and other impact costs.
2. This Change Order will become a supplement to the Contract and all Contract provisions will apply hereto.
3. It is understood that this Change Order shall be effective on the date the Owner authorizes the Change Order by their signature.
4. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party.
5. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

Change in Contract Price	Change in Contract Times [State Contract Times as either a specific date or a number of days]
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. [Number of previous Change Order] : \$ _____	[Increase] [Decrease] from previously approved Change Orders No. 1 to No. [Number of previous Change Order] : Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: \$ _____	[Increase] [Decrease] this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

Recommended by Engineer
(if required)

Authorized by Owner

By: _____

Title: _____

Date: _____

Authorized by Contractor

By: _____

Title: _____

Date: _____

Approved by Funding Agency

(if applicable)

END OF DOCUMENT

DOCUMENT 00_94_22

FIELD ORDER

Owner:	Weber Basin Water Conservancy	Owner's Project No.:	
Engineer:	District	Engineer's Project No.:	203356
	Carollo Engineers	Contractor's Project	
Contractor:		No.:	
Project:	Davis North Water Treatment Plant Solids Dewatering Improvement Project		
Contract			
Name:			
	Effective Date of Field		
Date Issued:	Order:		

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

Attachments:

Issued by Engineer

By: _____

Title: _____

Date: _____

END OF DOCUMENT

SECTION 01_11_00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Detailed description of the Work.

1.02 THE WORK

- A. The Work consists of:
 - 1. Demolition and rerouting of existing asphalt pavement, sidewalk and curb/gutter, yard piping, utilities and electrical ductbank to accommodate new thickened sludge pump and storage facilities.
 - a. Temporary electrical power and yard piping to keep existing gravity thickeners, thickened sludge feed pumps and centrifuges in service.
 - 2. Earthwork, including excavation and offsite disposal of soil, shoring and importation and placement of new engineering earthwork materials for structural base below new sludge pump station.
 - 3. Demolition of existing sludge feed pumps inside the existing Dewatering Building, new sludge manifold piping and connection of new thickened sludge feed piping from the new Sludge Pump Station.
 - a. A portion of the existing floor inside the truck load-out bay will be removed and replaced to install new thickened sludge feed, natural gas and utility water piping.
 - 4. Construction of a new sludge pump station, including the construction of cast-in-place concrete below grade foundation, and walls and deck. New thickened sludge feed and thickened sludge transfer pumps and associated piping, valves and field instruments will be installed inside the below-grade portion of the new structure. The above grade electrical room walls will be constructed of CMU masonry and house new motor control center and programmable logic equipment.
 - 5. Construction of a new Sludge Day Tank with 2 cells, including construction of below/above grade cast-in-place concrete foundation, walls and deck, and the installation of new vertical mixers, thickened sludge inlet/outlet, overflow box and vent piping, fittings, and associated field instruments and incidentals for complete and usable facility.
 - 6. Civil site work including asphalt pavement, curb and gutters and sidewalks.
 - 7. Equipment testing, Start-Up, and Commissioning of the Work.

1.03 LOCATION OF PROJECT

- A. The Work is located at Weber Basin Water Conservancy District, Davis North Water Treatment Plant, 2837 East Highway 193, Layton, Utah 84040.

1.04 ACTIVITIES BY OTHERS

- A. Activities by others which may affect performance of work include:
1. [.]
 2. [.]
 3. [.]

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_14_00
WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01_33_00 – Submittal Procedures:
 - 1. Baseline Schedule with MOP tasks.
 - 2. Method of Procedure (MOP) Form.
 - 3. Method of Procedure (MOP) Log.
 - 4. Progress Schedule with MOP tasks.
- B. Specific MOPs shall be submitted for Owner and Engineer consideration at least 4 weeks ahead of scheduled activity.

1.03 METHOD OF PROCEDURE (MOP)

- A. Comply with MOP Instructions as specified in Attachment A - Method of Procedure (MOP).
- B. Prepare MOP for the following conditions:
 - 1. Shutdowns, diversions, and tie-ins to the existing facility.
 - 2. Process start-up activities.
 - 3. Power interruption and tie-ins.
 - 4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
 - 5. Process constraints requiring interruption of operating processes or utilities.
- C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.
- D. Submit Baseline Schedule, as specified in Section 01_32_21 - Schedules and Reports with proposed MOPs.
- E. Submit MOP Log at construction progress meetings.
- F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

- G. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.04 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

- A. Plant access for Contractor will be provided at the Davis North Water Treatment Plant main entrance gate.
- B. Water projects:
 - 1. The Davis North Water Treatment Plant is the Owner's primary source of drinking water.
 - 2. Conduct Work such that the Owner's ability to meet its customer's demands for treated drinking water shall not be impaired or reduced in terms of the required quantity or quality of treated water. Do not impair the operational capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time.
 - 3. Conduct commissioning activities as specified in Section 01_75_17 - Commissioning in a manner that will not impair capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
 - 4. PCIS Optimization and Fine-Tuning as specified in Section 01_75_17 - Commissioning.
 - 5. The status of the treatment plant shall be defined as "operational" when the plant is capable of meeting the Owner's customer's demands for treated drinking water in terms of the required quantity or quality of treated water as defined in this Section.

1.05 COMPLIANCE WITH DRINKING WATER PERMIT

- A. The existing facility is operating under the terms of a Drinking Water permit issued by the State of Utah Division of Drinking Water.
 - 1. This permit specifies the water quality limits that the plant must meet prior to discharge of finished water.
 - 2. A copy of the existing permit is on file for review at the Davis North Water Treatment Plant.
- B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.
- C. Bear the cost of penalties imposed on the Owner for water quality violations caused by actions of the Contractor.
- D. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational.
- E. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.

1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.06 UTILITIES

- A. Provide advance notice to and utilize services of Blue Stake for location and marking of underground utilities operated by utility agencies other than the Owner.
- B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.
- C. New yard utilities were designed using existing facility drawings.
 1. Field verification of utilities locations was not performed during design.
 2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
 3. Pipe alignments as indicated on the Drawings.

1.07 WORK BY OTHERS

- A. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

1.08 SHUTDOWN CONSTRAINTS

- A. General shutdown constraints:
 1. Execute the Work while the existing facility is in operation.
 2. Most activities may be accomplished without a shutdown.
 3. Apply to activities of construction regardless of process or work area.
 4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
 5. Organize work to be completed in a minimum number of shutdowns.
 6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
 7. Shutdown MOPs:
 - a. Advise the Engineer a minimum of 4 weeks prior to need for any complete or partial plant shutdown for tie-ins.
 - b. Prepare and submit MOP to Engineer for any complete or partial plant shutdown required a minimum of 3 weeks prior to the shutdown.
 - c. Owner's written approval of MOP is required prior to beginning Work.
 8. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary piping, pumping, power, lighting, controls, instrumentation, and safety devices.
 9. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
 10. Owner maintains the ability to abort on the day of the scheduled shutdown.
 11. Unplanned shutdowns due to emergencies are not specified in this Section.
- B. Unit process availability work limitations:
 1. Shutdowns and tie-ins or other activities that disrupt plant operations are prohibited unless the following unit process availability conditions exist and unless otherwise approved in writing by the Owner and Engineer.

2. At a minimum, the following facilities must be in service before proceeding with a scheduled shutdown.
 - a. One Gravity Thickener and yard piping, including Thickener Effluent (TE), Thickened Sludge (TS), Drain (DR) and Sludge (SL) lines.
 - b. One existing thickened sludge feed pump One Dewatering Centrifuge.
 - c. The 36" FFW pipeline and at least One Settling Pond.
 - d. Truck Load Out Bay and haul truck road access in/out of Davis North WTP.
- C. Plant water system (UW2):
 1. Maximum shutdown duration: 2 hours.
 2. Temporary shutdowns of the plant water system at the existing Dewatering Building will be allowed to make piping connections.
- D. Solids dewatering systems, including gravity thickener splitter box, gravity thickeners, sludge feed pumps and centrifuges.
 1. Maximum shutdown duration: 2 days.
 2. Temporary shutdowns of the plant solids dewatering system will be allowed to make temporary and permanent piping connections.
- E. Existing Settling Ponds.
 1. Maximum shutdown duration: 18 hours (Summer) 36 hours (Winter).
 2. Several 6-hour period temporary shutdowns may be required to connect new Thickener Effluent (TE) from Gravity Thickener No. 2 to the existing 36" FFW pipeline. This tie-in impacts the plant and its ability to treat water as filters cannot be backwashed without the 36" FFW in service.
- F. The centrate, underdrain and recycle decant pump stations.
 1. Maximum shutdown duration: 2 hours.
 2. Temporary shutdowns will be allowed for temporary and permanent electrical power connections.
- G. Process, electrical and instrumentation - tie-in shutdowns:
 1. Maximum shutdown duration: 4 hours.
 2. Schedule no more than 1 tie-in shutdown per day.

1.09 WORK RESTRICTIONS

- A. Existing Pump Stations:
 1. Unless otherwise noted above, the existing pump stations shall remain in continuous service during construction.
 2. A temporary outage is necessary to provide temporary power to each pump station as the existing electrical ductbank from the Dewatering Building is relocated to accommodate excavation and construction of the new sludge pump station and sludge day tank.
 - a. Centrate Pump Station: This pump station must remain in operation during construction and be properly supported during excavation of the new Sludge Pump Station to ensure it or its valve box is not undermined or harmed in any way.
 - 1) This pump station may be taken offline outside of Davis North WTP normal operating hours when solids are not being dewatered.

- B. Existing Settling Ponds:
1. The existing settling ponds and 36-inch FWW inlet pipe must remain in operation during normal operating hours of the Davis North WTP.
 - a. To make piping modifications to the existing 36-inch FWW, the Contractor must schedule work with the Davis North WTP operations staff so work is performed between filter backwash cycles. This work must be completed between October and February when filter run times are longer.
- C. Yard piping:
1. The new Sludge Pump Station will be constructed first since it is located deeper in the ground than the new Sludge Day Tank.
 - a. The following existing pipelines must remain in service and be temporarily rerouted as the excavation and excavation shoring work for the new sludge pump station is completed:
 - 1) Six-inch TS - Thickened Solids (Typ of 2).
 - 2) One-inch NG - Natural Gas.
 - 3) Twelve-inch SL - Sludge Line.
 - 4) Six-inch DR – Drain
 - 5) Twelve-inch TE - Thickener Effluent
 - 6) Two-inch UW2 - Utility Water.
 - 7) Six-inch and 12-inch CN - Centrate.
 - b. Solids may be diverted between the 2 Gravity Thickeners where one can be taken offline at a time to make temporary or permanent yard piping improvements.
- D. Existing Gravity Thickeners and Splitter Box:
1. At least 1 Gravity Thickener must remain in service during construction. Wasted solids may be directed to either Gravity Thickener during construction via existing 12-inch SL pipelines.
 2. The existing gas-fired unit heater located inside the covered gravity thickener must be maintained in service through construction.
 3. It is recommended that Gravity Thickener 1 be exclusively used during construction to feed thickened solids to existing sludge feed pumps located inside the Dewatering Building.
 - a. Temporary 6-inch TS piping will be required to feed solids to existing sludge feed pumps in the Dewatering Building from Gravity Thickener 1.
 - b. Permanent or temporary 12-inch TE piping will be needed to route thickener effluent to the Recycle Decant Pump Station or to the settling ponds.
 - c. Temporary 12-inch DR piping will be needed to route gravity thickener drainage to the Recycle Decant Pump Station.
 - d. Temporary 1-inch NG piping will be needed for Gravity Thickener No. 1 to keep the existing gas-fired unit heater in operation through construction.
- E. New Sludge Pump Station:
1. Successful completion of functional testing of new sludge transfer and sludge feed pumps in the new Sludge Pump Station.
 - a. New Thickened Sludge Transfer Pumps can be tested/operated in a “Loop”, pumping to/from the new Sludge Day Tank at different pump flowrates to confirm pump performance.

- b. New Thickened Sludge Feed Pumps can be tested/operated using temporary piping directing pumped thickened sludge back to the Sludge Day Tank and/or used to feed thickened sludge to one of the three existing dewatering centrifuges.
 - 2. Provide temporary power if necessary and controls required to operate the new pumps if the new MCC-65 is delayed due to long lead times. Temporary power shall be constructed in accordance with the NEC and, at minimum, with capacity and means to run the following loads:
 - a. One 480-volt, 3 phase, 3 wire, VFD for the new 15 horsepower Thickened Sludge Feed Pump.
 - b. One 480-volt, 3 phase, 3 wire, VFD for the new 15 horsepower Thickened Sludge Feed Pump.
 - c. One 480-volt, 3 phase, 3 wire, 30-amp feeder breaker to power new In-line Sludge Grinder.
 - d. One 480-volt, 3 phase, 3 wire, 15-amp feeder breaker to power new Gravity Thickener Valve.
 - e. The VFDs shall be wired to run OFF/ON, in manual, or in automatic like the control schematic shown on contract drawing.
 - f. Contractor shall transfer the pumps to and from temporary power, one at a time.
- F. New Sludge Day Tank:
 - 1. Successful completion of hydraulic leak test and functional testing of new sludge holding tank prior to process operational period.
 - 2. Use of the new Sludge Day Tank prior to completion of the Sludge Pump Station may be approved by the Owner if the Contractor provides piping and valves or temporary pumps, piping, and valves to deliver sludge from the new sludge day tank to new Sludge Pump Station.
- G. Existing Dewatering Building:
 - 1. Existing dewatering system (with temporary yard piping) shall remain in service through construction, until the successful completion of process operational testing of the new Sludge Pump Station and Sludge Day Tank is completed.
 - a. Existing thickened sludge feed pumps shall remain in place until new pumps and MCC-65 are properly installed at the new sludge pump station and tested.
 - b. Existing inline sludge grinder shall remain in service until the new MCC-65 is installed at the new sludge pump station.
 - 2. Notify Owner at least 30 days in advance of decommissioning Work to begin removal of existing sludge feed pumps and in-line sludge grinder.
 - 3. A minimum of 1 existing centrifuge and associated thickened sludge feed pump shall remain in service at all times.
 - 4. Provide backup or temporary pumping and/or temporary power and controls to new thickened sludge feed pumps and drives to transfer sludge from the existing gravity thickeners to existing centrifuges as needed to complete the Work.
- H. Yard piping, electrical duct banks, and trenches:
 - 1. Provide continuous access to existing gravity thickeners, feed pumps, centrifuges, conveyors and solids load out in Truck Bay.

2. Provide 1 open fire lane where indicated on the Drawings, designed for H-20 loadings, at all times during construction.
- I. Provide safe, continuous access to process control equipment for plant operations and maintenance personnel.
- J. Piping:
 1. Provide temporary piping during construction for existing and new equipment to maintain plant operation in service during construction.
- K. Electrical:
 1. Provide temporary electrical conductors and conduits to keep existing gravity thickeners, centrate pump station, underdrain pump station and recycled decant pump station in service during rerouting of existing duct bank.
 2. Temporary power cables shall be diesel locomotives type and be protected in above ground rigid conduits during the installation of new duct bank.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - METHOD OF PROCEDURE (MOP)

“METHOD OF PROCEDURE” (MOP)

Instructions and Forms

Definition and Purpose

“Method of Procedure” (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	No later than 7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	No later than 7 days prior to work
Contractor	6. Complete Readiness Checklist.	No later than 5 days prior to work
Contractor	7. Complete Safety Checklist.	Immediately prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submits 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in Contract Documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the Work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete Work.

Contractor completes Work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

ATTACHMENT B - METHOD OF PROCEDURE (MOP) FORM



METHOD OF PROCEDURE (MOP) FORM

Owner: _____ Date: _____
Contractor: _____ Carollo Project No.: _____
Project Name: _____ Submittal No.: _____
Submittal Title: _____ Spec/Drawing. Ref.: _____

MOP #:	TASK TITLE: (Provide <10 word title)	SUBMITTAL DATE: (No later than 28 days prior to work)			
SCHEDULE OF WORK ACTIVITY: START: (Date/Time) _____ END: (Date/Time) _____					
REQUESTOR: _____					
PRIMARY POINT OF CONTACT:		PHONE/PAGER: _____			
SECONDARY POINT OF CONTACT:		PHONE/PAGER: _____			
NOTIFY:	☐ Control Room, Phone: _____	☐ Security, Phone: _____			
BUILDING: _____		LOCATION OF WORK FLOOR/LEVEL: _____			
DESCRIPTION OF WORK: (Provide sufficient details on process isolation, work sequencing, and safety (i.e. control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)					
Task Summary: _____					
Processes Affected: _____					
Trades Affected: _____					
WORK PLAN:					
Work Sequencing: _____					
Process Isolation: _____					
Spill Prevention Plan: _____					
Contingency Plans: _____					
CRITICAL EQUIPMENT / TOOLS: (Pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)					
☐	Acoustic Ceiling/or Walls Access	☐	Excavation Permit	☐	Lock Out/Tag Out
☐	Chemical Use Approval	☐	Fire Sprinkler Impairment	☐	Life Safety Systems
☐	Confined Space Permit	☐	Flammable Materials	☐	Roof Protocol
☐	Critical Lift Plan	☐	Flush / Discharge	☐	Work After Dark
☐	Energized Electrical Work	☐	High Pressure Test	☐	
☐	Elect. Panel Schedules	☐	Hot Work/Open Flame	☐	

Work Restrictions

01_14_00-Attachment B-1

203356

June 2025

pw://Carollo/Documents/UT/WBWC/203356-100000/04 Design/04 Specs/Carollo/01_14_00 (BidSet)

EXISTING SERVICE(S) AT RISK:							
☐	Breathing Air	☐	Elect Normal	☐	Process Access	☐	Telephones
☐	Chemical Distribution	☐	Fire Protection	☐	Safety Showers	☐	UPS
☐	City Water	☐	HVAC	☐	SCADA	☐	VAX/DATA
☐	Communication	☐	Inert Gas	☐	Security	☐	
☐	Domestic Drain	☐	Instrument - Air	☐	Solvent Drain	☐	
☐	Elect-Bus Duct	☐	Life Safety System	☐	Specialty Gases	☐	
☐	Elect. Emergency	☐	Natural Gas	☐	Storm Drain	☐	
REVIEWER'S INSTRUCTIONS/COMMENTS: _____							
☐	PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:						
	Full Name (printed)	Signature	Phone	Date			
Submitted By							
System Owner							
Reviewer (if needed)							
Reviewer (if needed)							
Reviewer (if needed)							
Reviewer (if needed)							

ATTACHMENT C - READINESS CHECKLIST

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____

2. Review work plan: _____

3. Review contingency plan: _____

ATTACHMENT D - SAFETY CHECKLIST

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
 - a. Emergency exits: _____
 - b. Emergency shower and eyewash: _____
 - c. Telephones and phone numbers: _____
 - d. Shut-off valve: _____
 - e. Electrical disconnects: _____
2. Inspect work area:
 - a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
 - a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/Tagout Procedure:
 - a. Lockout/tagout energy sources before beginning work.
 - b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
 - c. Make sure the lines are depressurized.
5. Overhead work:
 - a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
 - b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
 - c. Spotter assigned and in position.
 - d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
 - a. Shepherd's hook.
 - b. ARC flash protection.
 - c. Fire extinguisher.
 - d. Other: _____
7. Accidents:
 - a. Should accidents occur, do not shut off and do not attempt to correct the situation unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
 - a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
 - a. Do not obstruct evacuation routes.
 - b. Take time to survey the area for evacuation routes.

ATTACHMENT E - METHOD OF PROCEDURE (MOP) LOG

METHOD OF PROCEDURE (MOP) LOG
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (Yes/No)
001					
002					
003					

SECTION 01_20_20
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Procedures for measurement and payment of Work under this Contract for lump sum items and unit prices.

1.02 LUMP SUM ITEMS

- A. Item 1: Lump Sum Base Bid:
 - 1. Measurement:
 - a. Includes all costs as described in the Contract Documents, excluding bid items 2 and 3.
 - 2. Payment:
 - a. Lump sum.
 - b. Paid as work is completed per Section 01_29_73 - Schedule of Values.
- B. Item 2: Allowances.
 - 1. Measurement:
 - a. Per Section 01_21_00 - Allowances.
 - 2. Payment:
 - a. Lump sum.

1.03 UNIT PRICE ITEMS

- A. No Work items are to be paid under a unit price payment approach.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_21_00

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Listing of allowance items:
 - a. Related responsibilities of Contractor and procedures.

1.02 ALLOWANCE AMOUNTS

- A. Include following amounts in Contract Price:
 - 1. \$20,000 for Layton City building permit where the Contractor is responsible for preparing and submitting plans and specifications to the City Building Department to obtain a Building Permit for the Project. The Contractor will be the Permittee. .

1.03 ADJUSTMENT OF COSTS

- A. When actual cost is more or less than amount of allowance, Contract Price will be adjusted by Change Order.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_29_73
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for preparation, format, and submittal of Schedule of Values.

1.02 PREPARATION

- A. Schedule of Values shall be a listing of all on-site construction activities from the progress schedule, listed in numerical order, showing that the sum total of all activities equal the Contract value.
- B. When the schedule is changed or revised to include added or deleted work, the Schedule of Values shall also be revised such that the sum total of all activities continuously equal the current Contract value.
 - 1. Equate the aggregate of these costs to the Lump Sum Contract Price.
- C. Prepare Schedule of Values identifying costs of Major Items of Work as indicated below:
 - 1. Mobilization: Mobilization work as defined in Section 01_11_00 - Summary of Work. No breakdown is required but amount cannot exceed 2 percent of the Contract Price.
 - 2. Allowances: List each allowance items as described in Section 01_21_00 - Allowances.
 - 3. Schedules and Report Work Items as described in Section 01_32_21 - Schedules and Reports.
 - 4. Submittal Work.
 - 5. Demolition Work.
 - 6. Earthwork Work Items shall be itemized by excavation and temporary excavation support as specified in Section 31_50_00 - Excavation Support and Protection.
 - 7. Civil Work Items
 - 8. Yard Piping Work Items shall be itemized between temporary and permanent systems.
 - 9. Architectural Work Items.
 - 10. Structural Work Items shall be broken down per structure and include foundation, slabs on grade, wall/columns, suspended slabs/decks and equipment pads. Structural Work Items shall include roof joists and metal decking.
 - 11. Mechanical Work Items shall be itemized by structure, equipment and equipment installation.
 - 12. Building Systems Work Items shall be itemized by plumbing and HVAC mechanical systems and itemized per structure and include balancing and testing and commissioning.

13. Protective Coating Work Items.
14. Electrical Work Items shall be itemized per structure and further itemized by motor control centers, power distribution panels, yard facilities, conduit and raceway, cable and wire installation, lighting and electrical equipment installation.
15. The Instrumentation and Control Work shall be broken down between programming/integration and by structure.
 - a. Structures Instrumentation and Control Work Items shall be further itemized by field instruments, wiring and commissioning.
 - b. Programming/Integration Work Items shall be further itemized by SCADA Programming, PLC factory testing, programming and commissioning.
16. Commissioning Work Items. The sum of all commissioning work shall exceed 1 percent of the Contract Price.

1.03 SUBMITTALS

- A. Submit Schedule of Values for the Preliminary Schedule as specified in Section 01_32_21 - Schedules and Reports.
- B. Submit a detailed Schedule of Values no less than 2 weeks before the second pay request.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_29_77

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Procedures for preparation and submittal of Applications for Payment.
- B. Acceptance of a Baseline Schedule of Values or Baseline Project Schedule (if cost-loaded) is a condition precedent to making payment after the first 90 calendar days after the Notice to Proceed.

1.02 FORMAT

- A. Use the Contractor's Application for Payment in Section 00_62_77 - Contractor's Application for Payment. Complete this spreadsheet-type form by inserting costs items for the accepted/approved Schedule of Value or downloaded cost data from the accepted/approved Progress Schedule if cost-loaded.
 - 1. Submit payment requests and attach spreadsheet with cost data related to Progress Schedule.
- B. Fill in information required on form.
- C. When Change Orders are executed, add Change Orders at end of listing of scheduled activities:
 - 1. Identify change order by number and description.
 - 2. Provide cost of change order in appropriate column.
- D. After completing, submit Application for Payment.
- E. Engineer will review application for accuracy. When accurate, Engineer will transmit application to Owner for processing of payment.
- F. Execute application with signature of responsible officer of Contractor.

1.03 SUBSTANTIATING DATA

- A. Provide Substantiating Data identifying:
 - 1. Project.
 - 2. Application number and date.
 - 3. Cost flow summary.
 - 4. Updated schedule of values.
 - 5. Progress schedule.
 - 6. Detailed list of enclosures.
 - 7. Stored products log.
 - 8. Equipment log.
 - 9. Submit "certified" payroll, if applicable.

10. Record (as-built) documents.
11. Photos and videos from current pay period.
12. Applicable unconditional waiver and release on progress payment for previous payment made by Owner.

1.04 SUBMITTALS

- A. Submit Application for Payment and Substantiating Data with cover letter.

1.05 PAYMENT REQUESTS

- A. Prepare progress payment requests on a monthly basis. Base requests on the breakdowns of costs for each scheduled activity and the percentage of completion for each activity.
- B. Indicate total dollar amount of work planned for every month of the project. Equate sum of monthly amounts to Lump Sum Contract Price.
- C. Generate Progress Payment request forms by downloading cost data from the schedule information to a spreadsheet type format if using a cost-loaded progress schedule.
- D. If using a cost-loaded progress schedule, identify each activity on the Progress Schedule that has a cost associated with it, the cost for each activity, the estimated percent complete for each activity, and the value of work completed for both the payment period and job to date.
- E. Prepare summary of cost information for each Major Item of Work listed in the Schedule of Values. Identify the value of work completed for both the payment period and job to date.
- F. Payment period:
 1. Monthly Application for Payment period shall begin on the 1st day of each month, and end on the last day of each month.
 2. Submit Application for Payment to Engineer no later than the 5th day of each month for work completed the previous month.
 3. Engineer will finalize and submit recommendation for Application for Payment to Owner by the 15th day of each month to allow time for processing and approval.

1.06 COST SUMMARIES

- A. Prepare Summary of Cost Information for each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.
- B. Cash flow summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_31_19
PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest.

1. The Work includes the following project meetings:
 - a. Qualifications of Meeting Participants.
 - b. Basic Meeting Requirements.
 - c. Pre-construction Conference.
 - d. Pre-construction Safety Conference.
 - e. Pre-submittal Conference.
 - f. Web Based Construction Document Management Software Training.
 - g. Progress Meetings.
 - h. Schedule Update Meetings.
 - i. Quality Control Meetings.
 - j. Pre-Installation Meetings.
 - k. Maintenance of Plant Operations (MOPO) Meetings.
 - l. Commissioning Coordination Meetings.
 - m. Instrumentation and Control Coordination Meetings.
 - n. Close-out Meeting.
 - o. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

- A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.03 BASIC MEETING REQUIREMENTS

- A. Attendees:
 1. Meeting leader shall require attendance of parties directly affecting, or affected by, Work being discussed at the meeting.
- B. Location:
 1. In location convenient for most invitees which may include virtual meeting using Microsoft Teams™ software when needed participants cannot all meet in person.
- C. Notification:
 1. Meeting leader shall notify attendees of meeting, including an agenda, a minimum of 7 days prior to meeting.

- D. Agenda:
 - 1. Meeting leader shall prepare copies of the agenda for participants and distribute at the meeting.
 - 2. Minimum requirements:
 - a. Meeting purpose.
 - b. Review minutes of previous meeting.
 - c. Safety and security.
 - d. Discuss issues.
 - e. Action items.
 - f. Next meeting.
- E. Meeting minutes:
 - 1. Meeting leader shall prepare draft minutes and send to attendees for comment within 7 days.
 - 2. Meeting leader shall incorporate comments from attendees and submit final meeting minutes to attendees within 7 days of receipt of comments.

1.04 PRE-CONSTRUCTION CONFERENCE

- A. **The Owner** leads the meeting.
- B. Timing:
 - 1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.
- C. Required attendees:
 - 1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to the agenda.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. To establish working understanding between parties and to discuss Construction Schedule, Shop Drawings and other Submittals, cost breakdown of major lump sum items, processing of Submittals and applications for payment, and other subjects pertinent to execution of the Work.
 - 2. Adequacy of distribution of Contract Documents.
 - 3. Distribution and discussion of list of major subcontractors and suppliers.
 - 4. Proposed progress schedules and critical construction sequencing.
 - 5. Major equipment deliveries and priorities.
 - 6. Project coordination.
 - 7. Designation of responsible personnel.
 - 8. Procedures and processing of:
 - a. Field decisions.
 - b. Proposal requests.
 - c. Submittals - separate meeting.
 - d. Change Orders.
 - e. Request for Information/Interpretations.
 - f. Applications for Payment.
 - g. Record documents.

9. Use of premises:
 - a. Office, construction, and storage areas.
 - b. Owner's requirements.
10. Construction facilities, controls, and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Security procedures.
14. Housekeeping procedures.
15. Safety and security.
16. Review proposed photographer Submittal.
17. Action items.
18. Next meeting.

1.05 PRE-CONSTRUCTION SCHEDULING MEETING

- A. The Owner leads the meeting.
- B. Timing:
 1. Within 7 days of Notice to Proceed, or earlier when mutually agreeable.
- C. Required attendees:
 1. Contractor's project manager, superintendent, scheduler, Owner, Engineer, and others necessary to the agenda.
- D. Agenda minimum requirements:
 1. Meeting purpose:
 - a. To establish the format and features of the Construction Schedule.
 2. Schedule preparation.
 3. Reporting requirements.
 4. Updates and revision procedures.
 5. Schedule delay analysis procedures.
 6. Schedule methodology.
 7. Planned sequence of operations.
 8. Cost and labor loading methodology (if cost-loaded project schedule is used).
 9. Proposed activity coding structure as specified in Section 01_32_21 - Schedules and Reports.
 10. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule.
 - a. Example 1: 2021_07_30 rev 1 draft baseline schedule.xer.
 - b. Example 2: 2021_09_30 rev 2 sep final update.xer.
 11. Action items.
 12. Next meeting.

1.06 PRE-CONSTRUCTION SAFETY CONFERENCE

- A. The Owner leads the meeting.
- B. Timing:
 1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

- C. Required attendees:
 - 1. Contractor's project manager, safety representative, and superintendent; Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to the agenda.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. To establish safety procedures and identify lead participants.
 - 2. Review minutes of previous meeting.
 - 3. Safety and first aid procedures.
 - 4. Review of Experience Modification Rating for Contractor and each Subcontractor.
 - 5. Security procedures.
 - 6. Housekeeping procedures.
 - 7. Safety and security.
 - 8. Action items.
 - 9. Next meeting.

1.07 PRE-SUBMITTAL CONFERENCE

- A. The Owner leads the meeting.
- B. Timing:
 - 1. Prior to producing any Submittals.
- C. Required attendees:
 - 1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors, individual equipment manufacturers furnishing major pieces of equipment, and others involved in performance of the Work, and others necessary to the agenda.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. Review the entire Project, equipment, control philosophy, schedules, and Submittal requirements.
 - b. Awareness of requirements by major subcontractors, major suppliers, and major equipment manufacturers.
 - c. Format and procedures for Submittals.
 - d. Review of the master Submittal schedule.
 - 2. Review equipment list.
 - 3. Review Submittal schedule.
 - 4. Format of Submittals.
 - 5. Procedures and processing of Submittals.
 - a. Review turn-around time.
 - 6. Discuss specific electrical and instrumentation and controls Submittal requirements.
 - 7. Safety and security.
 - 8. Action items.
 - 9. Next meeting.

1.08 WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT SOFTWARE TRAINING

- A. Contractor can submit a written request to the Engineer to waive the training based on staff having sufficient familiarity with the software and its complete usage. Engineer will lead the meeting.
- B. Timing:
 - 1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable,
 - 2. Duration minimum: 2 hours.
- C. Required attendees:
 - 1. Mandatory attendance.
 - a. Contractor's project manager.
 - b. Contractor's field superintendent.
 - c. Contractor's project engineer.
 - 2. Other attendees:
 - a. Owner, Engineer, Contractor's quality control manager, Contractor's project scheduler and any other persons involved with preparing and transmitting documents.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. Train construction team on the use of the web based document management system software.
 - 2. Safety.
 - 3. General Items.
 - 4. Contractor functions.
 - 5. Owner functions.
 - 6. Engineer functions.
 - 7. Action items.

1.09 PROGRESS MEETINGS

- A. The Owner will lead these meetings.
- B. Timing:
 - 1. Hold meetings throughout progress of the Work at maximum bi-weekly intervals.
- C. Required attendees:
 - 1. Owner, Engineer, Contractor, Contractor's project manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to the agenda topics for each meeting.
 - 2. Additional invitees:
 - a. Owner utility companies when the Work affects their interests, and others necessary to the agenda.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. Provide the status of the Work.
 - 2. Review minutes of previous meeting.

3. Safety and security.
4. Construction schedule summary.
5. Review of 6 weeks schedule.
 - a. Contractor shall provide printed hard copies for each attendee.
6. Review of off-site fabrication and delivery schedules.
7. Review of Submittals schedule and status of Submittals.
8. Request for information (RFI's) status.
9. MOP's/shutdown coordination.
10. Change order management status.
11. Maintenance of quality standards (QA/QC).
12. Field observations, problems, and conflicts.
13. Commissioning.
14. Partnering recognition status (optional).
15. General items.
16. Action items.
17. Next meeting.

1.10 SCHEDULE UPDATE MEETINGS

- A. Contractor leads the meeting.
- B. Timing:
 1. Hold meetings throughout progress of the Work at maximum monthly intervals.
- C. Required attendees:
 1. Owner, Engineer, Contractor, Contractor's project manager, general superintendent, project scheduler, major subcontractors and suppliers as appropriate to the agenda topics for each meeting.
 2. Additional invitees:
 - a. Owner utility companies when the Work affects their interests and others necessary to the agenda.
- D. Agenda minimum requirements:
 1. Meeting purpose:
 - a. Identify and troubleshoot scheduling issues in a collaborative environment.
 - b. Provide further detail on Work status.
 2. Review minutes of previous meeting.
 3. Review Monthly Schedule, (Actual Progress and Variance).
 - a. "Activities Started/Completed" this period.
 - b. "Activities Started/Completed" "Variance" Baseline vs. current.
 - c. "Added/Deleted Activities".
 - d. "Revised Activity Descriptions".
 - e. Any significant Proposed Logic Changes.
 4. Review milestone "Substantial Completion" Schedule:
 - a. "Critical" Activities - "Critical Area, Float and Vital Statistics".
 5. Review "Cumulative and Monthly Costs" graph.
 6. Review "Budgeted Cost" indicating the Current Project Budgeted Cost.
 7. Safety and security.
 8. Action items.
 9. Next meeting.

1.11 PRE-INSTALLATION MEETINGS

- A. Contractor leads the meeting.
- B. Timing:
 - 1. When specified in Technical Sections or requested by Engineer, before commencing Work of specific section.
- C. Required attendees:
 - 1. Owner, Engineer, Contractor, Contractor's project manager, general superintendent, project scheduler, major subcontractors including electrical instrumentation, and suppliers as appropriate to the agenda topics for each meeting.
 - 2. Additional invitees:
 - a. Owner utility companies when the Work affects their interests and others necessary to the agenda.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. Review conditions of installation, preparation, and installation procedures.
 - b. Review coordination with related work.
 - 2. Review minutes of previous meeting.
 - 3. Safety and security.
 - 4. Action items.
 - 5. Next meeting.

1.12 PRE-SHUTDOWN MEETINGS

- A. Contractor leads the meeting.
- B. Timing:
 - 1. Short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP require a pre-shutdown meeting at Project site at least 3 working days prior to commencing shutdown for tie-in or modification of specific plant systems.
- C. Required attendees:
 - 1. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.
- D. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. Review conditions of installation, preparation, and installation procedures.
 - b. Review coordination with related work.
 - 2. Review minutes of previous meeting.
 - 3. Review accepted Construction Method of Procedure (MOP), as specified in Attachment A of Section 01_14_00 - Work Restrictions, including conditions of shutdown, preparation, and installation procedures.
 - 4. Review timelines and sequences.
 - 5. Review responsibilities.

6. Review dry run plan and schedule, as necessary.
7. Review coordination with related work.
8. Safety and security.
9. Action items.
10. Next meeting.

1.13 QUALITY CONTROL MEETINGS

- A. Contractor leads the meeting.
- B. Timing:
 1. Hold meetings throughout progress of the Work at maximum monthly intervals.
- C. Required attendees:
 1. Engineer, Construction manager and staff, Contractor's quality control manager, and staff.
- D. Agenda minimum requirements:
 1. Meeting purpose:
 - a. Update Contractor's efforts to comply with quality requirements in the Contract Documents.
 2. Review minutes of previous meeting.
 3. Review of Work progress and schedule.
 4. Review of out-of-compliance inspection or test results.
 5. Field observations, problems, and decisions.
 6. Review of offsite fabrication and delivery schedules.
 7. Planned progress during succeeding work period.
 8. Coordination of required inspections and tests.
 9. Review 6-week schedule report with upcoming inspections and special tests.
 10. Maintenance of quality and work standards.
 11. Other business relating to Work.
 12. Safety and security.
 13. Action items.
 14. Next meeting.

1.14 COMMISSIONING COORDINATION MEETINGS

- A. Contractor leads the meeting.
- B. Timing:
 1. Separate commissioning coordination meetings will be scheduled as required by the Engineer.
- C. Required attendees:
 1. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, Commissioning Coordinator, specific work crews, Owner's operations, and maintenance staff.
- D. Agenda minimum requirements:
 1. Meeting purpose:
 - a. Coordinate commissioning activities.

2. Review minutes of previous meeting.
3. Review Commissioning schedule.
4. Review Owner Training schedule.
5. Review test plans.
6. Review accepted Construction Method of Procedure (MOP), as specified in Attachment A of Section 01_14_00 - Work Restrictions.
7. Owner makes final decision for commissioning GO or NO GO.
8. Safety and security.
9. Action items.
10. Next meeting.

1.15 INSTRUMENTATION AND CONTROL COORDINATION MEETINGS

- A. Meetings and conferences as specified in Section 40_61_00 - Common Work Results for Process Control and Instrumentation Systems.

1.16 CLOSE-OUT MEETING

- A. The Owner leads the meeting.
- B. Timing:
 1. After punch list items are completed.
- C. Required attendees:
 1. Owner, Engineer, Contractor, Contractor's project manager, and superintendent.
- D. Agenda minimum requirements:
 1. Meeting purpose:
 - a. Coordinate close-out activities.
 2. Review minutes of previous meeting.
 3. Review punch list completion.
 4. Transfer of record documents.
 5. Finalize payment.
 6. Safety and security.
 7. Action items.
 8. Next meeting.

1.17 POST CONSTRUCTION MEETING

- A. The Owner leads the meeting.
- B. Timing:
 1. About 11 months after date of Substantial Completion.
- C. Location:
 1. Meet in Owner's office or other mutually agreed upon place.

- D. Required attendees:
 - 1. Engineer, Contractor, appropriate manufacturers, and installers of major units of constructions, affected Subcontractors, and Owner's operations and maintenance staff.
- E. Agenda minimum requirements:
 - 1. Meeting purpose:
 - a. Review Project for compliance with the Contract Documents.
 - 2. Inspect the Work and draft list of items to be completed or corrected.
 - 3. Review service and maintenance contracts and take appropriate corrective action when necessary.
 - 4. Complete or correct defective work and may extend correction period.
 - 5. Safety and security.
 - 6. Action items.
 - 7. Next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_31_24

WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for web-based construction document management.

1.02 REQUIREMENTS

- A. Owner, Engineer, construction manager, and Contractor shall utilize the specified Autodesk Build, web-based construction management software, for submission of data and documents.
 - 1. Web-based construction management software is available at no cost to the Contractor's personnel, subcontractor personnel, Suppliers, consultants, the Owner, construction manager, and the Engineer.
 - 2. Joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of the Contract Documentation.
 - 3. Web based construction management software shall be the primary means of project information submission and management.

1.03 USER ACCESS LIMITATIONS

- A. Provide a list of the Contractor's key web based construction management software personnel for the Engineer's acceptance.
- B. Engineer reserves the right to perform a security check on potential users.
 - 1. Contractor will be allowed to add additional personnel and subcontractors to the web-based construction management software.
 - 2. Subcontractors and Suppliers will be given access to web-based construction management software by and through the Contractor.
 - 3. Contractor is responsible for adding and removing users from the system after the initial setup by the Engineer.
- C. Engineer will grant initial access to the web-based construction management software by creating user profiles to accepted Contractor personnel.
 - 1. User profiles will define levels of access into the system; determine assigned function based authorizations and user privileges.

1.04 JOINT OWNERSHIP OF DATA

- A. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the web-based construction management software system) by the Engineer and the Contractor will be jointly owned.

1.05 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

- A. Review comments made (or lack thereof) by the Owner on Contractor-submitted documentation shall not relieve the Contractor from compliance with requirements of the Contract Documents.
- B. Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents.
- C. Owner's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

1.06 COMPUTER REQUIREMENTS

- A. Use computer hardware and software that meets the requirements of the web-based construction management software system as recommended by the web-based construction management software to access and utilize the web-based construction management software.
- B. As recommendations are modified by the web-based construction management software, the Contractor will upgrade their system(s) to meet or exceed the recommendations.
 - 1. Upgrading of the Contractor's computer systems will not be justification for a cost or time modification to the Contract.
- C. Ensure that connectivity to the web-based construction management software system is accomplished through DSL, cable, T-1 or wireless communications systems.
 - 1. Minimum bandwidth requirements for using the system is 5 Mbps. It is recommended a faster connection be used when uploading pictures and files into the system.
- D. Web-based construction management software supports the current version of Chrome (preferred), Mozilla's Firefox, Microsoft Edge, and Apple's Safari on a rolling basis.
 - 1. Each time a new version of one of these browsers is released, the web-based construction management software will begin supporting the update and stop supporting the fourth-oldest version.

1.07 CONTRACTOR RESPONSIBILITY

- A. Responsible for the validity of their information placed in the web-based construction management software and for the abilities of their personnel.
- B. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on the web-based construction management software shall be the responsibility of the Contractor.
- C. Accepted users shall be knowledgeable in the use of computers, including Internet browsers, email programs, CAD drawing applications, and Adobe Portable Document Format (PDF) document distribution program.

- D. Utilize the existing forms in the web-based construction management software to the maximum extent possible. If a form does not exist in the web-based construction management software, the Contractor must include a form of their own or one provided by the Engineer as an attachment to a Submittal.
- E. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. Contractor is responsible for the training of their personnel in the use of the web-based construction management software (outside what is provided by the Owner) and the other programs indicated above as needed.

1.08 TRAINING

- A. Owner has arranged and paid for web-based training on using web-based construction management software for the Contractor.
- B. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate the Contractor's training.

PART 2 PRODUCTS

2.01 DESCRIPTION

- A. Web-based construction management software provided by Autodesk Build.

PART 3 EXECUTION

3.01 WEB-BASED CONSTRUCTION MANAGEMENT SOFTWARE UTILIZATION

- A. Web-based construction management software shall be utilized in connection with all document and information management required by these Contract Documents.

3.02 SUBMITTALS

- A. Use the web-based construction management software feature for Master Submittals List.
 - 1. Select from the predefined submittals list.
- B. Content: As specified in Section 01_33_00 - Submittal Procedures.
- C. Format: As specified in Section 01_33_00 - Submittal Procedures.
- D. Submit Portable Document Format (PDF) documents to the web-based construction management software submittal workflow process and forms.
 - 1. Consolidate electronic format submittals with multiple pages into a single file.
- E. Hardcopy Submittals:
 - 1. Provide 3 hard copies of Submittals within 14 days of the Submittal being closed.

2. Hardcopy requirements as specified in Section 01_33_00 - Submittal Procedures.
- F. Samples:
1. Enter Submittal data information into the web-based construction management software.
 2. Attach a copy of the Submittal form(s) to the sample.
- G. Record and closeout Submittals:
1. Operation and maintenance data as specified in Section 01_78_24 - Operation and Maintenance Manuals.
 2. Extra materials, spare parts, etc.

3.03 REQUESTS FOR INFORMATION/INTERPRETATION (RFI)

- A. Use web-based construction management software for RFIs as specified in Section 01_26_00 - Contract Modification Procedures.

3.04 OFFICIAL CORRESPONDENCE

- A. Use web-based construction management software for memos, notices, change proposals, or any official correspondence.

3.05 INSPECTION REQUESTS

- A. Use web-based construction management software to request inspection for a portion of Work that is ready for inspection and prior to covering up the Work.

3.06 FINANCIAL SUBMITTALS

- A. Use web-based construction management software for financial Submittals as specified in Section 01_33_00 - Submittal Procedures.

3.07 OTHER

- A. Use web-based construction management software for daily reports, meeting agendas and minutes, and other construction documents.

END OF SECTION

SECTION 01_32_21
SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Schedules and reports.
- B. Cost-loading the project schedule is optional.

1.02 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Baseline schedule: A planned and approved timetable projection that illustrates the project execution strategy, key deliverables, planned activity dates and milestones.
 - 2. Critical path: The longest sequence of dependent tasks in a project.
 - 3. Near critical path: The longest path after the critical path.
 - 4. Weather day: The Contractor being prevented or inhibited from performing at least 4 hours of work on the critical path due to weather conditions.

1.03 SCHEDULING FORMAT

- A. Utilize critical path method (CPM) format.
- B. Provide a cost and labor loaded Schedule.
- C. Engineer approval of the format is required.

1.04 SCHEDULING HARDWARE AND SOFTWARE

- A. Prepare computerized schedule utilizing the most current version of Oracle Primavera P6, Asta Powerproject or Microsoft Project.
- B. Contractor and Engineer must agree on the format.

1.05 SCHEDULE PREPARATION

- A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints.
- B. All costs associated with Schedule requirements are included in the Contract Price.
- C. During preparation of the preliminary Progress Schedule, the Engineer will facilitate Contractor's efforts by answering questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

- D. Prepare Schedule utilizing precedence diagramming method (PDM).
- E. Prepare Schedule utilizing activity durations in terms of working days.
 - 1. Do not exceed a 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries.
 - 2. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.
 - 3. Coordinate holidays to be observed with the Owner and incorporate them into the Schedule as non-working days.
- F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract.
 - 1. Contract requirements are not waived by failure of Contractor to include required Schedule constraints, sequences, or milestones in Schedule.
 - 2. Contract requirements are not waived by Owner's acceptance of the Schedule. In the event of conflict between accepted Schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.
- G. Reference Schedule to working days beginning with Notice to Proceed as Contract Time as Day "1".
- H. Baseline Schedule and project completion:
 - 1. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor's Schedule completion date.
 - 2. Adjust accordingly any Contract milestone dates.
- I. Imposed dates and hidden logic are prohibited.
- J. Interim milestone dates, operational constraints:
 - 1. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on Schedule.
 - 2. Do not use zero total float constraint or mandatory finish date on such Contract requirements.
- K. Contract float is for the mutual benefit of both Owner and Contractor.
 - 1. Changes to the Project that can be accomplished within this available period of float may be made by Owner without extending the Contract Time by utilizing float.
 - 2. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date.
 - 3. Likewise, Contractor may utilize float to offset delays other than delays caused by the Owner.
 - 4. Mutual use of float can continue until all available float shown by Schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract Time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.

5. Non-sequestering of float: Pursuant to float sharing requirements of Contract, Schedule submittals can be rejected for use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations, or imposed dates.
- L. Resource loading and leveling:
 1. Input labor data on each schedule activity.
 2. Manpower data consists of the man-hours estimated to perform each task, categorized by trade.
 3. Provide leveled manpower requirements.
 - a. Availability of the resources drive activity duration.
- M. Cost loading (If used): All schedules:
 1. Only on-site construction activities.
 2. The sum total of all cost loaded activities equal to the current value of the Contract, including change orders, at all times.
 3. Payment for mobilization or payment for materials or equipment delivered to the site, not yet incorporated into the Work.
 4. Owner acceptance of the Baseline Schedule creates the Schedule of Values required as specified in Section 01_29_73 - Schedule of Values.
 5. Provide updated Schedule of Values as the monthly Payment Application as specified in Section 01_29_77 - Applications for Payment.
 6. Payments will not be made until the updated Schedule of Values is accepted.
- N. Schedule logic:
 1. Assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment.
 2. Form basis for assembly of schedule logic on the following criteria:
 - a. Which activities must be completed before subsequent activities can be started?
 - b. Which activities can be performed concurrently?
 - c. Which activities must be started immediately following completed activities?
 - d. What major facility, equipment, or manpower restrictions are required for sequencing these activities?
- O. Major subcontractor, parallel prime contractor sign off:
 1. Provide written confirmation of concurrence from all major subcontractors and independent prime contractors on site with all Schedule submittals.
 2. Term "major subcontractor" as used in this Section means any subcontractor, at any tier, with a subcontract worth 5 percent or more of the total cost of the Work.

1.06 SCHEDULER

- A. Designate, in writing within 5 calendar days after Notice of Award, the person responsible for preparation, maintenance, updating, and revision of all schedules.
- B. Scheduler shall have the authority to update Schedule on behalf of the Contractor.

- C. Qualifications:
 - 1. A minimum of 5 years' verifiable experience in preparation of construction schedules for projects of similar value, size, and complexity.
 - 2. Knowledge of critical path method (CPM) scheduling utilizing the specified software.

1.07 SUBMITTAL REQUIREMENTS

- A. Preliminary and Baseline Progress Schedule.
- B. Preliminary and Baseline Schedule of Values.
- C. Preliminary and Baseline Schedule of Submittals.
- D. On a monthly basis, updated Schedules as specified.
- E. Final Schedules update as specified.
- F. Revised Schedules and time impact analyses as specified.
- G. Submit Schedules in the media and number of copies as follows:
 - 1. PDF format and in other formats specified in this Section.
 - 2. Two sets of CPM Schedule data electronic files in a native backed-up file format.

1.08 GANTT CHART

- A. Produce a clear, legible, and accurate calendar based, time scaled, and graphical network diagram.
 - 1. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.
- B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.
- C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished.
 - 1. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.
- D. Provide Progress Schedule showing the critical path for the Project.
- E. Provide report of Near Critical Path activities for the Project, when required by the Engineer.
- F. Delineate the specified Contract Times and identify the planned completion of the Work as a milestone.
 - 1. Show the time period between the planned and Contract completion dates, if any, as an activity identified as Project float.

- G. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion dates as milestones.
- H. Include, in addition to construction activities:
 - 1. Submission dates and review periods for major equipment submittals and excavation shoring submittals, and indicator pile program:
 - a. Excavation Shoring reviews: Allow 4-week review period for each shoring submittal.
 - 2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
 - 3. Equipment and long-lead material deliveries over 8 weeks.
 - 4. Approvals required by regulatory agencies or other third parties.
- I. Produce electronic network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.
- J. Identify the execution of the following:
 - 1. Mobilization.
 - 2. All required Submittals and Submittal review times showing 30 calendar day duration for such activities and equal amount of time for resubmittal reviews.
 - 3. Equipment and materials procurement/fabrication/delivery.
 - 4. Excavation.
 - 5. Shoring design and submission of detailed shoring submittals. Identify submission as a milestone.
 - 6. Shoring review, shoring materials procurement, shoring installation, and shoring removal.
 - 7. Backfill and compaction.
 - 8. Dewatering (If necessary).
 - 9. Grading, subbase, base, paving, and curb and gutters.
 - 10. Concrete, including installation of forms and reinforcement, placement of concrete, curing, stripping, finishing, and patching.
 - 11. Tests for leakage of concrete structures intended to hold water.
 - 12. Masonry.
 - 13. Metal fastenings, framing, structures, and fabrications.
 - 14. Waterproofing and dampproofing, insulation, roofing and flashing, and sealants.
 - 15. Doors and windows, including hardware and glazing.
 - 16. Finishes including coating and painting, flooring, ceiling, and wall covering.
 - 17. Building specialties including furnishings, laboratory equipment, and toilet and bath accessories.
 - 18. Process equipment, including identification of ordering lead-time, factory testing, and installation.
 - 19. Pumps and drives, including identification of ordering lead time, factory testing, and installation.
 - 20. Other mechanical equipment including fans and heating, ventilating, and air conditioning equipment.
 - 21. Trenching, pipe laying, and trench backfill and compaction.
 - 22. Piping, fittings, and appurtenances, including identification of ordering and fabrication lead time, layout, installation and testing.
 - 23. Valves, gates, and operators, including identification of order lead-time, installation, and testing.

24. Plumbing specialties.
25. Electric transmission, service, and distribution equipment, including identification of ordering lead-time, and factory testing.
26. Other electrical work including lighting, heating and cooling, and special systems, including identification of ordering lead-time.
27. Instrumentation and controls, including identification of ordering lead-time.
28. Preliminary testing of equipment, instrumentation, and controls.
29. Commissioning phase:
 - a. Source Testing.
 - b. Owner Training.
 - c. Installation Verification.
 - d. Functional Testing.
 - e. Start-up Phase.
 - f. Start-up Period.
30. Instrumentation and Controls Performance Testing.
31. Substantial completion.
32. Punch list work.
33. Demobilization.

1.09 PRELIMINARY SCHEDULE

- A. Procedure:
 1. Submit proposed Preliminary Schedule within 14 calendar days after Notice to Proceed.
 2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments.
 3. Submit revised Preliminary Schedule within 5 calendar days after meeting.
 4. Update Preliminary Schedule monthly until the Baseline Schedule is accepted.
- B. Format:
 1. Simplified Gantt chart.
- C. Activities:
 1. Define activities to be completed in the first 90 calendar days of Work.
 2. Actualize activities performed during the first 90 days into the first monthly Schedule update.

1.10 PRELIMINARY SCHEDULE OF VALUES

- A. Preliminary Schedule of Values as specified in Section 01_29_73 - Schedule of Values.
- B. Procedure:
 1. Submit proposed Preliminary Schedule of Values within 14 calendar days after Notice to Proceed.
 2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule of Values to review and make necessary adjustments.
 3. Submit revised Preliminary Schedule of Values within 5 calendar days after meeting.

1.11 WORK WITHIN THE FIRST 90 DAYS

- A. Proceed with Work after Preliminary Schedule and Preliminary Schedule of Values have been accepted by Owner.
- B. Submittal and acceptance of Preliminary Schedule and Preliminary Schedule of Values is condition precedent to making of progress payments as specified in Section 01_29_77 - Applications for Payment and payments for mobilization costs otherwise provided for in the Contract.

1.12 SCHEDULE OF SUBMITTALS

- A. Schedule of Submittals shall include Submittals required in the Contract Documents but not limited to test plans, training plans, test procedures, operation and maintenance manuals, Shop Drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.
- B. Preliminary Schedule of Submittals:
 - 1. Due date: After Preliminary Schedule has been submitted and accepted by the Owner.
 - 2. Format:
 - a. Include Submittals anticipated in the first 90 calendar days after award of Contract using early start dates.
 - b. Indicate week and month anticipated for submittal to Engineer.
 - c. Indicate "Priority" Submittals where review time can impact Contractor's schedule.
 - 1) "Priority" indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
 - 2) Engineer will endeavor to provide early review of "Priority" Submittals where possible.
 - 3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to Owner making progress payments during the first 90 calendar days after award of Contract.
- C. Final Schedule of Submittals:
 - 1. Due date: 30 days after Baseline Schedule has been submitted and accepted by Owner.
 - 2. Format:
 - a. Include Submittals using early start dates.
 - b. Include all Submittals, including those required in the Preliminary Schedule of Submittals.
 - c. Indicate week and month anticipated for submittal to Engineer.
 - d. Indicate "Priority" submittals where review time can impact Contractor's schedule.
 - 1) "Priority" indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
 - 2) Engineer will endeavor to provide early review of "Priority" Submittals where possible.
 - 3. Submittal of final Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

- D. Provide updated Schedule of Submittals with updated schedules if Schedule revisions change listing and timing of Submittals.

1.13 BASELINE PROGRESS SCHEDULE AND BASELINE SCHEDULE OF VALUES

- A. Due date: No more than 45 calendar days after Notice to Proceed.
- B. Format:
 - 1. Progress Schedule: Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.
 - 2. Schedule of Values: As specified in Section 01_29_73 - Schedule of Values.
- C. Acceptance of the Baseline Progress Schedule and Baseline Schedule of Values by the Owner is a condition precedent to making payments as specified in Section 01_29_77 - Applications for Payment after the first 90 calendar days after Notice to Proceed.

1.14 SUMMARY SCHEDULE

- A. Due date: At weekly progress meetings and after each Schedule update or Schedule revision.
- B. Format:
 - 1. Consolidate groups of activities associated with Major Items of Work shown on Baseline Schedule.
 - 2. Intended to give an overall indication of the Project Schedule without a large amount of detail.

1.15 COST FLOW SUMMARY

- A. Due date: After Baseline Schedule has been submitted and accepted by the Owner, submit on a monthly basis as specified in Section 01_29_77 - Applications for Payment.
- B. Format:
 - 1. Tabular and graphic report showing anticipated earnings each month of the Contract period.
 - 2. Base tabulation on the summation of the cost-loaded activities each month.
 - 3. Show planned amounts.
 - 4. Show actual earned amounts and anticipated remaining earnings.
 - 5. Spreadsheet format of all schedule activities showing cost and percentage completion during the current month for which payment is sought.

1.16 PROGRESS SCHEDULE AND UPDATED SCHEDULE OF VALUES

- A. Due date: Submit on a monthly basis as specified in Section 01_29_77 - Applications for Payment.
- B. Format: As specified in Section 01_29_73 - Schedule of Values.

1.17 WEEKLY SCHEDULE

- A. Due date: At every weekly progress meeting.
- B. Format:
 - 1. Contractor and Owner must agree on the format.
 - 2. 6-week Schedule showing the activities completed during the previous week and the Contractor's schedule of activities for following 5 weeks.
 - 3. Use the logic and conform to the status of the current Progress Schedule when producing a weekly Schedule in CPM schedule or a bar chart format.
 - a. In the event that the weekly Schedule no longer conforms to the current Schedule, Contractor may be required to revise the Schedule as specified in this Section.
 - 4. Activity designations used in the weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule updates.

1.18 LABOR HISTOGRAM

- A. Due date:
 - 1. With progress payments after Baseline Schedule has been submitted and accepted by Owner.
- B. Format:
 - 1. Labor histogram depicting total craft manpower and craft manpower for Contractor's own labor forces and those of each subcontractor.
 - 2. Submit in electronic format.
- C.

1.19 COMMISSIONING SCHEDULE

- A. Commissioning activities and milestones, as specified in Section 01_75_17 - Commissioning, shall be an integral part of the overall Progress Schedule.
 - 1. Commissioning activities and milestones shall be extracted from the Progress Schedule to provide a separate Commissioning schedule that is submitted each time the Progress Schedule is submitted.
- B. Proposed Commissioning Schedule:
 - 1. Schedule requirements: As specified in Section 01_75_17 - Commissioning.
 - 2. Submittal due date: Within 90 days after Notice to Proceed.
 - 3. Engineer response due within 20 calendar days of receipt.
 - 4. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and Owner comments.
- C. Construction Schedule can include the Commissioning Schedule after Engineer acceptance of the Proposed Commissioning Schedule.
 - 1. Capable of extracting a stand-alone Commissioning Schedule.
 - 2. Capable of extracting a stand-alone Owner Training Schedule.

- D. Monthly update requirements:
 - 1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
 - 2. Include activities not previously included in the previously accepted detail work plan Commissioning Schedule.
 - 3. Change Order required for any change to contractual dates.
 - 4. Reviews of these Submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.20 PRE-CONSTRUCTION SCHEDULING MEETING

- A. As specified in Section 01_31_19 - Project Meetings.

1.21 REVIEW AND ACCEPTANCE OF SCHEDULES

- A. Engineer and Owner will review preliminary Schedules, Schedule updates, Schedule revisions, and time impact analyses to ascertain compliance with specified project constraints, compliance with milestone dates, durations and sequence, accurate inter-relationships, and completeness.
- B. Engineer and Owner will issue written comments following completion of review of baseline Schedules within 21 calendar days after receipt.
- C. Written comments on review of Schedule updates and Schedule revisions and time impact analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.
- D. Revise and resubmit Schedules in accordance with Engineer's comments within 7 calendar days after receipt of such comments or request joint meeting to resolve objections.
- E. If the Owner requests a meeting, the Contractor and all major subcontractors shall participate.
 - 1. Revise and resubmit Schedule within 7 calendar days after meeting.
- F. Use accepted Schedules for planning, organizing, and directing the Work and for reporting progress.
- G. Engineer's Submittal review response:
 - 1. When Schedules reflects the Owner's and Contractor's agreement of project approach and sequence, Schedules will be accepted by the Owner.
 - 2. Engineer's Submittal review response for Schedule Submittals will be "Receipt Acknowledged - Filed for Record".
 - 3. Acceptance of the Schedules by the Owner is for general conformance with the Contract Documents and for the Owner's planning information and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the Contract completion dates.
 - a. Omissions and errors in the accepted Schedules shall not excuse performance less than that required by the Contract Documents.

- b. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor's plan, sequence or means, methods, and techniques of construction.

1.22 SCHEDULE UPDATES

A. Any update:

1. Prepare update using most recent accepted version of Schedule including:
 - a. Actual start dates of activities that have been started.
 - b. Actual finish dates of activities that have been completed.
 - c. Percentage of completion of activities that have been started but not finished.
 - d. Actual dates on which milestones were achieved.
 - e. Update activities by inputting percent complete figures with actual dates.
 - f. Use retained logic in preparing Schedule updates.
 - g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
 - h. Revisions to the Schedule may be included that have been previously approved as specified.

B. Monthly updates:

1. Submit written narrative report in conjunction with each Schedule update, including descriptions of the following:
 - a. Activities added to or deleted from the Schedule are to adhere to cost and other resource loading requirements (if schedule is cost loaded).
 - 1) Identify added activities in manner distinctly different from original activity designations.
 - b. Changes in sequence or estimated duration of activities.
 - c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
 - d. Assumptions made and activities affected by incorporating change order work into the Schedule.
 - e. Include a response in writing to each of the Engineer's comments or questions from the previous month's schedule review and number responses consistent with the Engineer's numbering.
2. Submit updated Schedule and materials specified under Submittal of Progress Schedules 5 calendar days before the monthly schedule update meeting.
3. Since monthly Schedule update is the application for progress payment required as specified in Section 01_29_77 - Applications for Payment, submittal and acceptance of the monthly Schedule update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:

1. Update the Schedule prior to weekly progress meeting.
 - a. Identify overall progress of each major item of work in the summary schedule.
 - b. If there are significant changes to the Schedule, submit a written report at the weekly progress meeting.
2. Should monthly Schedule update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as "Project Float".

3. Should monthly Schedule update show Project completion later than current Contract completion date, prepare and submit a Schedule revision.

1.23 REVISIONS TO SCHEDULES

- A. Submit revised Schedules within 5 days:
 1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
 2. When delays in Submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
 3. When the Schedule does not represent the actual progress of activities.
 4. When any change to the sequence of activities, the completion date for major portions of the Work, or when changes occur which affect the critical path.
 5. When Contract modification necessitates Schedule revision, submit schedule analysis of Change Order work with cost proposal.
- B. Create a separate Submittal for Schedule revisions.
 1. Comply with Schedule updates as specified in this Section.
 2. Do not submit with Schedule updates.
- C. Schedule revisions will not be reflected in the Schedule until after the revision is accepted by the Owner.
 1. This includes Schedule revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.24 ADJUSTMENT OF CONTRACT TIME OR PRICE

- A. Contract Time will be adjusted only for causes specified in Contract Documents.
- B. If the Contractor believes that the Owner has impacted its work such that the Project completion date will be delayed, the Contractor must submit proof, in the form of a time impact analysis demonstrating the delay to the critical path.
- C. Time impact analysis:
 1. Use the accepted Schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the Schedule by:
 - a. Inserting new activities associated with the delay event into the Schedule.
 - b. Revising activity logic.
 - c. Revising activity durations.
 2. If the Progress Schedule's critical path and completion date are impacted as a result of adding this delay event to the Progress Schedule, a time extension equal to the magnitude of the impact may be warranted.
 3. The time impact analysis Submittal must include the following information:
 - a. A fragment of the portion of the Schedule affected by the delay event.
 - b. A narrative explanation of the delay issue and how it impacted the Schedule.
 - c. A schedule file used to perform the time impact analysis.

- D. When a delay to the Project as a whole can be avoided by revising preferential sequencing or logic and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.
- E. Indicate clearly that the Contractor has used, in full, all project float available for the Work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.
 - 1. Utilize the latest version of the Schedule update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.
- F. Adjustment of the Contract Times will be granted only when the Contract float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
 - 1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.
- G. Actual delays in activities which do not affect the Critical Path Work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.
- H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to jobsite or home office overhead beyond the Contractor's originally planned occupancy of the site.
- I. Notify Owner of a request for Contract Time adjustment.
 - 1. Submit request as specified in the Contract Documents.
 - 2. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.
- J. Owner will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
 - 1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule update.
 - 2. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Owner may accept as appropriate for such interim purpose.
 - 3. It is understood and agreed that any such interim acceptance by the Owner shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Owner has been made.
 - 4. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

1.25 WEATHER DAY ALLOWANCE

- A. Allowance:
 - 1. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Day Allowance".
- B. Actual Weather Day:
 - 1. Insert a weather delay activity in the critical path to reflect actual weather day occurrences when weather days are experienced and accepted by the Engineer.
 - 2. Reduce duration of Weather Day Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in the Weather Day Allowance at completion of the Project is considered float.
 - 3. Provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted.
 - a. A Schedule update will not suffice as a written notice.
 - b. Engineer will determine if the Weather Day constitutes a use of a portion of the Weather Day Allowance.
 - c. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions.

1.26 ALLOWANCE FOR OWNER-CAUSED DELAY

- A. Allowance:
 - 1. Include as a separate identifiable activity on the critical path, an activity labeled "Allowance for Owner-Caused Delay."
 - 2. Insert this activity at the end of the Schedule, following the Project Completion Milestone.
 - 3. Duration of this activity is specified in the Bid Form.
 - a. The duration of this Owner-Caused Delay Allowance is in addition to the contractual time frame.
- B. Actual delay:
 - 1. Insert an activity in critical path to reflect actual Owner-caused delay occurrences when Owner-Caused delay days are experienced and accepted by Engineer.
 - a. Identify this activity as an Owner-Caused delay.
 - 2. Reduce duration of Owner-Caused Delay Allowance activity as Owner-caused delays are experienced and inserted into the Schedule. Remaining days in Owner-Caused Delay Allowance at completion of project is considered float.

1.27 FINAL SCHEDULE

- A. The final Schedule update becomes the As-Built Schedule.
 - 1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.

2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule update is provided.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_32_34

PHOTOGRAPHIC AND VIDEOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for photographs and videos.
- B. The purpose of the photographs and videos is to document:
 - 1. The condition of the facilities prior to the Work beginning at the Project Site.
 - 2. The progress of the Work.
 - 3. The Project Site after Substantial Completion.
- C. The scope of the photographic and videographic documentation shall be the sole responsibility of the Contractor but shall be acceptable to the Owner.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-construction photographs and videos: Submit prior to beginning work at the Project Site or prior to the preconstruction conference specified in Section 01_31_19 - Project Meetings, whichever occurs earlier.
- B. Construction photographs and videos: Submit with each application for payment.
- C. Post-construction photographs and videos: Submit with project closeout documents as specified in Section 01_77_00 - Closeout Procedures.

1.03 SUBMITTALS

- A. Submit a key plan of the Project Site with notation of vantage points marked for location and direction of each photograph.
 - 1. Include the same label information as the corresponding set of photographs.

1.04 PHOTOGRAPHS

- A. Provide prints of each photograph for each area of Work.
- B. Provide a digital copy of each photograph of Work.
 - 1. Monthly: Upload to web-based construction management system.
 - 2. Project record documents:
 - a. Catalog and index prints in chronological sequence.
 - b. Include typed table of contents.
- C. Provide a drone flyover aerial digital photographs of area of Work.
 - 1. Prior to first drone flight, meet with the Owner and Engineer to define required photo views and Work areas to be photographed.
 - 2. Take 5 photos from each view.

3. Views:
 - a. Take photos at oblique angles from the north, south, east, and west directions.
 - b. Take photos directly overhead.
4. Some shots may cover the entire Project Site and some may detail the areas under construction at the time of photography.
5. Submit 5 proofs of each view within 7 calendar days of the date the photographs were taken.
 - a. Owner will select the preferred photograph from each view that will be printed.
6. Frequency of flyover aerial digital photos: Quarterly

1.05 PRE-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

- A. Provide photographs and video of the condition entire site, including each area of Work prior to the start of Work.
 1. Areas to be photographed and videoed shall include the site of the Work and all existing facilities, either on or adjoining the Project Site, including the interior of existing structures that could be damaged as a result of the Contractor's work.
 2. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.
 3. Upload all pre-construction photos of the area of Work to the web-based construction management system.

1.06 CONSTRUCTION PHOTOGRAPHS AND VIDEOS

- A. Provide photographs and videos of construction in area of Work throughout the progress of Work, including a key plan designating where each photograph was taken.
- B. Take site and interior photographs and videos from differing directions of building demolition, pre-excavation, footing excavation, soil testing, utility crossings, installation of bypass piping, excavation of access pits, installation of lining system in pipes, rehabilitation of manholes, building modifications, utilities, electrical and instrumentation modifications, and other applicable activities indicating relative progress of the work.
- C. Take photos a maximum of 7 calendar days prior to Submittal.

1.07 POST-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

- A. Provide photographs of the entire site, including each area of Work at the completion of Work.
 1. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.
 2. Take photos and video from same points in same direction as pre-construction examination.
 3. Upload all post-construction photos of the area of Work to the web-based construction management system

PART 2 PRODUCTS

2.01 MEDIA

- A. Digital media:
 - 1. Provide photos as individual, indexed JPG files with the following characteristics:
 - a. Compression shall be set to preserve quality over file size.
 - b. Highest resolution JPG images shall be submitted. Resizing to a smaller size when high resolution JPGs are available shall not be permitted.
 - c. JPG image resolution shall be 5 megapixels at 2,400 by 1,800 or higher.
 - d. Images shall have rectangular, clean images. Artistic borders, beveling, drop shadows, etc., are not permitted.
 - 2. Identification: On photograph, provide the following information:
 - a. Name of project.
 - b. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
 - c. Description of vantage point, indicating location and direction by compass point.
- B. Videos:
 - 1. Quality: 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
 - 2. Digital color video format.
 - 3. Provide audio portion of the composite video sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
 - 4. Identification: On each copy provide a label with the following information:
 - a. Name of project.
 - b. Date video was recorded.
 - 5. Submit 1 copy of each video within 7 days of recording.
 - 6. Display continuous running time.
 - 7. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at the Project Site.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_33_00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements and procedures for Submittals to confirm compliance with the Contract Documents.

1.02 GENERAL INSTRUCTIONS

- A. Contractor is responsible to determine and verify field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved Shop Drawings and Contract Document requirements.
- B. Provide Submittals:
 - 1. That are specified or reasonably required for construction, operation, and maintenance of the Work.
 - 2. That demonstrate compliance with the Contract Documents.
- C. Where multiple Submittals are required, provide a separate Submittal for each Specification section.
 - 1. In order to expedite construction, the Contractor may make more than one Submittal per Specification section, but a single Submittal may not cover more than one Specification section:
 - a. The only exception to this requirement is when one Specification section covers the requirements for a component of equipment specified in another section.
 - b. For example, circuit breakers are a component of switchgear. The switchgear Submittal must also contain data for the associated circuit breakers, even though they are covered in a different Specification section.
- D. Prepare Submittals in the English language. Do not include information in other languages.
- E. Present measurements in customary American units (feet, inches, pounds, etc.).
- F. Must be clear and legible, and of sufficient size for presentation of information.
- G. Page size, other than drawings:
 - 1. Minimum: 8-1/2 inches by 11 inches.
 - 2. Maximum: 11 inches by 17 inches.

- H. Drawing sheet size:
 - 1. Maximum: 22 inches by 34 inches.
 - a. Minimum plan scale: 1/8 inch equals 1 foot-0 inches.
 - b. Minimum font size: 1/8-inch.
 - 2. 11-inch by 17-inch sheet:
 - a. Minimum plan scale: 1/8 inch equals 1 foot-0 inches.
 - b. Minimum font size: 1/8-inch.
- I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.
- J. Provide Submittal information from only one manufacturer for a specified product. Submittals with multiple manufacturers for one product will be rejected without review.

1.03 SUBMITTAL ORGANIZATION

- A. Organize Submittals in exactly the same order as the items are referenced, listed, and/or organized in the Specification section.
- B. For Submittals that cover multiple devices used in different areas under the same Specification section, the Submittal for the individual devices must list the area where the device is used.
- C. Bookmarks:
 - 1. Bookmarks shall match the table of contents.
 - 2. Bookmark each section (tab) and heading.
 - 3. Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
 - 4. At file opening, display all levels of bookmarks as expanded.
- D. Where applicable (i.e., except for Drawings, figures, etc.), Submittal content shall be electronically searchable utilizing the PDF file as submitted.
- E. Thumbnails optimized for fast web viewing.
- F. Sequentially number pages within the tabbed sections:
 - 1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
- G. Attachments:
 - 1. Include with each Submittal a copy of the relevant Specification section.
 - a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - 2. Include with each Submittal a copy of the relevant Drawing, including relevant addendum updates.
 - a. Indicate either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).

- b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.
- H. Contractor: Prepare Submittal information in sufficient detail to show compliance with specified requirements.
 - 1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
 - 2. Coordinate Submittal with other Submittals and with the requirements of the Contract Documents.
 - 3. Check, verify, and revise Submittals as necessary to bring them into conformance with the Contract Documents and actual field conditions.
- I. Contractor: Prepare "Or Equal" Submittal information.
 - 1. Provide standard Submittal requirements.
 - a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
 - 2. Provide reason the specified product is not being provided.
 - 3. Explain the benefits to the Owner for accepting the "Or Equal".
 - 4. Itemized comparison of the proposed "Or Equal" with product specified, including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
 - e. Availability of maintenance services and sources of replacement materials.
 - 5. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 - 6. Define impacts:
 - a. Impacts to other contracts.
 - b. Impacts to other work or products.
 - 7. Contractor represents the following:
 - a. Contractor bears the burden of proof of the equivalency of the proposed "Or Equal".
 - b. Proposed "Or Equal" is equal or superior to the specified product.
 - c. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed "Or Equal", unless the Owner requires a Special Warranty.
 - d. Contractor will coordinate installation of accepted "Or Equal" into the Work and will be responsible for the costs to make changes as required to the Work.
 - e. Contractor waives rights to claim additional costs caused by proposed "Or Equal" which may subsequently become apparent.

- J. Contractor: Prepare substitution Submittal information.
1. Provide standard Submittal requirements.
 - a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
 2. Provide reason the specified product is not being provided.
 3. Explain the benefits to the Owner for accepting the substitution.
 4. Itemized comparison of the proposed substitution with product specified, including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
 - e. Availability of maintenance services and sources of replacement materials.
 5. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 6. Define impacts:
 - a. Impacts to Contract Price.
 - 1) Required license fees or royalties.
 - 2) Do not include costs under separate contracts.
 - 3) Do not include Engineer's costs for redesign or revision of the Contract Documents.
 - b. Impacts to Contract Time.
 - c. Impacts to Contract Scope.
 - d. Impacts to other contracts.
 - e. Impacts to other work or products.
 7. Contractor represents the following:
 - a. Contractor shall pay associated costs for the Engineer to evaluate the substitution.
 - b. Contractor bears the burden of proof of the equivalency of the proposed substitution.
 - c. Proposed substitution does not change the design intent and will have equal performance to the specified product.
 - d. Proposed substitution is equal or superior to the specified product.
 - e. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution, unless the Owner requires a Special Warranty.
 - f. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
 - g. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

1.04 SUBMITTAL IDENTIFICATION NUMBERING

A. Number each Submittal using the format defined in the table below:

	Spec Section Number	Dash	Initial Submittal - Sequential Number	Decimal Point	Subsequent Submittal Revisions Sequential Number
<i>Example 1 Description</i>	<i>Cast-In-Place Concrete</i>		<i>8th initial Submittal</i>		
	03_30_00	-	0008		
<i>Example 2 Description</i>	<i>Cast-In-Place Concrete</i>		<i>8th initial Submittal</i>		<i>First revision to the 8th initial Submittal</i>
	03_30_00	-	0008	.	1

B. Number each Submittal using a sequential numbering sequence. All Submittals must be assigned to a Specification Section.

1.05 SUBMITTALS IN ELECTRONIC MEDIA FORMAT

- A. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.
- B. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).
- C. Graphics: Provide graphic Submittals (Drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.06 SUBMITTAL PROCEDURE

- A. Engineer: Review Submittal and provide response:
 - 1. Review description:
 - a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular Submittal, whether or not a stamp or seal is required by the Contract Documents or Laws and Regulations.
 - b. Engineer's review of Submittals shall not release the Contractor from the Contractor's responsibility for performance of requirements of the Contract Documents. Neither shall the Engineer's review release the Contractor from fulfilling purpose of installation nor from the Contractor's liability to replace defective Work.
 - c. Engineer's review of Shop Drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in the Contract Documents.
 - d. Engineer's review does not extend to:
 - 1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by the Contractor.

- 2) Contractor's means, methods, techniques, sequences, or procedures, except when specified, indicated on the Drawings, or required by the Contract Documents.
 - 3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
 - e. Engineer can Approve or Not Approve any exception at their sole discretion.
- 2. Review timeframe:
 - a. Except as may be provided in technical Specifications, a Submittal will be returned within 30 days.
 - b. When a Submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the Submittal, give notice of the date by which that Submittal will be returned.
 - c. Engineer's acceptance of progress schedule containing Submittal review times less than those specified or agreed to in writing by the Engineer will not constitute Engineer's acceptance of review times.
 - d. Critical Submittals:
 - 1) Contractor will notify Engineer in writing that timely review of a Submittal is critical to the progress of Work.
- 3. Schedule delays:
 - a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of Submittals unless all of the following criteria are met:
 - 1) Engineer has failed to review and return first submission within the agreed upon time frame.
 - 2) Contractor demonstrates that delay in progress of Work is directly attributable to the Engineer's failure to return Submittal within time indicated and accepted by the Engineer.
- 4. Review response will be returned to the Contractor with one of the following dispositions:
 - a. Approved:
 - 1) No Exceptions:
 - a) There are no notations or comments on the Submittal and the Contractor may release the equipment for production.
 - 2) Make Corrections Noted - See Comments:
 - a) Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
 - b) Resubmittal not required.
 - 3) Make Corrections Noted - Confirm:
 - a) Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
 - b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
 - b. Not Approved:
 - 1) Correct and Resubmit:
 - a) Contractor may not proceed with the Work described in the Submittal.
 - b) Contractor assumes responsibility for proceeding without approval.

- c) Resubmittal of complete Submittal package is required within 30 calendar days of the date of the Engineer's Submittal review response.
 - 2) Rejected - See Remarks:
 - a) Contractor may not proceed with the Work described in the Submittal.
 - b) Submittal does not meet the intent of the Contract Documents. Resubmittal of complete Submittal package is required with materials, equipment, methods, etc., that meet the requirements of the Contract Documents.
 - c. Receipt Acknowledged:
 - 1) Filed for Record:
 - a) This is used in acknowledging receipt of informational Submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
 - 2) With Comments - Resubmit:
 - a) This is used in acknowledging receipt of informational Submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.
- B. Contractor: Prepare resubmittal, if applicable:
 - 1. Clearly identify each correction or change made. Provide page references to the changed information within the resubmittal.
 - 2. Include a response in writing to each of the Engineer's comments or questions for Submittal packages that are resubmitted in the order that the comments or questions were presented from the first and subsequent Submittals and numbered consistent with the Engineer's numbering.
 - a. Acceptable responses to the Engineer's comments are listed below:
 - 1) "Incorporated" - Engineer's comment or change is accepted and appropriate changes are made.
 - 2) "Response" - Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by the Engineer.
 - b. Reviews and resubmittals:
 - 1) Contractor shall provide resubmittals which include responses to all Submittal review comments separately and at a level of detail commensurate with each comment.
 - 2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment
 - a) Responses such as "acknowledged" or "noted" are not acceptable.
 - 3) Resubmittals which do not comply with this requirement may be rejected and returned without review.
 - 4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant Submittals.

- 5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.
- c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for revision and resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
- 3. Resubmittal timeframe:
 - a. Contractor shall provide resubmittal within 15 days.
 - b. When a resubmittal cannot be returned within the specified period, Contractor shall notify the Engineer in writing.
- 4. Review costs:
 - a. Costs incurred by the Owner as a result of additional reviews of a particular Submittal after the second time it has been reviewed shall be borne by the Contractor.
 - b. Reimbursement to the Owner will be made by deducting such costs from the Contractor's subsequent progress payments.

1.07 PRODUCT DATA

- A. Edit Submittals so that the Submittal specifically applies to only the product furnished.
- B. Neatly cross out all extraneous text, options, models, etc., that do not apply to the product being furnished so that the information remaining is only applicable to the product being furnished.

1.08 SHOP DRAWINGS

- A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of Shop Drawings.
- B. Indicate project-designated equipment tag numbers for Submittal of devices, equipment, and assemblies.

1.09 SAMPLES

- A. Details:
 - 1. Submit labeled samples.
 - 2. Samples will not be returned.
 - 3. Provide the minimum number of sample Submittals as below:
 - a. Total: 3 minimum.
 - 1) Owner: 2.
 - 2) Engineer: 1.
 - 3) Contractor: None.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	Click here to enter text.	Date:	MM/DD/YYYY
Contractor:	Click here to enter text.	Project No.:	XXXXX.XX
Project Name:	Click here to enter text.	Submittal Number:	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal/Equipment Supplier			
Spec ##:	Spec ##.	Subject:	Click here to enter text.
Authored By:	Click here to enter text.		Date Submitted: XX/XX/XXXX

Submittal Certification	
Check Either (A) or (B):	
☐ (A)	We have verified that the equipment or material contained in this Submittal meets all the requirements specified in the project manual or shown on the Contract Drawings with no exceptions.
☐ (B)	We have verified that the equipment or material contained in this Submittal meets all the requirements specified in the project manual or shown on the Contract Drawings, except for the deviations listed.
Certification Statement: By this Submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved Shop Drawings and all Contract requirements.	
General Contractor's Reviewer's Signature:	
Printed Name:	

PM/CM Office Use	
Date Received GC to PM/CM:	_____
Date Received PM/CM to Reviewer:	_____
Date Received Reviewer to PM/CM:	_____
Date Sent PM/CM to GC:	_____

SECTION 01_35_21

SELECTIVE ALTERATIONS AND DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cutting or modifying of existing and new work.
 - 2. Partial demolition of structures.
 - 3. In-place abandonment of pipe.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A10.6 - Safety and Health Program Requirements for Demolition Operations.
- B. International Concrete Repair Institute (ICRI):
 - 1. Guideline No. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
 - 2. Guideline No. 310.3R - Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Chipping hammer: A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight of less than 15 pounds and an impact frequency of greater than 2,000 blows/minute.
 - 2. Concrete breaker: A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight greater or impact frequency less than the limits defined for a chipping hammer.
 - 3. Coring equipment: Non-impact rotary drill with diamond cutting edges.
 - 4. Heavy abrasive blast: Cleaning procedure by which various abrasives materials, or steel shot, are forcibly propelled by high pressure against a surface to remove loose material and produce a concrete surface roughened to ICRI Surface Profile CSP-7, or higher, as specified in ICRI 301.3R.
 - 5. Salvage material: Materials removed from existing facilities and stored for the Owner's future reuse.

1.04 DESCRIPTION OF WORK

- A. The Work includes partial demolition, cutting, and modifying of existing facilities, utilities, and/or structures.

- B. These facilities may be occupied and/or operational. Satisfactory completion of the Work will require:
 - 1. Planning activities carefully to work around unavoidable obstacles and to maintain overall stability of structures and structural elements.
 - 2. Restoration of existing facilities, utilities, and structures that are to remain in place and that are damaged by demolition or removal operations.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop Drawings:
 - 1. Show the location of all embedded items using diagrams and/or other media that clearly show dimensions and locations of existing structural elements, existing embedded items and any new embedded items and their relationship to each other.
 - 2. Drawings and/or other media documenting locations of service lines and capped utilities.
- C. Pipe abandonment plan:
 - 1. Prepare a comprehensive pipe abandonment plan for the Work.
 - a. Include provisions to demonstrate and verify with camera inspection that all solids have been removed and that the pipe is free of residuals.
 - 2. At a minimum, define the following elements:
 - a. Proposed sequence, methods, cleaning procedures, or demolition, removal, and disposal of contents of the piping.
 - b. Method of verification of final pipe condition.
 - c. Detailed drawings showing treatment of pipe ends.
 - 3. Submit plan a minimum of 4 weeks before abandonment is scheduled to begin.
- D. Selective demolition plan:
 - 1. Prepare a comprehensive selective demolition plan for the Work, including the following elements, at a minimum:
 - a. Proposed sequence, methods, temporary support, and equipment for demolition, removal, and disposal of portions of structure(s).
 - b. Provisions and procedures for salvage and delivery to the Owner of salvaged items, if required.
 - 2. Submit plan a minimum of weeks before demolition is scheduled to begin.
- E. Submittals for record only:
 - 1. Permits and notices authorizing demolition.
 - 2. Certificates of severance of utility services.
 - 3. Permit for transport and disposal of debris.
 - 4. Selective demolition plan.
 - 5. Pipe abandonment plan.
- F. Quality Assurance Submittals:
 - 1. Qualifications of non-destructive testing agency/agencies.
- G. Project Record Documents:
 - 1. As specified in Section 01_77_00 - Closeout Procedures.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Assign relocation, removal, cutting, coring, and patching to trades and workers qualified to perform the Work in manner that causes the least damage and that provides means of returning surfaces to an appearance at least equal to that of the surrounding areas unaffected by the Work.
 - 2. Non-destructive testing agencies:
 - a. Minimum of 5 years' experience performing non-destructive testing for location of steel reinforcement in existing concrete under conditions similar to that required for this Work.

1.07 SEQUENCING

- A. Perform Work in sequences and within times specified in Section 01_14_00 - Work Restrictions.
- B. Owner will cooperate to assist in expediting the Work.
- C. Coordinate the Work with operation of the facility:
 - 1. If the facility or utility to be modified cannot be removed from service, perform the Work while the facility is in operation using procedures and equipment that do not jeopardize operation or materially reduce the efficiency the facility.
 - 2. Do not begin alterations of designated portions of the Work until specific permission for activities in each area has been granted by the Owner in writing.
 - 3. Operational functions of the facility that are required to be performed to facilitate the Work will be performed by facility personnel only.
 - 4. Engineer will coordinate the planned procedure with the facility manager.
 - 5. Complete Work as quickly and with as little delay as possible.
 - a. When necessary for the proper operation or maintenance of portions of the facility, reschedule operations so the Work will not conflict with required operations or maintenance.

1.08 REGULATORY REQUIREMENTS

- A. Dispose of debris in accordance with governing regulatory agencies.
- B. Comply with applicable air pollution control regulations.
- C. Obtain permits for building demolition, transportation of debris to disposal site, and dust control.

1.09 PROJECT CONDITIONS

- A. Do not interfere with use of adjacent structures and elements of the facility not subject to the Work described in this Section. Maintain free and safe passage to and from such facilities.

- B. Provide, erect, and maintain barricades, lighting, guardrails, and protective devices as required to protect building occupants, general public, workers, and adjoining property:
 - 1. Do not close or obstruct roadways without permits.
 - 2. Conduct operations with minimum interference to public or private roadways.
- C. Prevent movement, settlement, or collapse of structures adjacent services, sidewalks, driveways and trees:
 - 1. Provide and place bracing or shoring.
 - 2. Cease operations and notify the Engineer immediately when the safety of structures appears to be endangered.
 - a. Take precautions to properly support structure.
 - b. Do not resume operations until safety is restored.
 - 3. Assume liability for movement, settlement, or collapse. Promptly repair damage.
- D. Arrange and pay for capping and plugging utility services. Disconnect and stub off.
 - 1. Notify affected utility company in advance and obtain approval before starting demolition.
 - 2. Place markers to indicate location of disconnected services.
- E. Unknown conditions:
 - 1. Drawings may not represent all conditions at the Site and adjoining areas. Compare actual conditions with Drawings before commencement of Work.
 - 2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other surface fixtures.
 - 3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition.
 - a. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the Work until written instructions are received from the Engineer.

PART 2 PRODUCTS

2.01 SALVAGE MATERIALS

- A. Materials designated for salvage:
 - 1. Existing Sludge Feed Pumps and associated Variable Frequency Drives.
 - 2. Existing In-Line Sludge Grinder.
- B. Handling and storage:
 - 1. Prevent damage to salvaged materials during removal, handling, and transportation.
 - 2. Prepare salvaged materials for storage.
 - 3. Store salvaged materials in the following locations:
 - a. Dewatering Building.

- C. Pay costs associated with salvaging materials, including handling, transporting, and storage.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to beginning selective demolition operations, perform a thorough inspection of the facility and Site.
 - 1. Report to the Engineer defects, structural damage, and deterioration of existing construction to remain in place.
- B. Examine areas affected by the Work and verify the following conditions prior to commencing demolition:
 - 1. Disconnection of utilities as required.
 - 2. Verify that utilities serving occupied or active portions of surrounding facilities will not be disturbed, except as otherwise indicated.
- C. If unsatisfactory conditions exist, notify the Engineer, and do not begin demolition operations until such conditions have been corrected.

3.02 PREPARATION

- A. Plan and organize Work to minimize inconvenience to adjacent buildings and to plant operations.
- B. Non-destructive evaluation of existing concrete and masonry:
 - 1. Prior to cutting, drilling, coring, and/or any other procedure that penetrates existing concrete or masonry, retain and pay for the services of a qualified non-destructive testing agency to perform investigations to determine the location of existing steel reinforcement, plumbing, conduit, and/or other embedments in the concrete.
 - 2. Submit documentation of the investigations to the Engineer for review and approval as specified in Section 01_33_00 - Submittal Procedures, before any work involving penetration of existing concrete is initiated.
- C. Protection:
 - 1. Building and structure entrances, stair landings and walkways so Owner may safely enter/exit facilities and operate water treatment systems during construction.
 - 2. Erect weatherproof closures to protect the interior of facilities and elements or equipment that are not designed for exposure to the weather.
 - 3. Provide temporary heat, cooling, and humidity control as necessary to prevent damage to existing and new equipment and construction.
 - 4. Maintain existing exiting paths and/or provide new paths in accordance with Building Code requirements.
 - 5. Erect and maintain dustproof partitions as required to prevent spread of dust to other parts of building. Maintain negative pressure in the area where the Work is being performed to prevent the accidental spread of dust and to minimize the spread of fumes related to the Work.

6. Upon completion of the Work, remove weatherproof closures and dustproof partitions.
 7. Repair damaged surfaces to match adjacent surfaces.
 8. Provide and maintain protective devices to prevent injury from falling objects.
 9. Locate guardrails in stairwells and around open shafts to protect workers. Post clearly visible warning signs.
 10. Protect the following from damage or displacement during the Work.
 - a. Benchmarks and survey points.
 - b. Existing construction that will remain in place.
 - c. Trees and landscaping designated to remain in place.
 11. Carefully remove designated materials and equipment to be salvaged by the Owner or reinstalled.
 12. Store and protect materials and equipment to be reinstalled.
- D. Layout:
1. The limits of selective demolition are indicated on the Drawings. Confine demolition operations within the limits indicated on the Drawings.
 2. Lay out demolition and removal work at the Site and coordinate with related work for which demolition and removal is required.
 3. Clearly mark the extent of structural elements to be removed on the actual surfaces that will be removed.
 4. Arrange for the Engineer's inspection of the layout extents.
 5. Do not begin demolition/removal operations until the layout markings have been reviewed by the Engineer.

3.03 DEMOLITION

- A. General:
1. Perform demolition work in accordance with ANSI A10.6.
 2. Demolish designated portions of structures and appurtenances in orderly and careful manner in accordance with the selective demolition plan.
 3. Conduct demolition and removal work in a manner that will minimize dust and flying particles.
 - a. Use water or dust palliative when necessary to prevent airborne dust.
 - b. Provide and maintain hoses and connections to water main or hydrant.
 4. Remove materials carefully, to the extent indicated and as required.
 - a. Provide neat and orderly junctions between existing and new materials.
 - b. Use methods that terminate surfaces in straight lines at natural points of division.
 5. Do not remove anything beyond the limits of the Work indicated without prior written authorization from the Engineer.
 - a. If in doubt about whether to remove an item, obtain written authorization from the Engineer prior to proceeding.
 6. Perform Work so as to provide the least interference and most protection to existing facilities to remain.
 7. Demolished materials:
 - a. Assume possession of materials unless otherwise indicated on the Drawings or specified.
 - b. Owner claims the following materials:
 - 1) Valves
 - 2) Circuit breakers.

- c. Remove demolished materials from the Site at least weekly and dispose of them in accordance with laws and regulations.
 - d. Do not burn or bury materials on site.
- B. Demolition of concrete and masonry:
 - 1. Demolish in small sections.
 - a. Perform demolition with small tools as much as possible.
 - b. Blasting with explosive charges is not permitted.
 - 2. Saw cut concrete to establish the edges of demolition, wherever possible.
 - a. Do not use a concrete breaker within 6 inches of reinforcing or structural metals that are designated to remain in place.
 - b. At edges that are not saw cut, remove the final 6 inches of material with a chipping hammer as specified in this Section. At surfaces where material is removed with a chipping hammer, follow with a heavy abrasive blast to remove loose material and microcracking.
 - c. Alternate techniques to remove concrete may be used if acceptable to the Engineer, however, techniques other than those deemed by ICRI Guideline No. 310.2R to provide a low risk of introducing microcracking will require a subsequent procedure to remove loose material and microcracked.
 - d. Provide final surface preparation for repairs as specified in Section 03_35_29 - Concrete Finishes.
 - 3. At locations indicated on the Drawings where the existing reinforcing is to be preserved, remove concrete using methods that do not damage the reinforcing. Use one of the following techniques:
 - a. Hydrodemolition techniques as outlined in ICRI Guideline No. 310.3R.
 - b. Chipping hammer, as specified in this Section, followed by heavy abrasive blast to remove loose material and microcracking at remaining surfaces impacted by the chipping hammer.
 - c. Alternate methods may be used, only when accepted in advance by the Engineer.
 - d. For all methods, provide a small, completed area for the Engineer's review and acceptance. If the proposed method, in the opinion of the Engineer, damages the reinforcing, revise the removal method to remove the concrete with a less aggressive technique to protect the reinforcing.
 - 4. Removal of concrete bases for equipment:
 - a. Saw-cut perimeter of removal in a regular shape, along straight lines, without overcutting corners at intersections.
 - 1) Cut to a depth below the finished surface equal to the concrete cover over the reinforcement, minus 1/2 inch.
 - 2) Do not cut existing reinforcement in slab.
 - b. Chip concrete within scored lines and to the cut depth within the full area of the saw cut.
 - c. Cut reinforcing steel and anchor bolts that will project above the surrounding concrete at the bottom of the chipped excavation.
- C. Sizing of openings in existing concrete or masonry:
 - 1. Make openings large enough to permit final alignment of pipe and fittings without deflections, but without oversizing.
 - 2. Allow adequate space for packing around pipes and conduit to ensure watertightness.

3. If the Engineer deems the opening to be insufficient in size to accomplish this criteria, remove additional material using the procedures outlined in this Section.
- D. Cutting openings in existing concrete or masonry:
1. Do not allow saw cuts to extend beyond limits of openings.
 2. Create openings by the following method or other means acceptable to the Engineer that prevents over-cutting of member at corners:
 - a. Core-drill through slab or wall at corners, being careful not to damage materials beyond the area to be removed.
 - b. Saw cut completely through the member, between the core holes at the corners.
 - c. As an alternate to saw cutting through the member, score the edges of the opening with a saw to a 1-inch depth.
 - 1) Provide score on both surfaces (when accessible).
 - 2) Remove concrete or masonry to within 6 inches of material to remain with a concrete breaker.
 - 3) Remove the remaining material with a chipping hammer.
 - d. Remove the remaining material at the corners left by the core-drilling with a chipping hammer.
 3. Prevent debris from falling into adjacent tanks or channels in service or from damaging existing equipment and other facilities.
- E. In-place abandonment of pipe:
1. As indicated on the Drawings.
 2. Clean buried or exposed solids service piping to a condition free of residual.
 - a. Solids service piping includes: Raw wastewater (RAW WW), primary sludge or scum (PS), sludge lines (SL), mixed liquor (ML), return activated sludge (RAS), waste active sludge (WAS), surface waste activated sludge (SWAS), thickened waste activated sludge (TWAS), digested sludge (DS), centrate, or other similar solids service subject to biological degradation, etc.
 3. Provide closure of abandoned pipe cut ends as indicated on the Drawings using one of the following methods:
 - a. Leave one end open.
 - b. Install cap.
 - c. Install plug.
- F. Buried structures:
1. Pump out buried tanks.
- G. Immediately upon discovery, remove and dispose of contaminated, vermin-infested, or dangerous materials using safe means that will not endanger the health of workers and the public.
- H. Remove trees and shrubs within marked areas, and clear undergrowth and dead plant material as specified in Section 31_00_00 - Earthwork.
- I. Backfill open pits and holes caused by demolition as specified in Section 31_00_00 - Earthwork.

- J. Rough grade areas affected by demolition.
- K. Remove demolished materials, tools, and equipment upon completion of demolition.

3.04 RESTORATION

A. General:

1. Repair damage caused by demolition to conditions equal to those that existed prior to beginning of demolition.
 - a. Patch and replace portions of existing finished surfaces that are damaged, lifted, and discolored.
 - 1) Refinish patched portion surfaces in a manner which produces uniform color and texture to entire surface, and that matches color and texture of adjacent surfaces.
 - b. When existing finish cannot be matched, refinish entire surface to nearest change of plane where the angle of change exceeds 45 degrees.
2. Cost of repairs shall be at the Contractor's expense at no increase in the Contract Price.
3. When new construction abuts or finishes flush with existing construction, make smooth transitions. Match finish of existing construction.
4. Where partitions are removed, patch floors, walls, and ceilings with finish materials that match existing materials.
5. Where removal of partitions results in adjacent spaces becoming one, rework floors, walls, and ceilings to provide smooth planes without breaks, steps, or bulkheads.
 - a. Where change of plane between adjacent surfaces exceeds 2 inches, request and obtain instructions for making transition from the Engineer.
 - 1) Refinish door surfaces and edges as necessary.
6. Trim existing doors as necessary to clear new floors.
7. Match patched construction with adjacent construction in texture and appearance so that patch or transition is invisible at 5-foot distance.
8. When finished surfaces are cut so that smooth transition is impossible, terminate existing surface in neat manner along straight line at natural line of division and provide appropriate trim.

B. At areas where existing concrete reinforcement is exposed:

1. Where existing reinforcement is to be incorporated into the new Work:
 - a. Protect, clean, and extend existing reinforcement into new concrete as indicated on the Drawings.
2. Where existing reinforcement is not to be incorporated into the new Work, cut off as follows:
 - a. Where new concrete joins existing concrete at the removal line:
 - 1) Cut reinforcement flush with concrete surface at the removal line.
 - 2) Bond new concrete as indicated on the Drawings.
 - b. Where concrete surface at the removal line will become the finished surface in the new Work:
 - 1) Cut reinforcement at least 1-1/2 inches below the surface,
 - 2) Pressure wash cut ends of reinforcement and the surrounding concrete depression.

- 3) Paint concrete surfaces within the depression and cut ends of bars with epoxy bonding agent as specified in Section 03_63_01 - Epoxies.
 - 4) Fill depressions with dry-pack mortar as specified in Section 03_35_29 - Concrete Finishes. Finish exposed surfaces to match the surrounding concrete.
- C. Restore areas affected by removal of existing equipment, equipment pads and bases, piping, supports, electrical panels, electric devices, conduits, and fasteners so little or no evidence of the previous installation remains:
 - 1. After removal of piping, conduit, fasteners, and other construction, fill areas in existing concrete and masonry as indicated on the Drawings.
 - 2. Finish surfaces exposed in the finished Work to match the surrounding surfaces.
- D. Terminate abandoned piping and conduits with blind flanges, caps, or plugs.
 - 1. Secure closures in place.
- E. Where existing fasteners projecting from concrete and masonry are not to be retained, cut off and repair as specified in the preceding paragraphs for reinforcement.

3.05 FIELD QUALITY CONTROL

- A. Do not proceed with demolition without the Engineer's inspection of the layout.
- B. Do not deviate from the submitted demolition plan without notifying the Engineer prior to the Work.

END OF SECTION

SECTION 01_35_73

DELEGATED DESIGN PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Delegated Design procedures.

1.02 GENERAL

- A. Delegated Design - Professional design services assigned to the Contractor by express delegation in the Contract Documents. Work is "Delegated Design" where the Technical Sections require the Contractor to provide professional design services and to submit signed and sealed documents from a registered Professional Engineer licensed in the State of Utah.
- B. Contractor's Professional Engineer - The design professional retained by the Contractor to perform Delegated Design.
- C. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents.
 - 1. Requirements of Delegated Design component as specified in the Technical Section and as indicated on the Drawings.
 - 2. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that the Contractor must furnish to the Engineer with respect to the Delegated Design.
- D. Contractor shall cause such Delegated Design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal shall appear on Drawings, calculations, Specifications, certifications, and Submittals prepared by such design professional.
 - 1. Contractor shall not be responsible for the adequacy of performance or design criteria specified by the Owner or Engineer.
 - 2. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.
 - 3. Such design professional shall issue certifications of design required by Laws and Regulations.
 - 4. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by the Contractor, a Subcontractor, or others for submittal to the Engineer, then such Shop Drawing or other Submittal shall bear the written approval of Contractor's design professional when submitted by the Contractor to the Engineer.
- E. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under Delegated

Design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

- F. Engineer's review, approval, and other determinations regarding design drawings, calculations, Specifications, certifications, and other Submittals furnished by Contractor pursuant to a Delegated Design will be only for the following limited purposes:
 - 1. Confirming that Submittal is in conformance with the performance and design criteria specified in the Contract Documents.

1.03 CONTRACTOR'S PROFESSIONAL ENGINEER

- A. Contractor or Subcontractor shall retain a licensed Professional Engineer in the State of Utah to perform Delegated Design.
- B. Qualifications:
 - 1. Holding a current license to perform the specified design in the same jurisdiction as the Project Site.
 - 2. Experienced in designing similar systems of similar complexity.
- C. Insurance:
 - 1. Provide Contractor's Professional Engineer's Professional Liability Insurance as specified in Section 00_73_00 - Supplementary Conditions.
- D. Responsibilities:
 - 1. Review and design in accordance with system performance and design criteria stated in the Contract Documents.
 - a. Prepare written requests for clarifications or interpretations of performance or design criteria for submittal to the Engineer by the Contractor.
 - 2. Sign and seal design reports, calculations, design drawings and specifications, and other design Submittals for the Delegated Design Work.
 - 3. Review and submit written approval of Submittals related to the Delegated Design Work.
 - 4. Design modifications to the Delegated Design Work as required.
 - 5. Visit the Site, as required, to verify that installation of the Delegated Design Work is in conformance with the Delegated Design Drawings and Specifications.
 - 6. Submit through Contractor to Engineer written, signed, and sealed certification that the installed Delegated Design Work complies with Contractor's Professional Engineer's design.

1.04 SUBMITTALS

- A. Prior to the start of Delegated Design:
 - 1. Contractor's Professional Engineer's qualifications:
 - a. Experience for the Delegated Design.
 - b. Evidence of Professional Engineering license.
 - 2. Contractor's Professional Engineer Professional Liability Insurance certificate.

- B. Delegated Design:
 - 1. Product data:
 - a. Details related to the Delegated Design as specified in Technical Sections to completely describe the system.
 - 2. Design documents with signature and seal from the Contractor's Professional Engineer.
 - a. Design documents include, but are not limited to, Drawings, calculations, Specifications, inspection reports, and certifications.
 - 3. Lists and schedules:
 - a. Prepare and submit lists or schedules of items where Delegated Design is required by the Contract Documents.
 - b. Group items by location in the Work.
 - 1) When "Area Numbers" are indicated on the Contract Drawings, group lists in accordance with those "areas."
 - 2) For work without area numbers, group using logical divisions acceptable to the Engineer.
 - 3) Group items within each "area" as follows:
 - a) Systems.
 - b) Components.
 - c) Supports.
 - d) Anchorage.
 - e) Bracing.
- C. Construction services:
 - 1. Contractor's Professional Engineer's comments on Submittals.
 - 2. Other construction documents, as required.

1.05 ENGINEER RESPONSE TO DELEGATED DESIGN SUBMITTALS

- A. Engineer response will be either of the following:
 - 1. Approved. Make Corrections Noted - See Comments:
 - a. Contractor may proceed with the Work; however, all notations and comments must be incorporated into the final product.
 - b. Review was for the limited purpose of determining that the document was stamped by a Professional Engineer and that such design is generally consistent with and will not negatively affect the design concept presented in the Contract Documents.
 - 2. Rejected - See Remarks:
 - a. Contractor may not proceed with the Work described in the Submittal.
 - b. Submittal does not meet the intent of the Contract Documents.
 - c. Resubmittal of complete Submittal package is required with materials, equipment, methods, etc., that meet the requirements of the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_41_00
REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION (AHJ)

- A. Also referred to as the permitting agency.
- B. Safe Drinking Water: Environmental Protection Agency
 - 1. National Sanitation Foundation (NSF)
 - 2. American National Standards Institute
- C. Safe Drinking Water: State of Utah Department of Environmental Quality - Division of Drinking Water (DDW)
- D. Building Department: Layton City.
- E. Fire Department: Layton City Fire Department.
- F. Electrical Utility: Rocky Mountain Power.
- G. Natural Gas: Enbridge Gas.

1.03 APPLICABLE CODES

- A. International Code Council (ICC).
 - 1. Building code:
 - a. International Building Code (IBC), 2021.
 - 1) Local amendments.
 - 2. Electrical code:
 - a. National Fire Protection Association (NFPA), NFPA 70: National Electrical Code (NEC), 2020.
 - 1) Local amendments
 - 3. Energy code:
 - a. International Energy Conservation Code (IECC), 2021.
 - 1) Local amendments.
 - 4. Fire code:
 - a. International Fire Code (IFC), 2021.
 - 1) Local amendments.
 - 5. Fuel gas code:
 - a. International Fuel Gas Code (IFGC), 2021.
 - 1) Local amendments.

6. Mechanical code:
 - a. International Mechanical Code (IMC), 2021.
 - 1) Local amendments.
7. Plumbing code:
 - a. International Plumbing Code (IPC), 2021.
 - 1) Local amendments.

PART 2 PRODUCTS (NOT USED)

2.01 DRINKING WATER MATERIALS

- A. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372:
 1. Certification by an independent ANSI accredited third party, including, but not limited to, NSF international, as being lead free.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_43_39

MOCKUPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Mockups of specific assemblies to be installed on this Project.

1.02 VISUAL MOCKUPS

- A. Separate mockup construction incorporating elements specified in various sections, intended to illustrate materials and workmanship in an assembly, and used for technical and aesthetic evaluation.
 - 1. Mockup shall not be a part of the finished construction.
 - 2. Mockup shall be accepted by the Owner prior to beginning this work on the building.
 - a. Configuration and extent of mockup: As required to illustrate the design intent for Owner's evaluation.
 - b. Place mockup on-site in a location where it will not be disturbed or damaged during construction.
- B. Maintain and protect Visual Mockups from damage during construction, and dispose of mockups when no longer required, as determined by the Owner.

1.03 BENCHMARK MOCKUPS

- A. Definition:
 - 1. In-place portions of assemblies to be repeated throughout the Work.
 - 2. Accepted benchmark mockups are intended to serve as a standard by which the work will be judged.
 - 3. Accepted benchmark mockups may be incorporated into the final construction.
- B. Construct benchmark mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.
- C. Acceptance of benchmark mockups incorporated in the Work does not constitute approval of deviations from the Contract Documents unless the Owner specifically approves such deviations in writing.
- D. Protect benchmark mockup from damage and ensure it is not disturbed at time of Project Completion.

1.04 MOCKUP DESCRIPTION

- A. Provide mockups as specified below:
 - 1. Mockup construction schedule: Indicate time required for mockup construction, Engineer's and Owner's review and acceptance, and removal/demolition work associated with mockups, in Construction Progress Schedule.
- B. Building façade colored and textured concrete (visual mockup):
 - 1. Provide building façade mock-up involving the following Section:
 - a. Section 03_30_00 - Cast-In-Place Concrete.
 - 2. Mockup shall consist of a 4-inch thick vertical concrete panel divided into three 36-inch by 36-inch sections.
 - a. Each section shall have the texture imparted by specified formliner and be finished with specified concrete stain in color selected by the Owner.
 - b. Stain shall be applied at a 1:1 dilution ratio at the first section, a 1:10 dilution ratio at the second section, and a 1:20 dilution ratio at the third section.
- C. Structural concrete F4 finish and tie-hole repair (visual mockup):
 - 1. Provide concrete finish mock-up involving the following Sections:
 - a. Section 03_30_00 - Cast-In-Place Concrete.
 - b. Section 03_35_29 - Concrete Finishes.
 - 2. Mockup shall consist of a 4-inch thick vertical concrete panel divided into two 36-inch by 36-inch sections.
 - a. One section shall demonstrate the F4 concrete. Section shall include 1 horizontal and 1 vertical form joint.
 - b. Other section shall demonstrate the tie-hole repair. A minimum of 4 tie-holes shall be included.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials as specified in the following Section:
 - 1. Section 03_30_00 - Cast-In-Place Concrete.
- B. All other products and materials as required for a complete mockup.

PART 3 EXECUTION

3.01 MOCKUP MATERIALS

- A. Contractor is cautioned to not purchase all materials for the project that are involved in any one mockup until after the mockup has been reviewed and accepted by the Engineer.

END OF SECTION

SECTION 01_45_00

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. General requirements for Quality Control.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with the manufacturers' instructions.
- C. When the manufacturers' instructions conflict with the Contract Documents, request clarification from the Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by qualified persons.
- F. Verify field measurements are as indicated on the Drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
- H. When specified in the Technical Specifications, products will be tested and inspected at the point of origin (Source Testing):
 - 1. Satisfactory tests and inspections at point of origin does not constitute final acceptance of products.
 - 2. Satisfactory tests or inspections at point of origin does not preclude testing or inspection at the Work Site.
 - 3. Do not install products prior to satisfactory completion of point of origin tests and inspections.

1.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products.
- B. Comply with the manufacturers' tolerances. When the manufacturers' tolerances conflict with the Contract Documents, request clarification from the Engineer before proceeding.

- C. Adjust products locations to maintain appropriate dimensions; confirm position before securing products in place.

1.04 REFERENCES

- A. ASTM International (ASTM):
 - 1. E329 - Standard for Agencies Engaged in Construction Inspection, Testing or Special Inspection.
- B. National Institute of Standards and Technology (NIST).

1.05 TESTING AND INSPECTION SERVICES

- A. Contractor shall employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the Technical Specifications for various work and materials.
- B. Owner will hire a testing firm to perform only the quality control testing specified to be done by the Owner in the Technical Specifications.
 - 1. Testing and employment of an Owner's independent testing firm or laboratory shall not relieve the Contractor of obligation to perform Work in accordance with requirements of the Contract Documents.
- C. Testing firm qualifications:
 - 1. Has authorization to operate in the state where the Project is located.
 - 2. Meets "Recommended Requirements for Independent Laboratory Qualification," published by American Council of Independent Laboratories.
 - 3. Meets requirements of ASTM E329.
 - 4. Laboratory staff: Maintain full-time specialist on staff to review services.
 - 5. Testing equipment: Calibrated at reasonable intervals with devices of accuracy traceable to NIST or accepted values of natural physical constants.
 - 6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NIST during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.
- D. Testing firm is not authorized to:
 - 1. Release, revoke, alter, or enlarge on requirements of the Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Assume duties of the Contractor.
 - 4. Stop the Work.
- E. Testing firm responsibilities:
 - 1. Provide qualified personnel on site. Cooperate with the Engineer and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of the Contract Documents.
 - 4. Promptly notify the Engineer and Contractor of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests required by the Engineer.

6. Attend preconstruction meetings and progress meetings as required in the Technical Specifications.
- F. Testing firm individual test reports:
1. After each test, the testing firm will promptly submit an electronic version of the certified test report to the Contractor.
 2. Test reports shall include at least the following information:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in Project.
 - g. Type of inspection or test.
 - h. Date of test.
 - i. Certified test results stamped and signed by a registered Engineer in the state where the Project is located.
 - j. Summary of conformance with the Contract Documents.
 - k. When requested by the Engineer, provide interpretation of test results.
- G. Testing, inspections, and source quality control may occur on or off the Project Site. Perform off-site testing inspections and source quality control as required by the Engineer or Owner.
- H. Contractor shall cooperate with the independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
1. Notify the Owner and the independent testing firm 48 hours prior to expected time for operations requiring testing.
 2. Make arrangements with the independent testing firm and pay for additional samples and tests required for the Contractor's use.
- I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed on instructions by the Engineer.
1. Contractor is responsible for costs for re-testing or re-inspection because of non-conformance.
 - a. Payment for re-testing or re-inspection by the Owner's testing firm will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.

1.06 SAMPLING AND TESTING

- A. Cooperate with the testing firm or laboratory personnel and provide access to construction and manufacturing operations.
- B. Secure and deliver to the test firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.
- C. Provide the testing firm and the Engineer with the preliminary mix design proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.

- D. Submit product test reports electronically.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to construction to be tested.
 - 2. To obtain and handle samples at Work Site or at source of product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_45_17
CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Contractor Quality Control Plan.

1.02 SUBMITTALS

- A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager.
- B. Contractor's Daily Quality Control Report:
 - 1. Submit to Engineer within 1 day of completion of each inspection using the approved form.
- C. Daily Inspection Report:
 - 1. Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day using the approved form.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

- A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.
- B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

- A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifying registrations.
- B. Minimum qualifications: Candidate must have a minimum of 10 years of experience on projects of similar type and size.

1.05 COVERING WORK

- A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Owner not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Owner in accordance with this requirement shall be resolved according to Article 14 of the General Conditions.

1.06 CONTRACTOR'S QUALITY CONTROL PROGRAM

- A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.
- B. CQC personnel:
 - 1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
 - 2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
 - 3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.
- C. CQC Plan:
 - 1. Contractor's CQC Plan shall include a statement by the Senior Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
 - 2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
 - 3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
 - 4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
 - 5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
 - 6. Commissioning quality control: Include procedures to verify that the commissioning requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
 - 7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
 - 8. Procedures to preclude the covering of deficient or rejected Work.
 - 9. Procedures for halting or rejecting Work.
 - 10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.

11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.
- D. Daily Inspection Report: Include, at a minimum:
1. Inspection of specific work.
 2. Quality characteristics in compliance.
 3. Quality characteristics not in compliance.
 4. Corrective/remedial actions taken.
 5. Statement of certification.
 6. CQC Manager's signature, electronic signature is acceptable.
 7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.
- E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
1. Personnel responsible for identifying deficient and non-complying items within Work.
 2. How and by whom deficient and non-compliant items are documented "in the field."
 3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
 4. Tracking processes and tracking documentation for deficient and non-conforming Work.
 5. Personnel responsible for achieving resolution of outstanding deficiencies.
 6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
- F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Owner upon request.
- G. Documented control/quality records:
1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to ensure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Owner and Engineer.
 2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification and certification records, procedures, and document review records.
 3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.

4. Develop a list of specific records as required by the Contract Documents that will be furnished to Owner and Engineer at the completion of activities.
- H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole discretion, and without cause, may direct Contractor to remove and replace the CQC Plan Manager.
1. Acceptance of the CQC Plan by the Owner is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
 2. After acceptance of the CQC Plan, notify the Owner in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_45_24

REGULATORY QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Project regulatory requirements for quality assurance that includes Special Inspections, Special Certification, and Structural Observation.
- B. Special Certification and Special Inspections in this Section are in addition to the requirements specified in Section 01_45_00 - Quality Control, and in the individual Sections.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete.
 - 2. 530 - Building Code Requirements for Masonry Structures.
 - 3. 530.1 - Specification for Masonry Structures.
- B. American Institute of Steel Construction (AISC):
 - 1. 360 - Specification for Structural Steel Buildings.
- C. American Society of Civil Engineers (ASCE):
 - 1. 7 - Minimum Design Loads for Buildings and Other Structures.
- D. American Welding Society (AWS):
 - 1. D1.3 - Structural Welding Code - Sheet Steel.
 - 2. D1.4 - Structural Welding Code - Reinforcing Steel.
- E. ASTM International (ASTM):
 - 1. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 3. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 - 4. C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete.
- F. Building Code:
 - 1. As specified in Section 01_41_00 - Regulatory Requirements.
- G. The Masonry Society (TMS):
 - 1. 402 - Building Code for Masonry Structures.
 - 2. 602 - Specifications for Masonry Structures.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Special Certification: Certification for designated seismic systems that demonstrates compliance with performance requirements.
 - 2. Special Inspection: Inspection of the materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.
 - 3. Special Inspection, Continuous: The full-time observation of work requiring Special Inspection by an approved special inspector who is present in the area where the work is being performed.
 - 4. Special Inspection, Periodic: The part-time, or intermittent observation of work requiring Special Inspection by an approved special inspector who is present in the area where the work is being performed and at the completion of the work.
 - 5. Structural Observation: The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system.

1.04 SUBMITTALS

- A. Submit Special Certifications for designated seismic systems.
- B. Schedule and coordinate the submittal of Special Inspection reports and test results prepared by others.

1.05 SPECIAL INSPECTION

- A. Owner will employ one or more special inspectors who will provide Special Inspections during construction.
- B. Special inspector(s) shall be qualified for inspection of the particular type of materials or operations requiring Special Inspection.
- C. Duties of special inspector:
 - 1. General: Required duties of the special inspector(s) shall be as described in the Building Code.
 - 2. Reporting: Special inspector(s) shall provide reports of each inspection to the Owner and shall distribute copies of inspection reports to the Engineer and Contractor as required.
 - a. Reports shall, at a minimum, include the following items:
 - 1) Date and time of inspection, and name(s) of individual(s) performing the inspection.
 - 2) Structures and areas of the structure where work or testing was observed.
 - 3) Discrepancies between the requirements of the Contract Documents and the work or testing observed.
 - 4) Other areas of deficiency in the Work.

- D. Special Inspections shall not be construed as fulfilling the requirements for Structural Observation.
- E. Owner or special inspector will select materials for Special Inspection.
 - 1. Contractor shall not select materials for Special Inspection.

1.06 SPECIAL CERTIFICATION

- A. Provide equipment that meets the special certification requirements of the Building Code.
- B. Designated seismic systems shall be subject to the testing and qualification requirements of the regulatory Building Code, and shall require Special Certification as set forth in ASCE 7:
 - 1. Mechanical equipment that is assigned an importance factor of 1.50 as specified in Section 01_81_50 - Design Criteria.
 - 2. All electrical equipment.
- C. Special certification requirements for designated seismic systems:
 - 1. Submittals shall include certification that the equipment is seismically qualified. Certifications are subject to review and acceptance by Owner.
 - 2. Certifications may be at least one of the following in accordance with ASCE 7:
 - a. Analysis.
 - b. Testing.
 - c. Experience data.

1.07 STRUCTURAL OBSERVATION

- A. Owner will employ one or more registered design professionals to provide Structural Observation(s) during construction.
 - 1. Registered design professional will be a civil or structural engineer currently licensed as such in the state where the project is located and regularly engaged in structural design equivalent to or similar to that indicated on the Drawings.
- B. Structural Observations shall not be construed as fulfilling the requirements for Special Inspections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS

- A. Owner will provide Special Inspection of the following types of work as described in the Building Code wherever such work occurs, unless otherwise specified.
 - 1. Attachment A - Concrete - Special Inspection Schedule.
 - 2. Attachment B - Architectural, Mechanical, and Electrical Components - Special Inspection Schedule.

3. Attachment C1 - Masonry Special Inspection Schedule - "Level 2".
4. Attachment C2 – NOT USED.
5. Attachment D - Soils - Special Inspection Schedule.
6. Attachment E - NOT USED.
7. Attachment F - NOT USED.
8. Attachment G - Steel Construction - Steel Deck, Open Web Steel Joists and Joist Girders, and Cold Formed Steel Trusses - Special Inspection Schedule.
9. Attachment H - NOT USED.
10. Attachment I - NOT USED.

3.02 SPECIAL CERTIFICATION

- A. Special inspector shall examine the designated seismic system(s) and determine whether the designated system components, including anchorage, are consistent with the evidence of compliance submitted for Special Certification.

3.03 STRUCTURAL OBSERVATION

- A. The following work requires Structural Observation in accordance with the Building Code.
 1. New Sludge Pump Station:
 - a. Foundation.
 - b. Walls.
 - c. Elevated slabs.
 - d. CMU wall reinforcement prior to first grout lift placement.
 - e. Roof to wall connections and metal deck fastening.
 2. New Sludge Day Tank:
 - a. Foundation.
 - b. Walls.
 - c. Elevated slab.

3.04 SCHEDULE

- A. Allow time necessary for Special Inspections and Structural Observation specified in this Section.
- B. Sufficient notice shall be given so that the Special Inspections and Structural Observations can be performed. Allow time for individuals performing to travel to the Site.

3.05 PROCEDURE

- A. Special inspector will immediately notify the Owner and Engineer of any corrections required and follow notification with appropriate documentation.
- B. Contractor shall not proceed until the Work is satisfactory to the Owner and Engineer.

END OF SECTION

ATTACHMENT A - CONCRETE - SPECIAL INSPECTION SCHEDULE

CONCRETE - SPECIAL INSPECTION SCHEDULE
(Includes: Cast-in-place, precast, prestressed, precast-prestressed, and shotcrete.)

Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
1. Inspect reinforcement, including prestressing tendons, and verify placement.	ACI 318 Building Code		●
2. Reinforcing bar welding:			
a. Verify weldability of reinforcing bars other than ASTM A706;	AWS D1.4 ACI 318		●
b. Inspect single-pass fillet welds, maximum 5/16 inch; and	AWS D1.4 ACI 318		●
c. Inspect all other welds.	AWS D1.4 ACI 318	●	
3. Inspect anchors cast in concrete.	ACI 318		●
4. Inspect anchors post-installed in hardened concrete members:			
a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads.	ACI 318	●	
b. Mechanical anchors and adhesive anchors not defined in 4.a.	ACI 318		●
5. Verify use of required design mix.	ACI 318 Building Code		●
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	ASTM C172 ASTM C31 ACI 318 Building Code	●	
7. Inspect concrete and shotcrete placement for proper application techniques.	ACI 318 Building Code	●	
8. Verify maintenance of specified curing temperature and techniques.	ACI 318 Building Code		●
9. Inspect prestressed concrete for:			
a. Application of prestressing forces; and	ACI 318	●	
b. Grouting of bonded prestressing tendons.	ACI 318	●	
10. Inspect erection of precast concrete members.	ACI 318		●
11. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	ACI 318		●

Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	ACI 318		●
<u>Notes:</u> (1) “●” represents a required inspection activity for the project where it occurs.			

**ATTACHMENT B - ARCHITECTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS -
SPECIAL INSPECTION SCHEDULE**

**ARCHITECTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS -
SPECIAL INSPECTION SCHEDULE**

Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
1. Architectural components:			
a. Cladding - exterior, weighing more than 5 psf: Erection and fastening.	Building Code		●
b. Exterior insulation and finish system (EIFS):	Building Code		
c. Non-bearing walls - exterior: Erection and fastening.	Building Code		●
d. Non-bearing walls - interior, weighing more than 15 psf.	Building Code		●
e. Veneer, exterior and interior, weighing more than 5 psf: Erection and fastening.	Building Code		●
f. Access floors: Erection and anchorage.	Building Code		●
g. Suspended ceiling system: Bracing.			●
h. Storage racks - 8 feet or greater in height: Anchorage.	Building Code		●
i. Skylight: Verification of safety compliance and labeling and installation.	Building Code		●
2. Plumbing, mechanical, and electrical components:			
a. Anchorage of electrical equipment for emergency and standby power systems.	Building Code		●
b. Anchorage of other electrical and mechanical equipment over 400 lb. on floors or roofs.	Building Code		●
c. Installation and anchorage of pipelines carrying hazardous chemicals and their associated mechanical units.	Building Code		●
d. Installation and anchorage of pipelines greater than 8 inches in diameter.			●
e. Installation and anchorage of ductwork designed to carry hazardous materials.	Building Code		●
f. Installation and anchorage of ductwork greater than 6 sf in cross section.			●
g. Installation and anchorage of vibration isolation systems where Contract Documents require nominal clearance of 1/4 inch or less between the equipment support frame and its support/restraint.	Building Code		●

Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
h. Installation of mechanical and electrical equipment, including ductwork, piping systems and their structural supports, where automatic fire sprinkler systems are installed.	Building Code		●
3. Fire-resistance elements:			
a. Sprayed fire-resistant coatings:	Building Code		
b. Mastic and intumescent coatings:	Building Code		
c. Fire-resistant penetrations and joint systems:	Building Code		
4. Smoke control systems;	Building Code		
<u>Notes:</u> (1) “●” represents a required inspection activity for the project where it occurs.			

ATTACHMENT C1 - MASONRY SPECIAL INSPECTION SCHEDULE - “LEVEL 2”

MASONRY SPECIAL INSPECTION SCHEDULE - "LEVEL 2"

MINIMUM TESTS

Verification of Slump flow and Visual Stability Index (VSI) as delivered to the Project Site as determined by ASTM C1611 for self-consolidating grout.

Verification of f'_m in accordance with Specification Section 04_22_00 - Concrete Unit Masonry prior to construction.

MINIMUM SPECIAL INSPECTION - LEVEL 2			
Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
1. Verify compliance with the approved submittals.	TMS 602/ACI 530.1		●
2. As masonry construction begins, verify that the following are in compliance:			
a. Proportions of site-prepared mortar.	TMS 602/ACI 530.1		●
b. Grade, size, and placement of masonry units and construction of mortar joints.	TMS 602/ACI 530.1		●
c. Grade, size, and placement of reinforcement, connectors, and anchors.	TMS 602/ACI 530.1		●
d. Reinforcing bar couplers and terminators.	ICC-ES Evaluation Report	●	
3. Prior to grouting, verify that the following are in compliance:			
a. Placement of masonry units and construction of mortar joints	TMS 602/ACI 530.1		●
b. Grout space.	TMS 602/ACI 530.1		●
c. Grade, type, and size of reinforcement and anchor bolts.	TMS 602/ACI 530.1 TMS 402/ACI 530		●
d. Placement of reinforcement, connectors, and anchors.	TMS 602/ACI 530.1 TMS 402/ACI 530		●
e. Proportions of site-prepared grout.	TMS 602/ACI 530.1		●
4. Verify during construction:			
a. Materials and procedures with the approved submittals.	TMS 602/ACI 530.1		●
b. Size and location of structural elements.	TMS 602/ACI 530.1		●
c. Type, size, and location of anchors, including details of anchorage of masonry to structural members, frames, or other construction.	TMS 402/ACI 530		●
d. Welding of reinforcement.	TMS 402/ACI 530	●	

MINIMUM SPECIAL INSPECTION - LEVEL 2			
Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
e. Preparation, construction, and protection of masonry during cold weather (temperature below 40 degrees F) or hot weather (temperature above 90 degrees F).	TMS 602/ACI 530.1		●
f. Placement of grout is in compliance.	TMS 602/ACI 530.1	●	
5. Observe preparation of grout specimens, mortar specimens, and/or prisms.	TMS 602/ACI 530.1		●
<u>Notes:</u> (1) “●” represents a required inspection activity for the project where it occurs.			

ATTACHMENT C2 - NOT USED

ATTACHMENT D - SOILS - SPECIAL INSPECTION SCHEDULE

SOILS - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Building Code		●
2. Verify excavations are extended to proper depth and have reached proper material.	Building Code		●
3. Perform classification and testing of fill and backfill materials.	Building Code		●
4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of fill and backfill.	Building Code	●	
5. Prior to placement of fill, observe subgrade and verify that Site has been prepared properly.	Building Code		●
Notes: (1) "●" represents a required inspection activity for the project where it occurs.			

ATTACHMENT E - NOT USED

ATTACHMENT F - NOT USED

**ATTACHMENT G - STEEL CONSTRUCTION - STEEL DECK; OPEN WEB STEEL JOISTS
AND JOIST GIRDERS; AND COLD-FORMED STEEL TRUSSES -
SPECIAL INSPECTION SCHEDULE**

STEEL CONSTRUCTION - STEEL DECK; OPEN WEB STEEL JOISTS AND JOIST GIRDERS; AND COLD-FORMED STEEL TRUSSES - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection ⁽¹⁾ (During Task Listed)	
		Continuous	Periodic
1. Cold-formed steel deck:			
a. Materials: Identification markings in accordance with ASTM standards specified in the approved construction documents.	Applicable ASTM material standards		●
b. Materials: Manufacturer's certified test reports.			●
c. Welding: Floor and roof deck welds.	AWS D1.3		●
2. Open web steel joints and joist girders:			
a. End connections - welded or bolted	SJI specs		●
b. Bridging - horizontal or diagonal	SJI specs		●
3. Cold-formed steel:			
a. Trusses: Inspect temporary and permanent installation restraints/bracing conform to approved truss submittal.	Building Code		●
Notes: (1) "●" represents a required inspection activity for the project where it occurs.			

ATTACHMENT H - NOT USED

ATTACHMENT I - NOT USED

SECTION 01_50_00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Furnishing, maintaining, and removing construction facilities and temporary controls, including temporary utilities, construction aids, barriers and enclosures, security, access roads, temporary controls, project sign, field offices and sheds, and removal after construction.

1.02 REFERENCE

- A. American National Standards Institute (ANSI).
- B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.

1.04 TEMPORARY UTILITIES

- A. Temporary electrical power:
 - 1. Owner provides the power.
 - a. Temporary electrical power is available at the following locations:
 - 1) MCC-22, at the existing Dewatering Building.
 - b. The Contractor is responsible for providing breakers, switches, transformers, and cables required to obtain temporary power from these location(s).
 - c. Temporary power cables shall be diesel locomotives type and be protected in above ground rigid conduits during the installation of MCC-65 and PCM-910.
 - d. The Owner will pay charges for construction power obtained from these locations.
 - 2. Provide and maintain adequate job-site power distribution facilities conforming to applicable Laws and Regulations.
- B. Temporary power and controls:
 - 1. Provide temporary power cables to extend power to existing gravity thickeners, the Centrate Pump Station and the Recycle Decant Pump stations from existing MCC-22 when the existing electrical ductbank is removed.
 - 2. Provide any temporary power and controls required to operate the new pumps if the new MCC-65 is delayed due to long lead times. Temporary power shall

- be constructed in accordance with the NEC and, at minimum, with capacity and means to run the following loads:
- a. One 480-volt, 3-phase, 3-wire, VFD for the new 15 horsepower Thickened Sludge Feed Pump.
 - b. One 480-volt, 3-phase, 3-wire, VFD for the new 15 horsepower Thickened Sludge Transfer Pump.
 - c. One 480-volt, 3-phase, 3-wire, 30-amp feeder breaker to power new Inline Sludge Grinder.
 - d. One 480-volt, 3-phase, 3-wire, 15-amp feeder breaker to power new Gravity Thickener Valve.
 - e. The VFDs shall be wired to run OFF/ON, in manual, or in automatic like the control schematic shown on contract drawing.
3. Contractor shall transfer the pumps to and from temporary power, one at a time.
- C. Temporary electrical lighting:
1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
 2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
 - a. Prior to Substantial Completion of the Work, replace bulbs, lamps, or tubes used by Contractor for lighting.
- D. Temporary heating, cooling, and ventilating:
1. The existing gas-fired unit heater installed inside the existing gravity thickener must remain operational through construction. The contractor is responsible for providing all temporary gas piping, pressure regulating and shutoff valves for safe operation.
 2. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.
 3. Permanent heating system may be utilized when sufficiently completed to allow safe operation.
- E. Temporary water:
1. Non-potable water (UW2) is available from hydrants or hose valves within plant without cost. When combined demand of the Work and plant exceeds plant supply capacity, provide additional temporary supply capacity.
- F. Temporary fire protection:
1. Provide fire protection required to protect the Work and ancillary facilities.
- G. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.
- H. Utilities in existing facilities: As specified in Section 01_14_00 - Work Restrictions.
- I. Temporary piping systems:
1. Submit layout drawings showing proposed routing of piping, including proposed pipe support and pipe restraint locations.

2. Submit product data for piping, fittings, appurtenances, restraints, supports, and other components of the temporary piping system.
3. Submit information at least 28 days prior to when each temporary piping system is scheduled to be installed and allow 14 days for review and comment.

1.05 CONSTRUCTION AIDS

- A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.
- B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.
- C. Design temporary supports with adequate safety factor to ensure adequate load bearing capability:
 1. When requested, submit design calculations by professional registered engineer prior to application of loads.
 2. Submitted design calculations are for information and record purposes only.
- D. Accident prevention:
 1. Exercise precautions throughout construction for protection of persons and property.
 2. Observe safety provisions of applicable Laws and Regulations.
 3. Guard machinery and equipment and eliminate other hazards.
 4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
 5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.
- E. Barricades:
 1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
 2. Provide barriers with flashing lights after dark.
 3. Keep barriers in place until excavations are entirely backfilled and compacted.
 4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.
- F. Warning devices and barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers:
 1. Provide devices in accordance with minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.
- G. Hazards in public right-of-way:
 1. Comply with local jurisdiction standards and requirements for right-of-way barricades and other safety devices.

2. Mark at reasonable intervals, trenches, and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours:
 - a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
 3. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades:
 - a. During hours of darkness, provide warning lights at close intervals.
- H. Hazards in protected areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.
- I. Above grade protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.
- J. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage, or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.
- K. Fences:
1. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons.
 - a. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.
 2. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
 3. Fence temporary openings when openings are no longer necessary.

1.06 SECURITY

- A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.07 ACCESS ROADS

- A. General:
1. Build and maintain access roads to and on site of the Work to provide for delivery of material and for access to existing and operating plant facilities on site.
 2. Build and maintain dust free roads which are suitable for travel at 20 miles per hour.
- B. Off-site access roads:
1. Build and maintain graded earth roads.
 2. Build roads only in public right-of-way or easements obtained by Owner.
 3. Obtain rights-of-way or easements when electing to build along other alignment.

- C. On-site access roads:
 - 1. Refer to drawings for road requirements to support continuous operation of existing sludge dewatering operations.
 - 2. Maintain access roads to storage areas and other areas to which frequent access is required.
 - 3. Maintain similar roads to existing facilities on site of the Work to provide access for maintenance and operation.
 - 4. Protect buried vulnerable utilities under temporary roads with steel plates, wood planking, or bridges.
 - 5. Maintain on-site access roads free of mud.
 - 6. Provide controls to prevent vehicles leaving the site from tracking mud off the site onto the public right-of-way.

1.08 TEMPORARY CONTROLS

- A. Dust control:
 - 1. Prevent dust nuisance caused by operations, unpaved roads, excavation, backfilling, demolition, or other activities.
 - 2. Control dust by sprinkling with water, use of dust palliatives, modification of operations, or other means acceptable to agencies having jurisdiction.
- B. Noise control:
 - 1. Comply with noise and work hours regulations by local jurisdiction.
 - 2. In or near inhabited areas, particularly residential, perform operations in manner to minimize noise.
 - 3. In residential areas, take special measures to suppress noise during night hours.
- C. Mud control:
 - 1. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

1.09 PROJECT SIGN

- A. Provide and maintain Project identification sign consisting of painted 8-foot-wide by 4-foot-high exterior grade plywood and minimum 10-foot-long, 4-by-4 lumber posts, set in ground at least 3 feet, with exhibit lettering by professional sign painter using no more than 5 sign colors:
 - 1. List at least the title of the Project, and names of the Owner, Engineer, and Contractor.
 - 2. Identify Contractor's, Engineer's, names in upper right-hand corner underneath the bid number.
- B. On third and fourth lines of printing, paint appropriate dollar amounts.
- C. Erect Project identification sign where directed by Engineer within 14 days after the issuance of the Notice to Proceed.
- D. Replace or repair the project sign if it is damaged or covered with graffiti within 2 working days of observation or notification of damage or graffiti.

1.10 CONTRACTOR FIELD OFFICES AND SHEDS

- A. Maintain on Project Site weather tight space in which to keep copies of Contract Documents, progress schedule, shop drawings, and other relevant documents.

1.11 REMOVAL

- A. Remove temporary facilities and controls before inspection for Substantial Completion or when directed.
- B. Clean and repair damage caused by installation or use of temporary facilities.
- C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.
- D. Restore existing facilities used during construction to specified or original condition.

1.12 TEMPORARY PROCESS PIPING SYSTEMS

- A. Provide piping, appurtenances, and other materials as required to provide temporary piping systems as specified in this Section, as indicated on the Drawings, and as needed to perform the Work.
- B. Provide field route piping as needed and as field conditions dictate, unless otherwise indicated on the Drawings, and determine appropriate lengths of piping and quantity/type of pipe fittings needed to construct temporary piping system. Do not block access points such as stairs, doors, and walkways to existing facilities unless approved in writing by the Owner.
- C. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
 - 1. When piping is buried, use concrete thrust block or mechanical restraints.
 - 2. When piping is exposed or under water, use mechanical or structural restraints.
 - 3. Determine thrust forces by multiplying the nominal cross sectional area of the piping by the operating pressure of the piping.
- D. Install temporary piping systems in a manner that will not damage existing or new facilities.
- E. Piping material, including gaskets: Suitable for the process fluid requiring temporary piping, unless indicated otherwise.
- F. Temporary piping includes, but is not limited to, the following piping services:
 - 1. Gravity Thickener Piping:
 - a. Existing 6-inch TS piping to existing Dewatering Building and to new Sludge Pump Station.
 - b. Existing 1-inch NG piping from existing Dewatering Building to Gravity Thickener 2.
 - c. Existing 12-inch TE piping from Gravity Thickeners 1 and 2. Existing 12-inch TE piping may be rerouted permanently as shown on drawings.

- d. Existing 12-inch DR piping from Gravity Thickeners to Recycle Decant Pump Station.
- 2. Existing 2-inch UW2 piping from the Dewatering Building to each gravity thickener.
- G. After temporary piping system is no longer required:
 - 1. Remove temporary piping system.
 - 2. Clean and repair damage caused by installation or use of temporary piping system.
 - 3. Restore existing facilities to original condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_56_17

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Installation of erosion and sediment control filter fabric fences.
- B. Purpose of control fences is to contain pollutants from overland flow.
 - 1. Control fences are not for use in channelized flow areas.

1.02 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.

1.03 REFERENCES

- A. ASTM International (ASTM):
 - 1. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
 - 2. D4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.
 - 3. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 4. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 5. D4833 - Standard Test Method for Index Puncture Resistance of Geomembranes, and Related Products.
 - 6. D5665 - Standard Specification for Thermoplastic Fabrics Used in Cold-Applied Roofing and Waterproofing.
 - 7. D6459 - Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion.
 - 8. D6475 - Standard Test Method for Measuring Mass per Unit Area of Erosion Control Blankets.
 - 9. D6525 - Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products.
 - 10. D6567 - Standard Test Method for Measuring the Light Penetration of a Rolled Erosion Control Product (RECP).
 - 11. D6818 - Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products.

1.04 QUALITY ASSURANCE FOR EROSION CONTROL BLANKETS

- A. Product shall be manufactured in accordance with a documented quality control program. At a minimum, the following procedures and documentation shall be provided:
 - 1. Manufacturing Quality Control Program Manual.
 - 2. First piece inspection of products produced to assure component materials and finished product tolerances are within the manufacturer's specifications.
 - 3. Additional inspections for product conformance shall be conducted during the run after the first piece inspection.
 - 4. Every roll shall be visually inspected.
 - 5. Moisture content of straw and coconut fibers measured upon receipt.
 - 6. At a minimum, every third roll shall be weighed to ensure conformance with the manufacturer's specifications.
 - 7. Each individual erosion control blanket shall be inspected prior to packaging for conformance to manufacturing specifications.

1.05 PERFORMANCE REQUIREMENTS FOR EROSION CONTROL BLANKETS

- A. Shall provide a temporary biodegradable cover material to reduce slope and enhance vegetation.
- B. Performance capabilities shall be in accordance with ASTM D6459.

PART 2 PRODUCTS

2.01 FILTER FABRIC

- A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric:
 - 1. Grab strength of 100 pounds per square inch in any principal direction in accordance with ASTM D4632.
 - 2. Puncture strength exceeding 115 pounds per square inch in accordance with ASTM D4833.
 - 3. Equivalent opening size between 50 and 140 for soils with more than 15 percent by weight passing No. 200 sieve and between 20 and 50 for soil with less than 15 percent by weight passing No. 200 sieve.
 - 4. Maximum water flow rate of 40 gallons per minute per square feet in accordance with ASTM D4491.
- C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide expected usable life comparable to anticipated construction period.
 - 1. Ultraviolet stability shall exceed 70 percent after 500 hours of exposure in accordance with ASTM D4355.
- D. Manufacturers: The following or equal:
 - 1. Mirafi, Inc.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

- A. Provide erosion and sediment control systems at locations as indicated on the Drawings.
 - 1. Construct in accordance with requirements as indicated on the Drawings and of type specified in this Section.
- B. No clearing, grubbing, or rough cutting permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Project manager to allow soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within the Project Site until acceptance of the Project or until directed by the Project manager to remove and discard existing system.
- D. Regularly inspect and repair or replace damaged components of erosion and sediment control systems as specified in this Section.
 - 1. Unless otherwise directed, maintain erosion and sediment control systems until the Project area stabilization is accepted by the Owner.
 - 2. Remove erosion and sediment control systems promptly when directed by the Project manager.
 - 3. Discard removed materials offsite.
- E. Remove and dispose sediment deposits at designated spoil site for the Project.
 - 1. If a spoil site is not indicated on the Drawings, dispose of sediment offsite at a location not in or adjacent to a stream or floodplain.
 - 2. Assume responsibility for off-site disposal.
 - 3. Spread sediment evenly throughout the Site, compacted and stabilized.
 - 4. Prevent sediment from flushing into a stream or drainage way.
 - 5. If sediment has been contaminated, dispose of in accordance with existing federal, state, and local rules and regulations.
- F. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers.
 - 1. Compaction density shall be at a minimum of 90 percent Standard Proctor ASTM D698 density.
 - 2. Make at least 1 test per 500 cubic yards of embankment.
- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction.
 - 1. Immediately repair damage caused by construction traffic to erosion and sediment control.

3.02 GENERAL CONSTRUCTION METHODS

- A. Provide erosion and sedimentation control systems as indicated on the Drawings.
 - 1. Install erosion and sedimentation control systems in manner that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.

- B. Inspect erosion and sedimentation control systems after each rainfall, daily during periods of prolonged rainfall, and at minimum once each week.
 - 1. Repair or replace damaged sections immediately.
 - 2. Remove sediment deposits when silt reaches a depth 1/3 height of fence or 6 inches, whichever is less.

3.03 FILTER FABRIC FENCE CONSTRUCTION METHODS

- A. Attach filter fabric to 1-inch by 2-inch wooden stakes or driven steel rods spaced a maximum of 3 feet apart and embedded minimum of 8 inches or deeper to hold the fence in place.
 - 1. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 8 feet.
 - 2. Install anchoring stakes or rods at slight angle toward source of anticipated runoff.
 - 3. Contractor is responsible for providing adequate fence anchoring appropriate for the varying soil and rock conditions at the well sites.
- B. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow.
 - 1. V-trench configuration as indicated on the Drawings may also be used.
 - 2. Lay filter fabric along edges of trench.
 - 3. Backfill and compact trench.
- C. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
- D. Provide filter fabric in continuous rolls and cut to length of fence to minimize use of joints.
 - 1. When joints are necessary, splice fabric together only at support post with minimum 6-inch overlap and seal securely.

END OF SECTION

SECTION 01_60_00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for products.

1.02 TERMINOLOGY

- A. The words and terms listed below, are not defined terms that require initial capital letters, but, when this Section is referenced in other Specifications, have the indicated meaning.
 - 1. Manufacturer's instructions:
 - a. Stipulations, directions, and/or recommendations issued by the manufacturer of the product addressing handling, storage, installation, protection, erection, and/or application of the product.
 - 2. Product data:
 - a. Information about the product, typically found in the manufacturer's catalogs specifications or other resources, including data sheets, bulletins, and brochures.
 - 3. Spare parts and maintenance products:
 - a. Duplicate parts necessary to replace a damaged or worn part of the product.
 - b. Consumables such as operating fluids.
 - 4. Special tools:
 - a. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a product that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.

1.03 SHIPMENT

- A. Requirements prior to shipment of equipment:
 - 1. Engineer approved Submittals or other written documentation allowed by the Contract Documents.
 - 2. Engineer approved Manufacturer's Certificate of Source Testing.
 - 3. Operations and maintenance manuals as specified in Section 01_78_24 - Operation and Maintenance Manuals and the Technical Sections.
- B. Transport products by methods that avoid product damage.
- C. Deliver products in undamaged condition in the manufacturer's unopened packaging.

1.04 DELIVERY AND HANDLING

- A. Handle products in accordance with the manufacturer's instructions.
- B. Deliver products in undamaged condition in the manufacturer's unopened packaging.
- C. Provide construction equipment and personnel to handle products by methods in accordance with the manufacturer's instructions.
- D. Upon delivery, promptly inspect shipments:
 - 1. Verify compliance with the Contract Documents, correct quantities, and undamaged condition of products.
 - 2. Acceptance of shipment does not constitute final acceptance of products.
- E. Owner may request advanced delivery of spare parts, maintenance products, and special tools.
 - 1. Deduct the delivered items from the inventory list and provide transmittal documentation.

1.05 STORAGE

- A. Immediately store and protect products until installed in the Work.
- B. Store products with seals and legible labels intact.
- C. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage.
- D. Storage of equipment in accordance with the manufacturer's instructions.
 - 1. Including connection of motor heaters, lubrication, manually rotating shafts, etc.
 - 2. Furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of equipment and materials.
- E. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for mechanical equipment, valves, architectural items, electrical and instrumentation equipment.
- F. Storage of spare parts, maintenance products, special tools.
 - 1. Immediately store in accordance with the manufacturer's instructions.
 - 2. Store spare parts, maintenance products, and special tools in an enclosed, weather-proof, and lighted facility during the construction period.
 - 3. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
 - 4. Store large items individually:
 - a. Weight: Greater than 50 pounds.
 - b. Size: Greater than 24-inches wide by 18-inches high by 36-inches long.
 - c. Clearly labeled:
 - 1) Equipment tag number.
 - 2) Equipment manufacturer.
 - 3) Subassembly component, if appropriate.

5. Store smaller items in spare parts boxes:
 - a. Weight: Less than 50 pounds.
 - b. Size: Less than 24-inches wide by 18-inches high by 36-inches long.
 - c. Clearly labeled:
 - 1) Equipment tag number.
 - 2) Equipment manufacturer.
 - 3) Subassembly component, if appropriate.
6. Spare parts and special tools box:
 - a. Box material: Waterproof, corrosion resistant.
 - b. Hinged cover with locking hasp:
 - 1) Inventory list taped to underside of cover.
 - 2) Clearly labeled:
 - a) "Spare Parts and/or Special Tools".
 - b) Equipment tag number.
 - c) Equipment manufacturer.
 - d) Subassembly component, if appropriate.
- G. Exterior storage of fabricated products:
 1. Place on aboveground supports that allow for drainage.
 2. Cover products subject to deterioration with impervious sheet covering.
 3. Provide ventilation to prevent condensation under covering.
- H. Store moisture sensitive products in watertight enclosures.
- I. Store loose granular materials on solid surfaces in well-drained area.
 1. Prevent materials mixing with foreign matter.
 2. Provide access for inspection.
- J. Provide an equipment log and stored products log with monthly pay applications.
 1. Include: Storage location, equipment or product identification, date stored, date of inspection/maintenance, date removed from storage, copy of manufacturer's recommended storage guidelines, description of inspection/maintenance activities performed, and signature of party performing inspection/maintenance.
- K. When needed and approved by the Engineer, offsite storage location shall be within 20 miles of the Project Site.
 1. Provide proof of insurance coverage for products stored offsite.
- L. Payment will not be made for products improperly stored or stored without providing the Engineer with the manufacturer's instructions for storage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide products by the same manufacturer when units are of similar nature, unless otherwise specified.
- B. Provide like parts of duplicate units that are interchangeable.

- C. Provide equipment or products that have not been in service prior to delivery, except as required by tests.
- D. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
 - 1. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- E. Provide products produced by manufacturers regularly engaged in the production of these products.
- F. Provide products that bear approvals and labels as specified such as Factory Mutual (FM), Underwriters Laboratory (UL), or National Sanitation Foundation (NSF International) that are acceptable to the Authority Having Jurisdiction.

2.02 MATERIAL

- A. Dissimilar metals:
 - 1. Separate contacting surfaces with dielectric material.
 - 2. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators, washers, petrolatum tape, or other materials as specified.
 - 3. Dielectric coatings can be used to separate dissimilar metal couples from surrounding environment if isolation of metals is not possible, with approval of the Engineer.
- B. Edge grinding:
 - 1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence and mitigate any safety hazard.
 - 2. A surface profile will need to be re-established for coating adherence based on coating manufacturer's profile requirements.
- C. Use anti-galling compound on threads of stainless steel fasteners during factory assembly.
- D. Provide anti-galling compound with stainless steel fasteners shipped for field assembly.
- E. Aluminum in contact with concrete or masonry: Apply epoxy mastic as specified in Section 09_96_01 - High-Performance Coatings, coating system EPX-M-5.

2.03 PRODUCT SELECTION

- A. When products are specified without named manufacturers, provide products that meet or exceed the Specifications.
- B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide products by one of the named manufacturers that meet or exceed specifications.

- C. When products are specified with names of manufacturers and model numbers or catalog designations, provide products with model numbers or catalog designations by one of the named manufacturers.
- D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
 - 1. Products specified by brand or trade name, model number, or catalog designation.
 - 2. Products by another named manufacturer proven, in accordance with requirements for an “or equal”, including the Engineer’s approval, to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.
- E. When products are specified with only one manufacturer followed by “or equal,” provide:
 - 1. Products meeting or exceeding specifications by specified manufacturer.
 - 2. Engineer deemed “or equal” evidenced by an approved Shop Drawing or other written communication.
- F. When products are specified by naming 2 or more manufacturers with 1 manufacturer as a “Basis of Design”:
 - 1. Any of the named manufacturers can be submitted.
 - 2. If the product submitted is not by the named “Basis of Design” product and requires a change in the scope (dimensions, configuration, physical properties, etc.), schedule (longer lead time), or budget, the Contractor must submit a substitution request.

2.04 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

- A. Provide spare parts and maintenance products as required by Technical Sections.
 - 1. Submit completed Attachment A - Spare Parts, Maintenance Products, and Special Tools Inventory List.
- B. Provide 1 set of special tools required to install or service the equipment.
- C. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to the Owner at a location on site, chosen by the Owner.
 - 1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
 - 2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.
- D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by the Owner.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Inspect equipment or products prior to installation.
- B. Repaint or recoat damaged painted or coated surfaces after installation.
- C. Use anti-galling compound on stainless steel threads used for field assembly.

3.02 PROTECTION AFTER INSTALLATION

- A. Provide coverings as necessary to protect installed products from damage due to traffic and subsequent construction operations.
 - 1. Remove covering when no longer needed.
 - 2. Replace corroded, damaged, or deteriorated products before acceptance of the Project.
- B. Update equipment log with monthly pay applications.
 - 1. Data includes as a minimum: Description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

END OF SECTION

**ATTACHMENT A - SPARE PARTS, MAINTENANCE PRODUCTS,
AND SPECIAL TOOLS INVENTORY LIST**

SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

Owner: _____ Date: _____
Contractor: _____ Project No.: _____
Project Name: _____

Inventory List				
Spec Number: _____		Spec Title: _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	Subassembly Component	Description	Manufacturer's Part Number	Storage Location

SECTION 01_75_17

COMMISSIONING

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PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Commissioning.
- B. See HVAC/Mechanical, electrical, and instrumentation/control sections for other more specific commissioning requirements.

1.02 DEFINITIONS

- A. Commissioning: The process of planning for, testing of, and start-up of systems, subsystems, equipment, components, and devices of the Work to demonstrate, through documented verification, that the Work has successfully met the Contract Documents. It includes training the Owner's staff on operation and maintenance of the installed Work.
- B. Commissioning Phases: The activities of commissioning are grouped into the phases defined in the following table.
 - 1. Table 1 - Commissioning Phases.

TABLE 1 - COMMISSIONING PHASES		
Planning Phase	Testing and Training Phase	Start-Up Phase
Draft Test Plans	Source Testing: • Documentation	Start-Up: • Documentation • Owner Training
	Installation Verification: • Documentation • Owner Training	
	Functional Testing: • Documentation • Owner Training	

- 2. Attachment A provides Commissioning Flowcharts.

- C. Component: A part of a system that does not have an electrical connection or internal electronics. Examples: Piping and pressure gauges.
- D. Device: A part of a system that has electrical connections or internal electronics. Examples: Level transmitter or pressure transmitter.
- E. Electrical Energization Plan: A plan to manage how and when power is applied to electrical equipment.
- F. Equipment: A factory or field assembled apparatus that performs an identifiable function. Examples: Pumps, motors, VFDs, MCCs.

- G. Functional Testing: Testing performed on a completed subsystem or system to demonstrate that the system meets the specified requirements. Example systems: Backwash system, dewatering system.
- H. Installation Verification: Testing to demonstrate that equipment or system and associated components or devices have been properly installed. Example equipment: Pumps, meters, and blowers with associated piping.
- I. Manufacturer's Certificate of Functional Compliance: The form completed by the manufacturer to confirm that testing of the installed equipment or system has been performed and the results conform to the specified performance. The form is provided in Attachment D provided at the end of this Section.
- J. Manufacturer's Certificate of Installation Verification: The form completed by the manufacturer to confirm that the equipment or system is installed in conformance with the Contract. The form is provided in Attachment C at the end of this Section.
- K. Manufacturer's Certificate of Source Testing: The form completed by the manufacturer to confirm that the specified source tests have been performed and the results conform to the specified requirements. The form is provided in Attachment B at the end of this Section.
- L. Owner Training: The Owner's staff is trained by the Contractor, with assistance from manufacturer, to operate and maintain the completed Work. This is sometimes referred to as Vendor Specific Training.
- M. Process Stream: A series of liquid or solids flow processes that are designed to improve the water quality to meet regulatory permit requirements.
- N. Source Testing: Test equipment or products for performance at point of manufacture or assembly for the requirements specified in the Contract Documents. Also referred to as factory testing and factory acceptance testing (FAT).
- O. Start-Up: Operating the Work with process water to verify the Work meets the Contract Documents.
- P. Start-Up Phase: The phase when Start-Up occurs.
- Q. Subsystem: A grouping of equipment, components, and devices that is a part of a larger system and that perform a single definable function. Examples: Sand filters, filter backwash.
- R. System: A grouping of equipment, components, and devices that perform a single definable function. If a system is a part of a larger system, it is referred to as a subsystem.
 - 1. Examples: Flocculation and sedimentation, filtration.
- S. System Testing: Testing of a completed system for an extended time period. Examples: Headworks, filtration.

- T. Water Management Plan: A plan to manage the test water used for commissioning from source to disposal. The test water may be clean water, potable water, non-potable water, or process water (e.g., raw water, plant water, sludge). The plan demonstrates how water will be produced, conveyed, treated, disposed of as directed by the plant manager, and/or recycled.
- U. Solids Management Plan: A plan to manage the test solids for commissioning from source to disposal. The source of test solids is existing gravity thickeners and majority of test solids will be disposed of using existing centrifuge dewatering equipment and only minor amounts of solids can be discharged to plant drains or settling ponds.

1.03 SUBMITTALS

- A. Project Commissioning:
 - 1. Commissioning Coordinator's qualifications.
 - a. Submit to Owner and Engineer no later than 30 days after Notice to Proceed.
 - b. Describe previous similar experience on similar projects with a list of references, including phone numbers.
 - c. Provide names and qualifications of commissioning assistants, if applicable.
 - 2. Schedules:
 - a. Commissioning Schedule containing all commissioning activities.
 - b. Owner Training Schedule.
 - 3. Test Plans:
 - a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
 - 1) Owner and Engineer approval of draft Test Plans required for successful completion of Planning Phase.
 - b. Submit final Test Plan a minimum of 45 calendar days prior to testing.
 - c. Owner and Engineer approval of final Test Plan required prior to start of testing.
 - 4. Test Reports:
 - a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
 - 1) Owner and Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
 - b. Submit final Test Report a maximum of 30 calendar days after testing.
- B. Technical Sections Commissioning:
 - 1. Manufacturer's representative's qualifications.
 - a. Submit to Owner and Engineer no later than 30 days in advance of required services.
 - b. Representative's name, phone, and e-mail address:
 - 1) May use 2 representatives: 1 for field testing and 1 for Owner Training.
 - 2) Provide resume stating instructor's technical expertise and instructional technology skills and experience.
 - 2. Provide submittals required in Section 23_05_93 – Testing, Adjusting, and Balancing for HVAC and Section 26_08_50 – Field Electrical Acceptance Tests.

3. Test Plans:
 - a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
 - 1) Owner and Engineer approval of draft Test Plans required for successful completion of Planning Phase.
 - b. Submit final Test Plan a minimum of 45 calendar days prior to testing.
 - c. Owner and Engineer approval of final Test Plan required prior to start of testing.
4. Test Reports:
 - a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
 - 1) Owner and Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
 - b. Submit final Test Report a maximum of 30 calendar days after testing.
5. Manufacturer's representatives field notes and data.
6. Owner Training:
 - a. Prior to the training session:
 - 1) Training instructor qualifications.
 - 2) Training course materials: Due 30 calendar days prior to initial training session.
 - a) If Owner requires, Continuing Education Units (CEUs), submit training materials to state regulatory agency in sufficient time to obtain approval for training prior to the training.
 - b) Drafts of training agenda, lesson plan, presentation, handouts, and list of audio-visual aids.
 - c) Format: 1 electronic copy in the format specified by the Owner and 3 hard copies organized in notebooks.
 - b. Post training session:
 - 1) Training course materials: Due 14 calendar days after class completion.
 - a) Recordings.
 - b) Class attendance sheet.
 - c) Final version of training agenda, final lesson plan, presentation, handouts, and audio-visual aids.
 - d) Format: 1 electronic copy in the format specified by the Owner and 3 hard copies organized in notebooks.
 - 2) Provide materials for all sessions of the class in a single transmittal.
 - 3) If the Owner requires training CEUs, issue training CEU certificates approved by the state regulatory agency to Owner's staff who successfully completed the training.

1.04 COMMISSIONING COORDINATOR (CC)

- A. Responsibilities include the following:
 1. Part-time person.
 2. Become thoroughly familiar with Contract Commissioning requirements.
 3. Provide the primary interface with Engineer and Owner for Commissioning efforts.
 4. Lead Commissioning efforts - all phases and tasks.
 5. Coordinate training efforts.

6. Meetings:
 - a. CC is responsible for setting Commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
 - b. CC shall conduct Commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
 - c. Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of Commissioning activities.
- B. CC on site:
 1. Testing and Training Phase: Full-time.
 2. Start-Up Phase: Full-time.

1.05 MANUFACTURER'S REPRESENTATIVES

- A. Qualifications: As specified below and in the Technical Sections:
 1. For Installation and Functional Testing:
 - a. Factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
 2. Training instructor qualifications:
 - a. Provide resume stating instructor's technical preparation and instructional technology skills and experience.
 - b. If CEUs are required, the operator training instructors must comply with state regulatory.
 - c. Knowledgeable in the equipment/system for which they are training.
 - d. Experienced in conducting classes.
 - e. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
 3. Representatives to be approved by Owner and Engineer.
 4. No substitute representatives without written approval by Owner and Engineer.
- B. Duties:
 1. Determine if additional time and/or trips (beyond those specified in the Technical Sections) is required to perform the specified services.
 2. Coordinate services in accordance with the Contractor's Project schedule, up to and including making multiple trips to the Project Site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.
 3. Perform on-site services as specified in the Technical Sections.
 4. Provide daily copies of manufacturer's representatives field notes and data to Contractor.

1.06 PLANNING PHASE

- A. Overview of Planning Phase:
 1. Define approach and timing for Commissioning.
 2. Obtain Engineer approval of draft Test Plans.

- B. Test Plans.
1. Define approach and timing for:
 - a. Testing and Training Phases.
 - 1) Major systems, with separate plans for each system.
 - b. Start-Up Phase.
 - c.
 2. Source Test (Factory Acceptance Test) and Functional Test Plans:
 - a. As specified in this Section and other Technical Sections.
 - b. Based on approved Shop Drawings.
 - c. Prepared by the Contractor.
 - d. Include the following items for each test:
 - 1) Purpose of the test.
 - 2) Identification of each item of equipment/system to be tested, including system designation, location, tag number, control loop identifier, etc.
 - 3) Description of the pass/fail criteria that will be used.
 - 4) Listing of pertinent reference documents (Contract and industry standards or sections applicable to the testing).
 - a) Credentials of test personnel.
 - 5) Test equipment:
 - a) Include Product Data for the test equipment.
 - b) Appropriate calibration records.
 - (1) Drawings or photographs of test stands and/or test apparatus.
 - 6) Duration: Determine test durations with Owner's input.
 - 7) Detailed step-by-step test procedures.
 - a) Level of detail shall be sufficient for the witness to follow the steps.
 - e. Define for Functional Testing:
 - 1) Required temporary systems (pumps, piping, etc.).
 - 2) Shutdown requirements for existing systems.
 - f. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to testing activities.
 3. Test forms minimum requirements:
 - a. Name of product to be tested.
 - b. Test date.
 - c. Names of persons conducting the test.
 - d. Names of persons witnessing the test, where applicable.
 - e. Test data.
 - f. Applicable project requirements as specified in the Technical Sections.
 - g. Check offs for each completed test or test step.
 - h. Place for signature of person conducting tests and for the witnessing person, as applicable.
 4. Owner responsibilities:
 - a. Owner will schedule staff within the constraints of their workloads.
 - 1) Those who will participate in this test have existing full-time work assignments, and testing is an additional assigned work task, therefore, scheduling is imperative.
 - 2) Treatment facilities are typically operated on an around-the-clock basis and are staffed in work shifts.
 - 1) Maximum hours per day available for commissioning activities: 8.

- 2) Days available for commissioning activities: Tuesday and Wednesday.
 - 3) Scheduling coordination with the CC.
 - 5. CC is responsible for the following:
 - a. Coordinate schedule with the Owner's personnel and manufacturer's representatives (instructors).
- C. Test Reports:
 - 1. Minimum requirements:
 - a. Title.
 - b. Abstract.
 - c. Equipment.
 - d. Procedures.
 - e. Results.
 - 1) Complete disclosure of the calculation methodologies.
 - f. Conclusions.
 - g. Signature by an authorized party.
 - h. Appendices.
 - 1) Completed test forms signed by witnesses.
 - 2. Solids and/or Water Management Plans:
 - a. Requirements:
 - 1) Demonstrate how water will be produced, conveyed, treated, recycled, and or disposed until testing verifies specified requirements.
 - 2) Determine how solids used for testing of equipment will be managed.
 - 3. Commissioning Schedule:
 - a. Content:
 - 1) Comply with Attachment G - Functional Testing Requirements and provide activities organized by system and subsystem.
 - 2) Include:
 - a) Source Testing when required.
 - b) Functional Testing.
 - c) Owner Training.
 - 3) Comply with Attachment F - Commissioning Roles and Responsibilities Matrix.
 - b. Procedures:
 - 1) Submit Commissioning Schedule as specified in Section 01_32_21 - Schedules and Reports.

1.07 TESTING AND TRAINING PHASE

- A. Overview of Testing and Training Phase:
 - 1. General:
 - a. Contractor tests the Work to verify it meets the Contract requirements.
 - b. Contractor trains the Owner to operate and maintain the Work.
 - 2. Contractor responsibilities:
 - a. Furnish labor, and temporary power tools, equipment, instruments, and services required for and incidental to completing Commissioning activities in accordance with the approved Commissioning Plans.

3. Owner responsibilities:
 - a. Furnish labor, power feed from existing MCC-22 or new MCC-65, and services required for and incidental to completing Commissioning activities in accordance with the approved Commissioning Plans.
 - b. Owner provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.

- B. Source Testing:
 1. As specified in the Technical Section.
 2. Source Test Plan:
 - a. Engineer approval of Source Test Plan required prior to testing.
 3. Witnessed in person:
 - a. As specified in the Technical Section.
 - b. Contractor is responsible for trip costs associated with Owner's and Engineer's representatives.
 - 1) Transportation:
 - a) Commercial airline costs to and from Salt Lake City International Airport, including related fees.
 - b) Rental car to and from arrival airport, hotel, and test site, including related fees.
 - 2) Hotel/Meals:
 - a) Hotel with an American Automobile Association 3 Diamond rating or higher equivalent for single occupancy room per person per day.
 - b) Meal allowance based on state government per diem guidelines per test site location.
 - c. When factory is located outside of the United States, Contractor is responsible for costs associated with additional security of Owner's and Engineer's representatives, including armed escorts, as determined appropriate by the Owner and/or Engineer.
 4. Virtual witness testing:
 - a. As specified in the Technical Sections.
 - b. Contractor is responsible for costs associated with virtual witness.
 - c. Provide the following:
 - 1) An agenda detailing start time of each major phase in the procedure defined in the approved Test Plan.
 - 2) A dedicated operator (separate from the test technician) to operate the camera, provide commentary throughout test, and inspect devices at the request of the attendees.
 - d. Online meeting platform: Microsoft Teams.
 - e. Share video through a high-definition camera.
 - f. Establish methods to communicate, convey, and record information clearly even in environments with loud background noise.
 - 1) Electronic feed for screen sharing of the control panel, HMI, or other screens used throughout testing.
 - 2) Provide recording of virtual sharing within 1 day after testing.
 - g. Test run of virtual sharing a minimum of 1 week prior to the test:
 - 1) Use current record documents in PDF format.
 - 2) Provide recording of virtual sharing within 1 day after the test run.
 - 3) Engineer approval of test run virtual sharing is required before Source Testing.

5. If the Source Test is not ready on the scheduled date or if the Source Test fails:
 - a. Contractor is responsible for associated costs:
 - 1) First test costs that are non-refundable, if applicable.
 - 2) Repeat test costs:
 - a) Trip costs, if applicable.
 - 3) Virtual witness costs, if applicable.
 - a) Witness labor costs:
 - (1) Travel time and witness time are included, if applicable.
 - (2) The greater of \$200 per hour or \$1,600 per day.
 6. Source Testing is complete after successful testing, submittal of test report, and Manufacturer's Certificate of Source Testing.
 7. Engineer approval of Source Testing Report is required.
- C. Installation Verification:
1. Overview:
 - a. Verifying the installation of equipment to be in accordance with Manufacturer's Instructions.
 2. Prerequisite:
 - a. Engineer approval of Source Testing Report.
 3. Perform checks:
 - a. Structural anchorage check.
 - b. Electrical energization check.
 - 1) As specified in the flowchart shown in Attachment A.
 - c. Health and safety check.
 4. Submit Manufacturer's Certificate of Installation Verification.
 5. Engineer approval of Manufacturer's Certificate of Installation Verification is required.
- D. Functional Testing:
1. Overview:
 - a. Testing the function of a system or subsystem.
 - b. Verify Gravity Thickener Performance.
 - 1) Influent Splitter Box:
 - a) Turbidity (NTU) and
 - b) Total Suspended Solids (TSS in mg/L) concentration.
 - 2) (Thickener Effluent) Turbidity: Maximum 1 NTU.
 - 3) Underflow TSS Concentration (mg/L) as measured at sludge sample tap inside new Sludge Pump Station.
 - 4) Confirm Minimum and Maximum liquid operating levels
 2. New Thickened Sludge Transfer Pumps:
 - a. Operate at:
 - 1) Minimum Liquid level in Gravity Thickeners;
 - 2) Maximum Liquid level; and
 - 3) Over entire maximum to minimum pump range.
 - 4) With and without in-line grinder operating.
 - b. Confirm pump discharge flowrate and pressure
 - c. Close a downstream valve and confirm operation of high pressure switch shut-off
 3. New Thickened Sludge Feed Pumps (including "Swing Pump"):
 - a. Confirm sludge TSS from Sludge Day Tank.
 - b. Pull sludge from each cell inside the new Sludge Day Tank.

- c. Operate:
 - 1) With and without in-line sludge grinder.
 - 2) From Sludge Day Tank
 - a) Minimum Liquid level
 - 3) From Gravity Thickeners
 - a) Minimum Liquid level
 - 4) Over entire maximum to minimum pump flowrate range
 - 5) Close a downstream valve and confirm operation of high pressure switch shut-off.
- 4. Yard Piping
 - a. Fill and drain each Gravity Thickener to existing Settling Ponds.
 - 1) Confirm final liquid levels.
 - b. Fill and drain each cell inside the new Sludge Day Tank.
- 5. Prerequisites:
 - a. Engineer approval of Manufacturer's Certificate of Installation Verification.
 - b. Engineer approval of Functional Test Plan required prior to testing.
 - c. Draft Operations and Maintenance Manual as specified in Section 01_78_24 - Operations and Maintenance Manual.
 - d. Completed pipe, valve, and gate labeling of system or subsystem.
 - 1) As specified in Section 40_05_00.03 - Pipe Identification prior to the start of Functional Testing.
- 6. Witnessed.
- 7. Discipline checks:
 - a. Verify support systems function properly, such as seal water, pipes, valves, etc.
 - b. As specified in the individual Technical Sections.
- 8. Consecutive Day Test:
 - a. Operate the Work as specified in Attachment G - Functional Testing Requirements and as specified in the individual Technical Sections.
 - 1) Successful completion of subsystem testing required prior to system testing.
 - b. Failure response time:
 - 1) Be equipped and ready to provide emergency repairs, adjustments, and corrections to comply with the "Significant Interruption Duration" requirements as specified in Attachment G - Functional Testing Requirements.
 - c. Duration:
 - 1) As specified in Attachment G - Functional Testing Requirements.
 - 2) Restart the consecutive day test when the system performance failures exceed the "Significant Interruption Duration" time period specified in Attachment G - Functional Testing Requirements.
 - a) Individual equipment/system failures that are corrected within the "Significant Interruption Duration" time specified in Attachment G - Functional Testing Requirements shall not require the consecutive day test to be restarted unless the failure recurs.
 - b) Engineer has the authority to reject the consecutive day test if individual equipment/system failures are repetitive.
- 9. Instrumentation and controls tests.
 - a. Loop Validation Tests.

- b. Complete End-to-End Testing (CEET):
 - 1) Signal are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
 - 10. Restore to condition prior to testing:
 - a. Pump water from basins after hydraulic leak testing is completed to the storm drain or as directed by the Owner.
 - 11. Submit Manufacturer's Certificate of Functional Compliance.
 - 12. Engineer approval of Manufacturer's Certificate of Functional Compliance is required.
- E. Documentation:
 - 1. Provide records generated during Commissioning Phase of Project, including, but not limited to:
 - a. Training documentation.
 - b. Manufacturer's Certificate of Source Testing.
 - c. Manufacturer's Certificate of Installation Verification.
 - d. Manufacturer's Certificate of Functionality Compliance.
 - e. Daily logs of equipment/system testing identifying tests conducted and outcome.
 - f. Test forms and documentation.
 - g. Functional Testing results.
 - h. Logs of time spent by manufacturer's representatives performing services on the job site.
 - i. Equipment lubrication records.
 - j. Electrical phase, voltage, and amperage measurements.
 - k. Insulation resistance measurements.
 - l. Bearing temperature measurements.
 - m. Data sheets of control loop testing, including testing and calibration of instrumentation devices and setpoints.
 - n. Provide: 1 electronic copy in format specified by Owner.
 - o. Due date: Within 14 calendar days of Substantial Completion.
 - 2. Engineer approval of documentation is required.
- F. Owner Training:
 - 1. Train Owner's staff on the operation and maintenance of the equipment/system.
 - a. Provide Owner staff with state regulatory agency approved training CEUs.
 - 2. Train on each topic of the approved Operation and Maintenance Manual.
 - a. Include classroom instruction and field demonstration with all necessary tools and test equipment.
 - 3. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
 - 4. Training outcomes:
 - a. Owner's staff can safely operate, maintain, and repair the equipment/systems provided as recommended by the manufacturer.
 - 5. Training plan:
 - a. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to commissioning of equipment/system.

- b. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
 - c. Conduct classroom training at location designated by Owner.
 - d. Scope and sequence:
 - 1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
 - a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
 - 2) If multiple classes are needed to meet the training objectives, they shall be included in the training plan.
6. Owner Training Schedule:
- a. Schedule Owner's staff training within the constraints of their workloads.
 - 1) Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative.
 - 2) Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
 - 3) Maximum training hours per week: 4.
 - 4) Days available for training:
 - a) Wednesday or Thursday.
 - b. Training scheduling coordination:
 - 1) CC is responsible for the following:
 - a) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
 - 2) Complete Owner Training no sooner than 15 calendar days prior to Functional Testing of each system.
 - c. Class logistics:
 - 1) Delivery time minimum: 2 hours.
 - 2) Delivery time maximum: 4 hours.
 - 3) Class agenda:
 - a) Refreshment break: One 20-minute break.
 - b) Meal break: One 60-minute break, unless otherwise specified.
 - c) Schedule refreshment breaks and meal breaks to meet the class needs and Owner work rules.
 - 4) Schedule specific sessions:
 - a) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
 - b) At the times requested by the Owner, within the period 8 a.m. to 5 p.m. Wednesday or Thursday.
 - (1) Times scheduled will be at Owner's discretion.
 - c) Owner approval and confirmation required for session schedules.
 - d) Provide minimum of 1 session for each class unless otherwise noted.
 - (1) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner personnel working different shifts as possible.
 - d. Number of students:
 - 1) Estimated class size maximum: 10 staff.

- 2) Engineer will confirm the headcount 1 week prior to the class so that the instructor can provide the correct number of training aids for students.
7. Submittals:
 - a. Submit Training Plan Schedule 60 calendar days before the first scheduled training session, including, but not limited to, lesson plans, participant materials, instructor's resumes, and training delivery schedules.
 - b. Submit training documentation, including the following:
 - 1) Training plan:
 - a) Training modules.
 - b) Scope and sequence statement.
 - c) Contact information for manufacturer's instructors. including name, phone, and e-mail address.
 - d) Instructor qualifications.
 - 2) Training program schedule:
 - a) Format: Bar chart:
 - (1) Include in the Project Progress Schedule.
 - b) Contents:
 - (1) Training modules and classes.
8. Lesson plans:
 - a. Divide training into discrete modules appropriate for the equipment and trades.
 - b. State performance-based learning objectives in terms of what the trainees will be able to do at the end of the lesson.
 - c. Define student conditions of performance and criteria for evaluating instructional success.
 - d. Minimum requirements:
 - 1) Hands-on demonstrations planned for the instructions.
 - 2) Cross-reference training aids.
 - 3) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
 - 4) Attach handouts cross-referenced by section or topic in the lesson plan.
 - 5) Indicate duration of outlined training segments.
 - e. Provide instruction lesson plans for each trade:
 - 1) Detailed component description:
 - a) Identify each component function and describe in detail.
 - b) Identify equipment's mechanical, electrical, and electronic components and features.
 - c) Where applicable, group relative components into subsystems.
 - d) Identify and describe in detail equipment safety features, permissive and controls interlocks.
 - 2) Equipment operation:
 - a) Describe equipment's operating (process) function and system theory.
 - b) Describe equipment's fundamental operating principles and dynamics.
 - c) Identify support equipment associated with the operation of subject equipment.

- d) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
 - e) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
 - f) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
 - 3) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
 - a) Review preventive maintenance frequency and task analysis table.
 - 4) Define equipment Corrective Maintenance (CM) troubleshooting:
 - a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
 - b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
 - c) Provide component specific troubleshooting checklists as they relate to specific craft problems.
 - d) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
 - e) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.
 - 5) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
9. Training instruction format:
- a. Training for operations and maintenance personnel shall be provided as one entity.
 - b. Training for operations personnel shall be provided separately from the maintenance personnel.
 - 1) Training for maintenance personnel shall be further subdivided into the following 4 trade groups.
 - a) Mechanical maintenance.
 - b) Electrical maintenance.
 - c) Instrumentation and controls maintenance.
 - d) Process Controls Network (PCN) maintenance.
 - c. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
 - d. Lecturing should be less than 30 percent of class time.
 - e. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture to support training objectives.
 - f. Conduct hands-on instruction according to the following descriptions:
 - 1) Present hands-on demonstrations of at least the following tasks:
 - a) Proper start-up, shutdown, and normal and alternative operating strategies.
 - b) Common corrective maintenance repairs for each group.

- c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
 - d) Preventative maintenance points.
 - e) Calibration, if applicable.
 - 2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
 - a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
 - 3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
- g. Training aids:
 - 1) Instructors shall provide needed audio-visual devices such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc., for each class.
 - 2) Instructor to confirm with Engineer in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.
- 10. Training sessions:
 - a. Provide training sessions for equipment/system as specified in the individual equipment/system section.
 - b. Include the following information in the agenda:
 - 1) Instructor name.
 - 2) Listing of subjects to be discussed.
 - 3) Time estimated for each subject.
 - 4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
 - 5) List of documentation to be used or provided to support training.
 - c. Owner may request that particular subjects be emphasized, and the agenda be adjusted to accommodate these requests.
 - d. Digitally record audio and video of each training session.
 - 1) Include classroom and field instruction with question and answering periods.
 - 2) Engineer approval required for producer of video materials from one of the following options:
 - a) Qualified, professional video production company or individual.
 - 3) Record in digital format and recording shall become property of the Owner with exclusive rights.
 - a) No video recording agreements will be entered into by the Owner.
 - 4) Media:
 - a) Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
 - b) Digital color video format.
 - c) Provide audio portion of the composite CD sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
 - d) Identification: On each copy provide a label with the following information:
 - (1) Name of training.
 - (2) Date video was recorded.
 - e) Display continuous running time.

- f) At start of each video recording, record training class name, date, and instructor's name.
 - g) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
 - 5) Contractor shall provide a written release from all claims to the recorded training material produced, if required.
 - e. Distribute copies of the agenda to each student at the beginning of each training class.
 - f. Trainees will keep training materials and documentation after the session.
- 11. Engineer approval of Owner Training is required.

1.08 START-UP PHASE

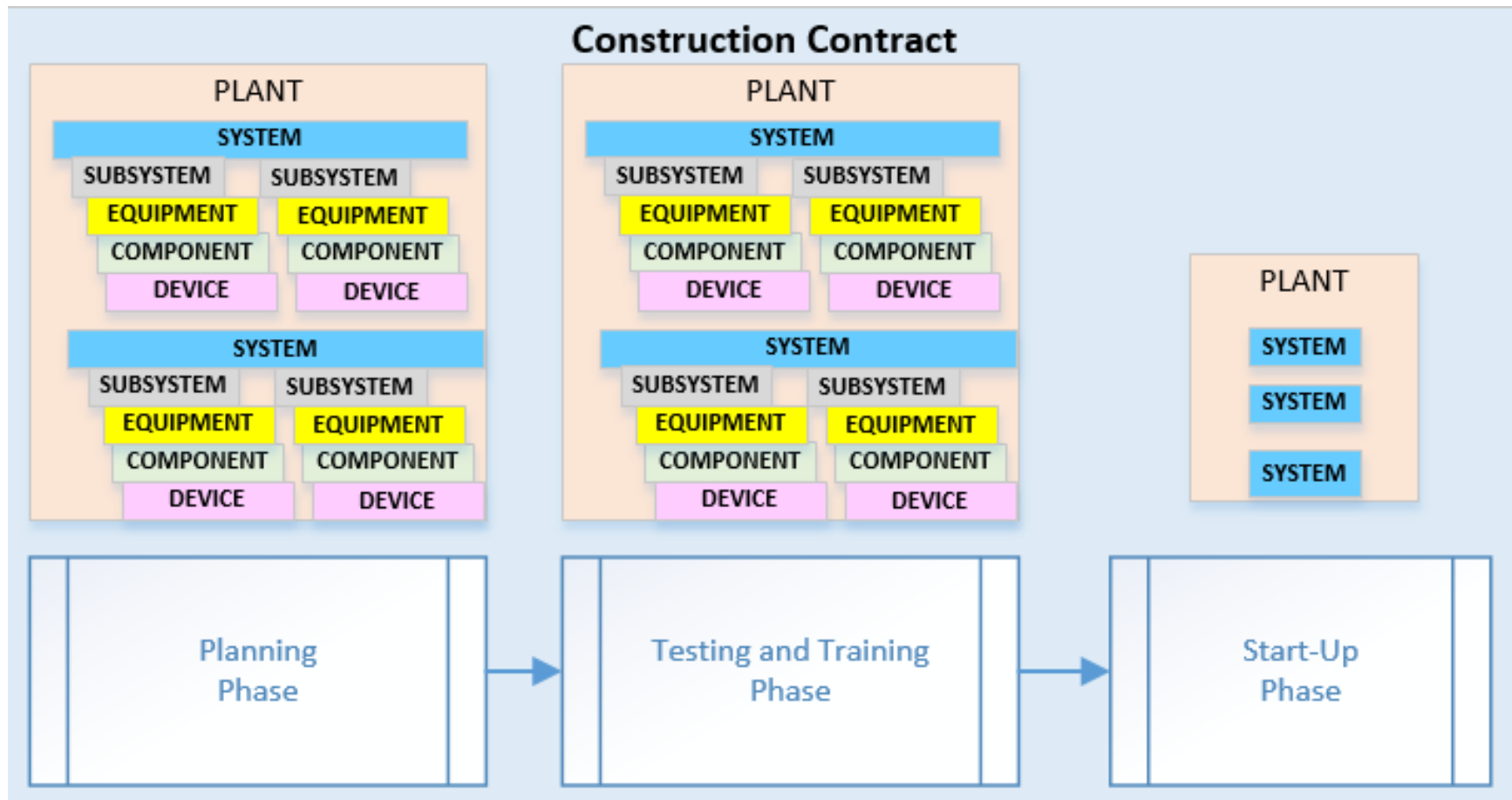
- A. Overview of Start-Up Phase:
 - 1. General:
 - a. Confirm reliability requirements.
 - b. Since start-up phase will space 1-2 weekends, confirm weekend Owner staffing levels and ability to operate new facilities on weekends.
- B. Start-Up Period:
 - 1. Contractor responsibilities:
 - a. Provide temporary power
 - b. Support Owner to operate the Work.
 - 2. Owner responsibilities:
 - a. Owner to operate the Work.
 - b. Owner-provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.
 - c. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
 - 3. Prerequisites:
 - a. Owner and Engineer approval of Testing and Training Phase.
 - 4. Witnessed.
 - 5. Duration: 14 non-consecutive days.
 - 6. Owner and Engineer approval of Start-Up Period is required to achieve substantial completion.

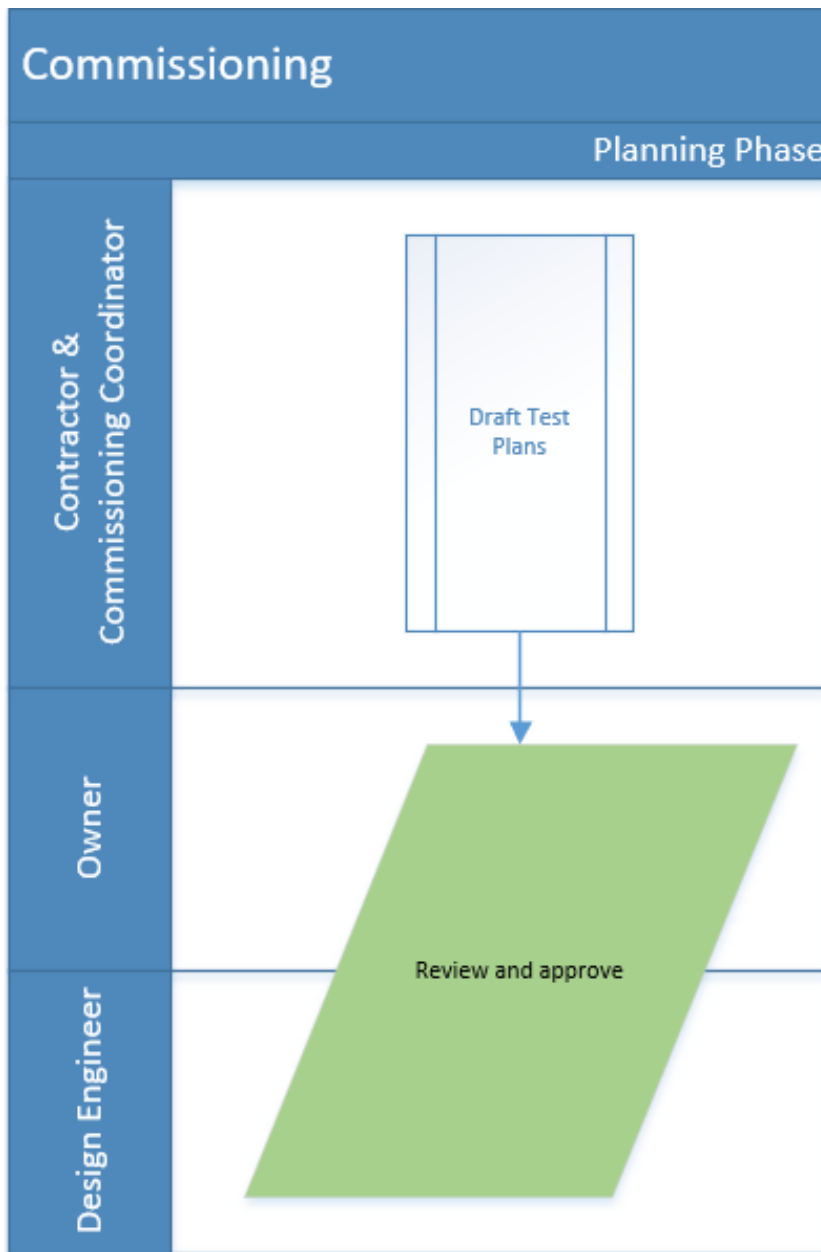
PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - COMMISSIONING FLOWCHARTS

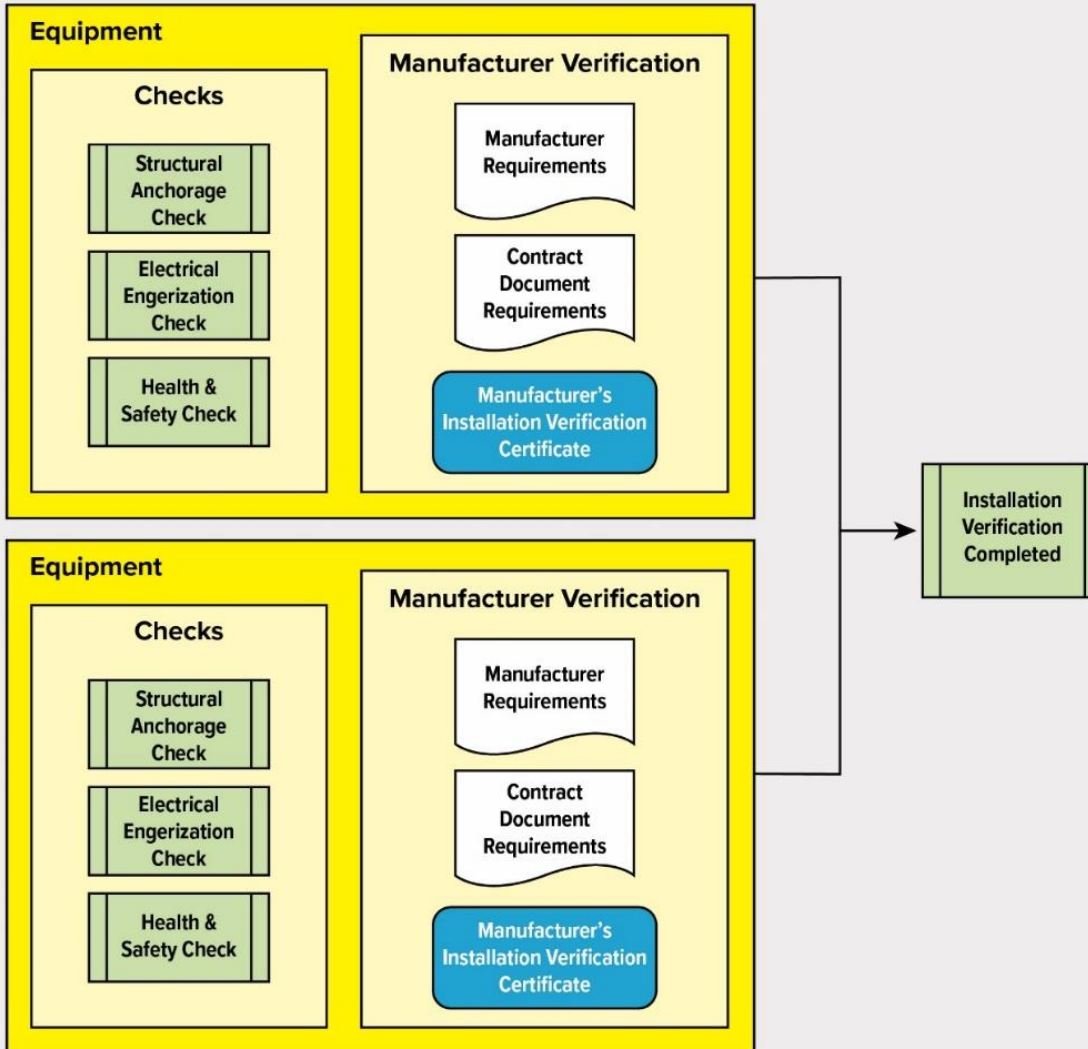




TESTING AND TRAINING PHASE

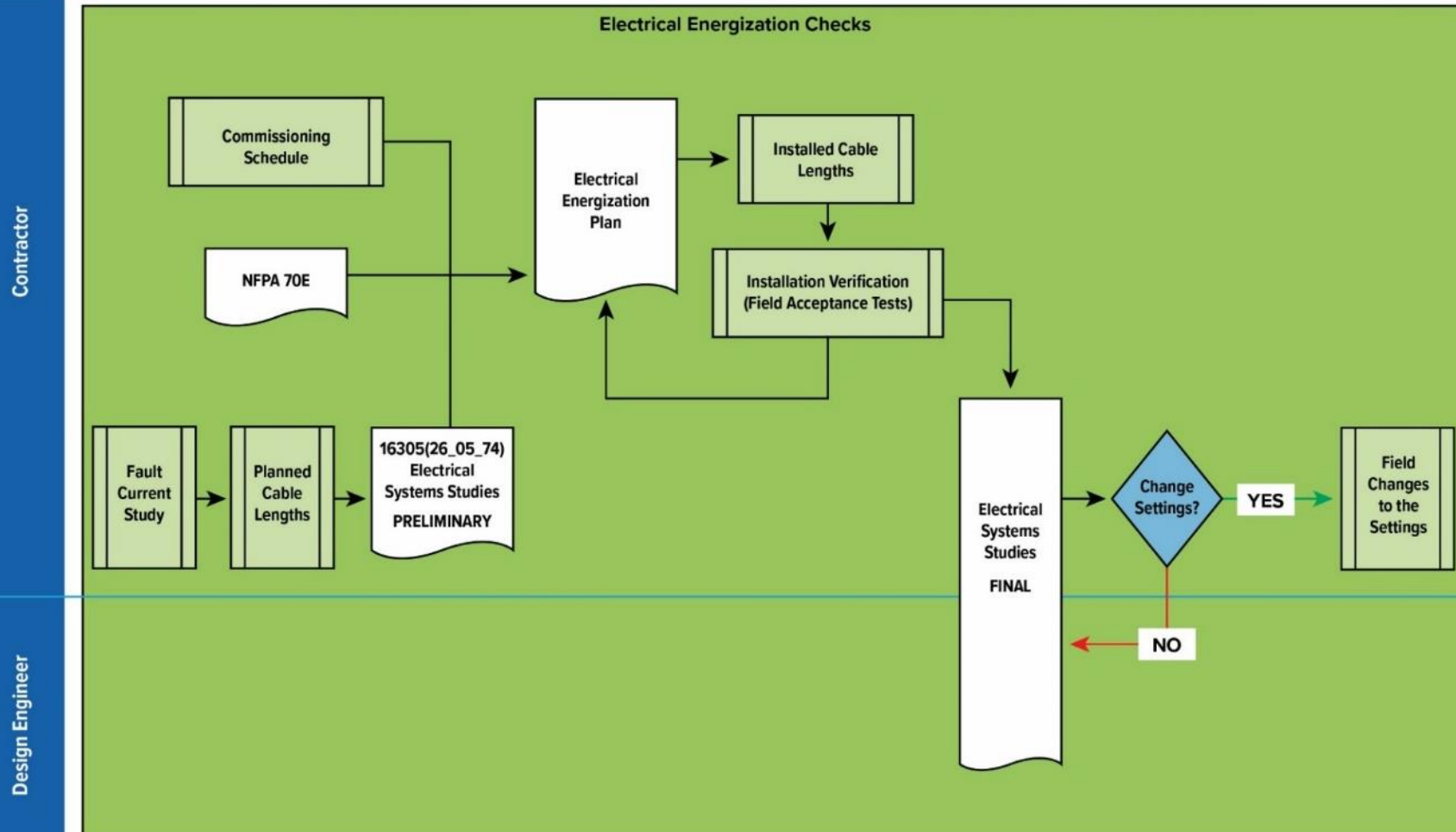
Installation Verification

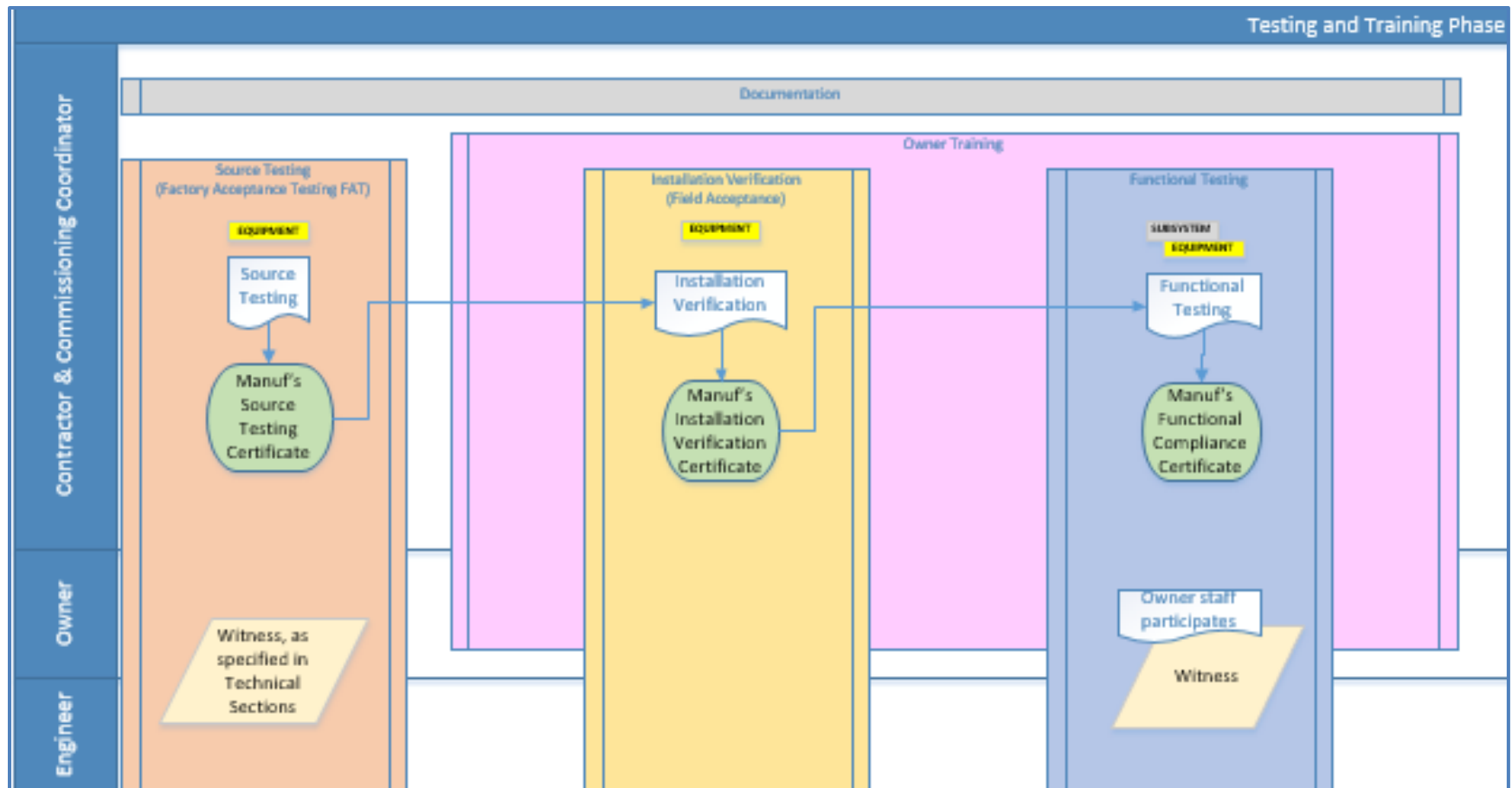
Contractor & Commissioning Coordinator

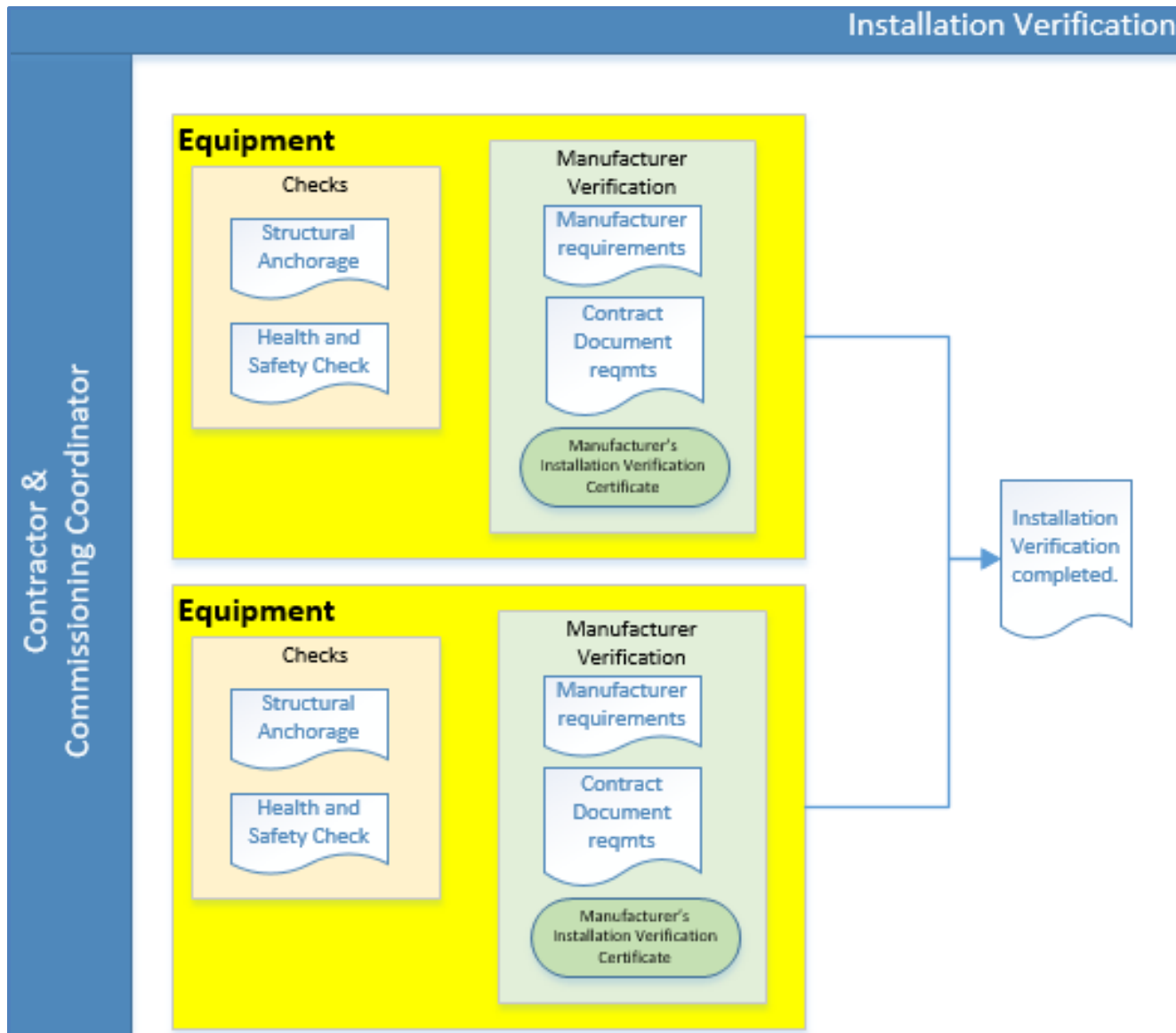


TESTING AND TRAINING PHASE - Installation Verification

Electrical Energization Checks



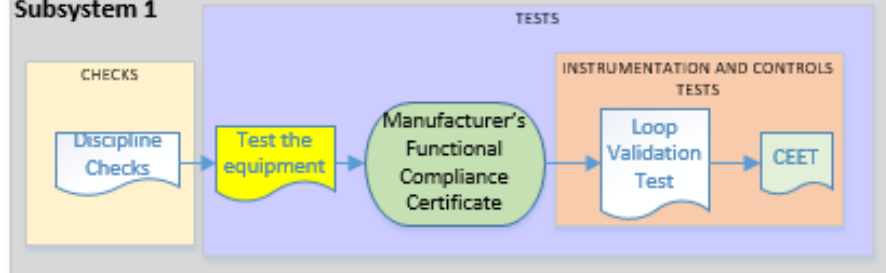




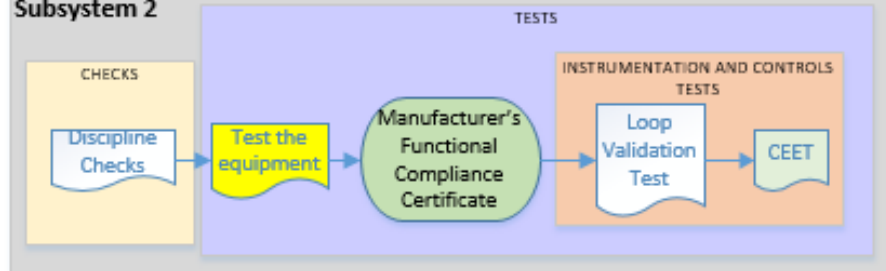
Functional Testing

Contractor &
Commissioning Coordinator

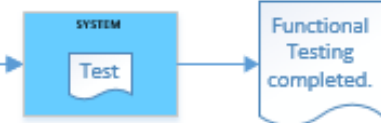
Subsystem 1



Subsystem 2



Complete End-to-End Testing (CEET) - Signals are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.



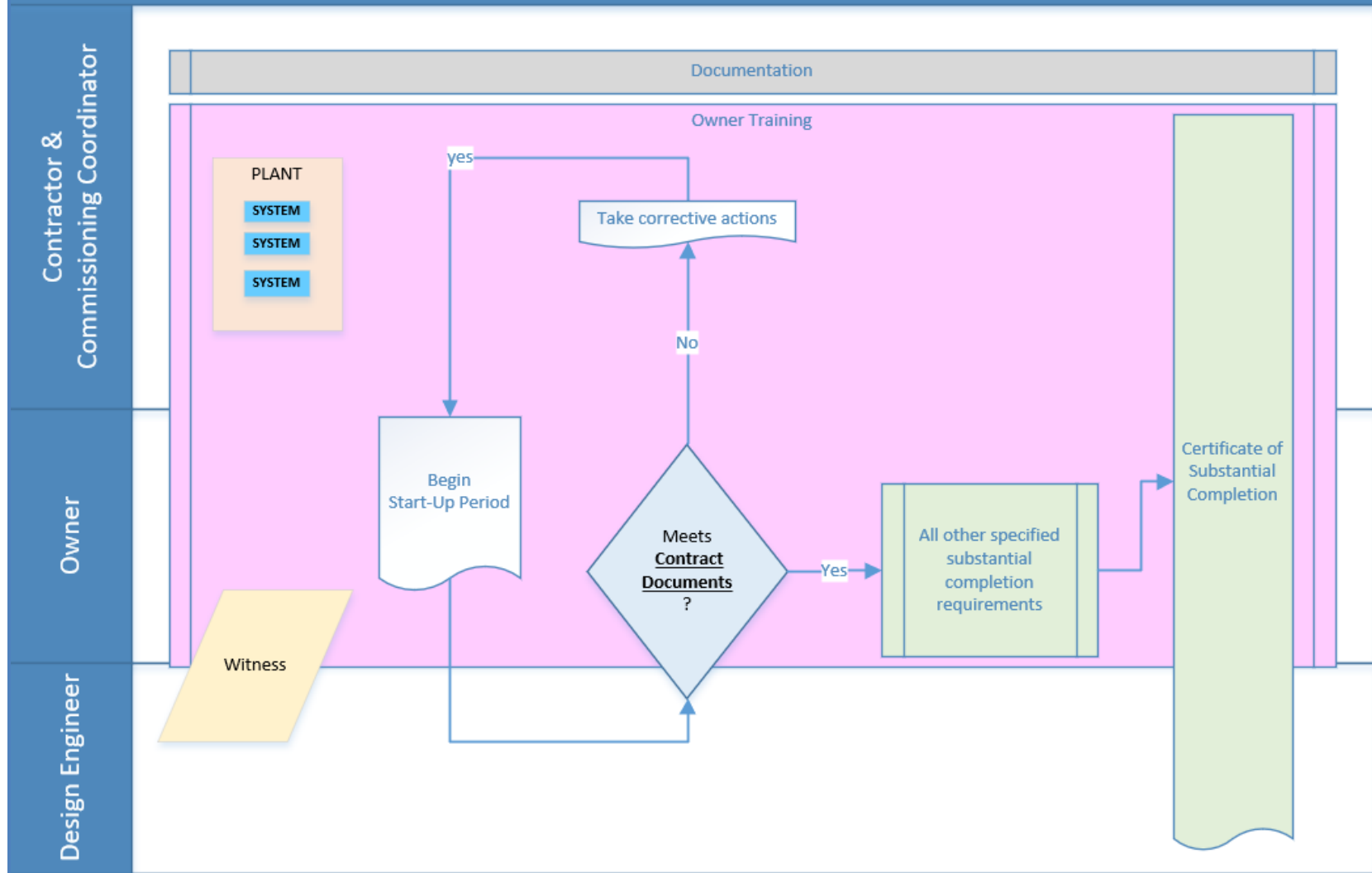
Owner

Design
Engineer

Witness

Commissioning

Start-Up Phase



ATTACHMENT B - MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20 _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

(Authorized Signature)

If applicable, Witness Name (*print*): _____

(Witness Signature)

ATTACHMENT C - MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the installation of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:

1. Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT D - MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the Functional Testing of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:

1. Attach test results with collected data and test report.
2. Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

WITNESSES:

By Owner's Authorized Representative: _____
(Authorized Signature)

By Engineer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT E - TRAINING EVALUATION FORM

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

1. Was representative prepared?	Acceptable	Unacceptable	or	N/A
2. Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3. Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4. Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5. Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6. Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7. Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8. Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9. Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A

10. Comments: _____

11. Overall Rating	Satisfactory	Unsatisfactory

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

ATTACHMENT F- COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
	Source Testing	Witnessed as specified in the Technical Sections.	Lead	Witnessed as specified in the Technical Sections. Review
	Manufacturer's Certificate of Source Testing	No Action	Lead	Review
Installation Verification				
	Structural Anchorage Check	Witness	Lead	Review
	Health and Safety Check	Witness	Lead	Review
	Manufacturer Requirements Verification	No Action	Lead	Review
	Contract Documents Verification	No Action	Lead	Review
	Manufacturer's Certificate of Installation Verification	No Action	Lead	Review
Functional Testing				
	Checks	Witness	Lead	Witness, Review
	Tests	Witness	Lead	Witness, Review
	Manufacturer's Certificate of Functional Compliance	No Action	Lead	Witness, Review
System Testing				
	System Testing	Witness	Lead	Witness, Review
Start-Up Phase				
	Start-Up	Lead	Support	Witness, Review
Legend: Lead: Primarily responsible for organization, coordination, and execution of task work product or result. Support: Assist the lead with organization, coordination, and execution of task work product or result. Witness: Observe and document completion of task work product or result. No Action: Limited or no involvement. Review: Approve for compliance with Contract Documents or reject.				

ATTACHMENT G - FUNCTIONAL TESTING REQUIREMENTS

FUNCTIONAL TESTING REQUIREMENTS

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
Gravity Thickeners					
	Influent Splitter Box	N/A	N/A	Test Solids	Owner
Sludge Pump Station		5	4	Test Solids	Contractor
	Thickened Sludge Transfer Pumps	5	4	Test Solids	Contractor
	Thickened Sludge Feed Pumps	5	4	Test Solids	Contractor
Sludge Day Tanks		5	4	Test Solids	Contractor
	Vertical Mixers				

A. Schedule delays:

1. Changes in the dates for Source Testing less than 30 days of the date provided in the latest approved Commissioning Schedule are considered delays.
2. Contractor is responsible for associated costs resulting from delays:
 - a. In person and/or virtual witnessing.
 - b. Travel costs and witness labor costs.
 - 1) Witness labor costs at \$250 per hour.

B. Repeat test costs:

1. Contractor is responsible for associated costs for repeat testing:
 - a. In person and/or virtual witnessing.
 - b. Travel costs and witness labor costs.
 - 1) Witness labor costs at \$250 per hour.

SECTION 01_75_19

WATER LEAKAGE TEST FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Hydrostatic leakage test for concrete water-holding structures.

1.02 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Containment structure, lined (not used): Liquid-containing structure with barrier coating or membrane applied to the inside surfaces to prevent leaking of contents to the outside.
 - 2. Containment structure, unlined: Liquid containing structure where only the concrete structure itself is used to prevent leaking of contents to the outside.
 - 3. Damp spots: Surfaces where visible moisture can be picked up by a dry hand.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination.
- B. Pre-installation meetings.
- C. Sequencing.
- D. Scheduling.

1.04 SUBMITTALS

- A. Product data.
- B. Shop Drawings:
 - 1. Description and details of each evaporation/precipitation-measuring device anticipated for use during the test.
- C. Samples.
- D. Certificates.
- E. Delegated Design Submittals.
- F. Tests and evaluation reports:
 - 1. Results of water leakage test for each structure and for each portion of a structure designated for testing.

- G. Manufacturer instructions.
- H. Source quality control Submittals.
- I. Field/site quality control Submittals.
- J. Manufacturer reports.
- K. Sustainable design Submittals.
- L. Special procedure Submittals:
 - 1. Testing plan for each structure, or portion thereof, required to be tested.
 - a. Describe methods of obtaining water for testing and of releasing water for disposal, including provisions for dechlorination if required.
 - b. Include plans showing locations where measurements will be made and locations of evaporation/precipitation-measuring device.
 - c. Indicate plans for filling and draining structure(s).
 - d. Include schedule showing duration of test for each structure or cell to be tested, date and time for start of each test, dates and times of observations and measurements during the test, dates and times for closeout of testing procedures, and date for submittal of final results.
 - 2. Proposed procedures and products for repair of leaks.
- M. Qualifications statements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Test structures and portions of structures listed in the following paragraphs for water leakage.
 - 1. Unless otherwise specified:
 - a. Obtain required permits for discharging testing water.
 - b. Provide dechlorination of such water if required by the permits.
 - c. Prepare and fill the structures.
 - d. Provide access and equipment required for testing and for recording test results.
 - e. Take measurements and make observations required for testing.
 - 2. At all times during testing, the Owner and Engineer shall have access to observe measurements by others or to make independent measurements.
- B. Test the following concrete structures for water leakage:
 - 1. Sludge Day Tank; both cells.
- C. Required preparation for testing is designated in this Section. Waiver of, or failure to complete preparations shall not change the testing criteria or approval criteria for the areas tested.

- D. Retest structures and portions of structures until the evaluation criteria are satisfied.

3.02 TEST WATER SOURCE AND DISPOSAL

- A. Water used for the first filling of the tank will be furnished by the Owner.
 - 1. Obtain water for leakage testing from UW2 utility water system.
- B. In the event that retesting is required, Contractor shall bear the cost of refilling the tank for subsequent tests.
- C. After leakage testing is complete, Contractor shall dispose of water by draining the tank to the Recycle Decant Pump Station.

3.03 PREPARATION

- A. For each structure to be tested, prepare and submit a plan showing schedule and sequence of activities, method of filling, and methods of disposing of test water.
- B. Sequencing requirements:
 - 1. Complete construction of concrete structure and cure concrete to obtain minimum specified 28-day compressive strength as specified in Section 03_30_00 - Cast-in-Place Concrete.
 - a. Do not begin tests until all portions of structure are complete and have reached their minimum specified 28-day compressive strength.
 - b. Do not begin tests until at least 14 days have passed since completion of the last concrete placement.
 - 2. Complete tests before:
 - a. Covering any surface of the structure with materials that might mask the location of leaks or obscure damp concrete surfaces. Such coverings include, but are not limited to, basin bottom grout, masonry veneer, stucco, plaster, and other coatings.
 - b. Installation of equipment, unless otherwise approved by the Engineer.
 - c. Backfilling structures to elevations above the limits indicated in the following paragraphs.
 - 3. Liners and coatings:
 - a. Install liners that are mechanically locked to the concrete surface during placement of plastic concrete and before leakage testing.
 - 1) Examine liners for pinholes, tears, and partially fused splices, complete required liner integrity testing, and make required repairs before commencing leakage testing.
 - b. Unless otherwise specified, do not install surface-applied protective or decorative coatings and linings until leakage tests have been completed.
- C. Weather requirements:
 - 1. Tests on structures with tops open to the atmosphere shall not be scheduled for periods when the 10-day weather forecast indicates a substantial change in weather patterns.
 - 2. Measurements of water surface levels in the structure shall not be scheduled for periods when the weather forecast indicates a difference of more than 35 degrees Fahrenheit between the ambient temperature readings at the times of initial and final measurements.

3. Tests shall not be scheduled for periods when the 10-day weather forecast indicates that the water surface may freeze before the test is complete.
- D. Groundwater requirements:
1. Bring groundwater (if present) to a level below the low point of the underdrain system and maintain at that level for the duration of the test.
- E. Clean interior of structure:
1. Remove dirt, contaminants, and construction debris.
 2. Flush floors and sumps to provide clean surfaces.
 3. Remove standing water that would interfere with examination of surfaces, cracks, or joints.
- F. Observe the structure, or portions of the structure being tested, for potential leak locations:
1. Give particular attention to cracks, open joints, voids, and honeycombed and repaired surfaces.
 2. Visually observe openings, fitting, and pipe penetrations in the structure at both faces, if possible.
 3. Repair potential leak locations in accordance with these Specifications and as approved by the Engineer.
 4. Backfill excavations to the top of the structure foundation. Do not place backfill against water-bearing walls or over footings unless approved in advance by the Engineer.
 - a. If requesting backfilling of walls before testing, include a description of methods that will be used to detect leakage in the backfilled areas.
 - b. Engineer's approval of backfilling before testing shall not relieve the Contractor of the responsibility to conduct leakage tests, to satisfy the leakage acceptance criteria for the structure, or to repair leaking portions of the structure, including those portions below or behind the backfill.
 5. See Drawings and Section 31_00_00 - Earthwork for requirements to provide wall stability before backfilling.
- G. Inlets to/outlets from the structure:
1. Make inlets to and outlets from the structure watertight.
 - a. Include valves; stop, sluice, and slide gates; and temporary bulkheads as required.
 - b. Inlets and outlets not required to be operable may be temporarily sealed before testing of the compartments to which they open.
 - c. Secure inlets used to fill the structure for testing to ensure that no water is entering or leaving the structure once it has been filled to the test level.
 2. Adjustments to measured leakage at inlets and outlets based on the manufacturer's or Contractor's estimates will not be allowed.
 - a. May be permitted by the Engineer, and, at his/her discretion, only when the Contractor makes specific measurements of leakage at each individual inlet and outlet using methods approved by the Engineer.

3.04 HYDROSTATIC LEAKAGE TEST FOR OPEN OR COVERED CONTAINMENT STRUCTURES ("HST-100")

- A. Isolate sections of water-holding structures that can be isolated in actual operation. Fill and test sections for leakage separately.
 - 1. Fill structures and sections of structures scheduled for testing to 1 inch below any fixed overflow level in covered structures.
- B. Initial rate for filling of structures shall not exceed 8 feet in 24 hours.
- C. HST-100 testing includes 2 parts, "Qualitative Testing," and "Quantitative Testing," as described in the following paragraphs:
 - 1. HST-100, Part 1 - Qualitative Testing:
 - a. During the first 24 hours after structures are filled, examine exposed concrete surfaces for damp spots or flowing water.
 - 1) Make observations in early morning, at midday, and in late afternoon.
 - 2) Continue observations through the duration of the Quantitative Testing period.
 - 3) Pay particular attention to conditions at joints, honeycombed areas, cracks, and repaired portions of the structure.
 - b. Evaluation criteria:
 - 1) Structure shall be considered to have failed these Qualitative Testing requirements if any of the following conditions are observed.
 - a) Water droplets or moist areas on an outside surface that could only have originated inside the structure.
 - b) Water is flowing or seeping from joints, cracks, or surfaces.
 - (1) Exception: Dampness or wetness on top of a footing, in the absence of flowing water, shall not be considered as failure to meet this criterion.
 - c) Moisture can be transferred to a dry hand from the outside surfaces of the filled area.
 - c. Repairs and retesting:
 - 1) Where damp spots or flowing water as described in the preceding paragraphs are observed, mark locations, provide repairs, and retest the structure as specified in subsequent paragraphs.
 - 2. HST-100 - Part 2: Quantitative Testing:
 - a. If approved by the Engineer, Quantitative Testing may begin before repairs are made to areas failing Part 1 of this test; however:
 - 1) Adjustments to volume loss calculations of Quantitative Testing based on observed leakage will not be permitted.
 - 2) Defects identified for repair during Qualitative Testing shall be repaired to the satisfaction of the Engineer before approval of the structure.
 - b. Report the results of quantitative testing.
 - 1) Submit completed Attachment A - Leakage Test Report or at a minimum, include the information specified in Attachment A - Leakage Test Report.
 - c. Unlined concrete structures:
 - 1) Fill to the designated water surface elevation. Maintain that level for at least 72 hours before recording initial water levels for leakage test.

- 2) Duration of test:
 - a) Theoretical time required to lower the water surface in the structure by 3/8 inch when leakage is occurring at the maximum allowable rate specified in subsequent paragraphs of this Section.
 - b) Duration ("D") of the test in days is determined by the following equation:

$$D = \frac{0.375 \text{ inches}}{(0.0005 \text{ in/in/day} \times H \text{ ft} \times 12 \text{ in/ft})}$$

Where: H = maximum liquid depth

- (1) Round results upward to the next full 24-hour period (day).
 - (2) Minimum duration of test: 24 hours (1 day).
 - (3) Maximum duration of test: 120 hours (5 days).
- 3) Duration of test:
 - a) Sludge Day Tank structure: 72 hours.
- d. Measurements: Water level:
 - 1) Record water levels at 24-hour intervals for the full duration of the test period.
 - 2) Measure water levels at not less than 2 locations on opposite ends of the structure and preferably at 4 locations spaced equally around the structure. Mark locations on the structure and take measurements at the same locations throughout the duration of the test.
 - 3) Measure, to an accuracy of 1/16 inch, the vertical distance to the water surface from a fixed point on the structure above.
- e. Measurements: Temperatures:
 - 1) As part of the first and last sets of level measurements, record water temperature at a depth of 18 inches below the water surface. Measure temperature at the same locations where level measurements are taken.
 - 2) Record ambient temperature at the time of each water level measurement.
- f. Measurements: Evaporation and precipitation:
 - 1) Measure evaporation and precipitation by floating pans inside the structures during testing.
 - a) For uncovered structures, measure both evaporation and precipitation.
 - b) For covered structures that are well ventilated, measure evaporation.
 - 2) Measure using specially constructed clear containers:
 - a) Provide clear plastic, calibrated, open-top containers not less than 18 inches in diameter and 18-inches deep.
 - b) Partially fill containers with water and float inside the structure. Make provisions to hold containers in place at each measurement location, but away from structure walls and items passing overhead, such as beams or pipes.

- c) Measure initial depth of water in each device. Measure changes in water level in each device at the same time measurements of the water level inside the structure are taken.
- g. Restart of test:
 - 1) Engineer may order a restart of the test when, in the Engineer's opinion, measurements have become unreliable due to unusual precipitation or other factors.
 - 2) If measurements or observed leakage during the testing period indicate that the allowable leakage requirements will be exceeded, the test may be terminated before completion of the full test period. Take appropriate actions to correct problems before restarting the test.
- h. Calculations of leakage test results:
 - 1) For each section of the structure tested, use water surface level records to calculate average loss of volume per 24-hour interval.
 - a) For each 24-hour interval during the test, calculate the average of all measured drops in water level around the structure.
 - b) Use the average drop thus determined to calculate an average loss of volume for each 24-hour interval.
 - 2) Adjustments to leakage calculations:
 - a) For uncovered basins, calculations shall be corrected for precipitation added to the structure.
 - b) Calculations may be corrected for evaporation and water temperature.
- i. Evaluation criteria:
 - 1) Unless otherwise specified, the average loss of volume during any 24-hour interval shall not exceed the limits shown in Table A.

Table A - Loss of Volume Criteria for Leakage Tests	
Structure Type	Maximum Loss of Water Volume
Structure fully lined prior to leakage test.	No measurable loss over 72-hour test period.
Secondary containment areas.	
Structure with monolithically placed membrane floor slab.	0.0125 percent of volume per 24-hour period.
Concrete paved canals, drying beds, lagoons, and similar structures.	0.100 percent of volume per 24-hour period.
Other containment structures.	0.050 percent of volume per 24-hour period.

- j. Repairs and retesting:
 - 1) Structures and portions of structures that have satisfied the qualitative requirements of HST-100 but have failed to satisfy the quantitative requirements of HST-100 may be immediately retested for volume loss.
 - a) If the structure fails the second test for volume loss, the structure shall be drained and the Contractor shall observe the interior for probable areas of leakage.
 - b) Structure shall not be retested until repairs to the probable areas of leakage are complete.

3.05 REPAIRS FOR RETESTING

- A. Locations showing damp spots or flowing water:
 - 1. Mark locations of visible leaks and damp spots.
 - 2. Drain structures for repair.
 - 3. Repair defects causing damp spots and flowing water using methods specified in Section 03_30_00 - Cast-in-Place Concrete and approved by the Engineer.
 - a. Repair both interior and exterior surfaces and make structures watertight.
 - b. Submit proposed repair products and procedures for Engineer's review.
 - c. Refill structures for retesting.
 - 4. Repeat filling, observations, and repairs until no leaks or damp spots appear.
- B. Structures for which water volume loss exceeds the limits specified after adjustments for evaporation, and precipitation:
 - 1. Determine cause of volume loss.
 - 2. Drain structures of water.
 - 3. Repair defects causing loss of water volume using methods specified in Section 03_30_00 - Cast-in-Place Concrete and approved by the Engineer.
 - a. Submit proposed repair products and procedures for Engineer's review.
 - 4. Refill water-holding structures.
 - 5. Repeat testing and repairs until volume loss does not exceed specified limits.

END OF SECTION

ATTACHMENT A - LEAKAGE TEST REPORT

LEAKAGE TEST REPORT

PROJECT: _____			SUBMITTED BY: _____				
STRUCTURE: _____			WITNESSED BY: _____				
AREA: _____			TEST DATES: _____				
TEST DURATION: _____			TEST DURATION: _____				

Surface area of structure tested: _____	(square feet)
Volume of structure tested: _____	(cubic feet)
Volume of structure tested: _____	(gallons)
Measured loss through gates, etc.: _____	(gallons / day)
Allowable loss of water volume: _____	(per day)
Allowable loss of water volume: _____	(% in 24 hours)
Allowable measured loss over test duration (inches): _____	
Measured loss of water: _____	(gallons / day - From E below)
Measured loss of water volume (%): _____	(in 24 hours - From E below)

Water Temperature:		Start of test: _____ °F		End of test: _____ °F	

			Water Surface Elevation (top of structure to top of water)				
			Location #1	Location #2	Location #3	Location #4	Initials**
Day	Date	Time	(inches)	(inches)	(inches)	(inches)	
1							
2							
3							
4							
5							
Changes in Level:							

A. Average change in level (feet): _____	(Average of total charges for all locations)
B. Correction for precipitation: _____	(Measured from pan)
C. Correction for evaporation: _____	(Measured from pan)
D. Corrected change in level (CL): _____	
E. Total days tested: _____	
F. Average measured % water loss in 24 hours: _____	$= \frac{(\text{CL}) \times (\text{surface area}) \times 100}{(\text{initial water volume}) \times (\text{number of test days})}$

Notes and field observations**

**Place date and initials at the beginning of each entry.

Water Leakage Test for Concrete Structures

01_75_19-Attachment A-1

203356

June 2025

pw://Carollo/Documents/UT/WBWC/203356-100000/04 Design/04 Specs/Carollo/01_75_19 (BidSet)

SECTION 01_77_00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Contract closeout requirements.

1.02 REFERENCES

- A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

- A. Perform final cleaning prior to inspections for Final Completion.
- B. Employ skilled workers who are experienced in cleaning operations.
- C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.
- D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.
- E. Clean roofs, gutters, downspouts, and drainage systems.
- F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
 - 1. Police yards and grounds to keep clean.
- G. Remove dust, cobwebs, and traces of insects and dirt.
- H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.
- I. Remove non-permanent protection and labels.
- J. Polish waxed woodwork and finish hardware.
- K. Wash tile.
- L. Wax and buff hard floors, as applicable.
- M. Wash and polish glass, inside and outside.
- N. Wash and shine mirrors.
- O. Polish glossy surfaces to clear shine.

- P. Vacuum carpeted and soft surfaces.
- Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.
- R. Clean ducts, blowers, and coils when units were operated without filters during construction.
- S. Clean light fixtures and replace burned-out or dim lamps.
- T. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

- A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
 - 1. Prior to making disposal on private property, obtain written permission from the Owner of such property.
- B. Do not create unsightly or unsanitary nuisances during disposal operations.
- C. Maintain disposal site in safe condition and good appearance.
- D. Complete leveling and cleanup prior to final completion of the Work.

1.05 TOUCH-UP AND REPAIR

- A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Final Completion.
- B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF PLANT FACILITIES

- A. Clean channels, pipe, basins, reservoirs, and tanks before running of 7-day test, or before facility goes on stream when 7-day test is not required. Membranes are to be installed after the sub-system function testing and before the membrane system functional testing.
- B. Wash, wherever practicable, or broom sweep channels, pipe, basins, reservoirs, and tanks.
- C. Disinfect filter basins, reservoirs, clear wells, tanks, channels, and piping intended to carry potable water as follows or in accordance with AWWA Standards.
- D. Provide ample sampling outlets in pipe for testing.
- E. Fill pipe and other plant facilities with chlorine solution of sufficient strength to retain residual of not less than 10 parts per million at end of 24 hours.

- F. When reservoirs and basins are too large to be economically disinfected by filling with chlorine solution, spray reservoirs and basins with solution containing 100 parts per million of chlorine.
- G. After disinfection, rinse entire potable water system with potable water sufficient to reduce chlorine residual to not more than 0.6 parts per million throughout system before system is put into service.

1.07 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF POTABLE WATER MAINS

- A. Clean interior of pipe and fittings.
- B. When pipe contains dirt that cannot be removed by flushing, swab pipe interiors with solution containing not less than 500 parts per million of chlorine until clean.
- C. Flush 12-inch diameter and smaller pipe as thoroughly as available water sources will permit.
- D. Fill pipe with chlorine solution of sufficient strength to provide 10 parts per million chlorine residual at end of 24 hours.
- E. Flush pipes with potable water until chlorine residual is less than 0.6 parts per million before pipes are put into service.

1.08 CLOSEOUT DOCUMENTS

- A. Submit the following before Substantial Completion:
 - 1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
 - 2. Evidence of Compliance with Requirements of Governing Authorities.
 - 3. Project Record Documents.
 - 4. Approved Operation and Maintenance Manuals.
 - 5. Approved Warranties and Bonds.
 - 6. Keys and Keying Schedule.
 - 7. Completed Contract requirements for Commissioning and process Start-Up.
- B. Submit the following before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
 - 1. Punch list items have been completed and the Engineer and Owner are satisfied that all deficiencies are corrected.
 - 2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
 - 3. Release of claims as outlined in Conditions of the Contract.
 - 4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
 - 5. Final statement of accounting.
 - 6. Submit Final (As-Built) Schedule as specified in Section 01_32_21 - Schedules and Reports.

1.09 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

- A. Submit the following:
 - 1. Certificate of Occupancy.
 - 2. Certificates of Inspection:

1.10 PROJECT RECORD DOCUMENTS

- A. Maintain at the Project Site, available to the Owner and Engineer, 1 copy of the Contract Documents, Shop Drawings, and other Submittals in good order:
 - 1. Mark and record field changes and detailed information contained in Submittals and Change Orders.
 - 2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
 - 3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
 - 4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
 - 5. Provide schedules, lists, layout drawings, and wiring diagrams.
 - 6. Make annotations in electronic format in accordance with the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

- B. Maintain documents separate from those used for construction:
 - 1. Label documents "RECORD DOCUMENTS."
- C. Keep documents current:
 - 1. Record required information at the time the material and equipment is installed and before permanently concealing.
 - 2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.
- D. Affix civil engineer's or professional land surveyor's signature and registration number to Record Drawings to certify accuracy of information shown.
- E. Deliver Record Documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of the Contractor.
- F. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

- G. Updated Record Documents are a condition for the Engineer's recommendation for progress payment.
- H. Final Schedule Submittal as specified in Section 01_32_21 - Schedules and Reports.

1.11 MAINTENANCE SERVICE

- A. As specified in Technical Specifications.

1.12 SUBSTANTIAL COMPLETION

- A. Obtain Certificate of Substantial Completion.

1.13 FINAL COMPLETION

- A. When Contractor considers the Work is complete, submit written certification that:
 - 1. Work has been completed in accordance with the Contract Documents.
 - 2. Punch list items have been completed or corrected.
 - 3. Work is ready for final inspection.
- B. Owner and Engineer will make an inspection to verify the status of completion with reasonable promptness.
- C. Should the Owner and Engineer consider that the Work is incomplete or defective:
 - 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective Work.
 - 2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Owner and Engineer that the Work is complete.
 - 3. The Owner and Engineer shall re-inspect the Work.

1.14 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement of accounting to the Owner and Engineer at least 7 days prior to final Application for Payment.
- B. Statement shall reflect all adjustments to the Contract amount.
 - 1. The original Contract amount.
 - 2. Additions and deductions resulting from:
 - a. Change Orders.
 - b. Units installed and unit prices.
 - c. Set-offs for uncorrected or incomplete Work.
 - d. Set-offs for liquidated damages.
 - e. Set-offs for reinspection payments.
 - f. Extended engineering and/or inspection services and inspection overtime.
 - g. Excessive Shop Drawings review cost by the Engineer.
 - h. Other adjustments.
 - 3. Total Contract amount, as adjusted.
 - 4. Previous payments.
 - 5. Remaining payment due.

- C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.15 FINAL APPLICATION FOR PAYMENT

- A. Submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

2.01 SPARE PARTS

- A. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to Owner at a location on site chosen by the Owner.
 - 1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
 - 2. Owner and Engineer will review the inventory and the itemized list to confirm it is completed and in good condition prior to signing for acceptance.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_78_24

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Preparation and submittal of manual with requirements to operate and maintain the equipment.

1.02 PREPARATION

- A. General requirements:
 - 1. Provide dimensions in English units.
 - 2. Assemble material, where possible, in the same order within each volume.
 - 3. Reduce drawings and diagrams to 8-1/2 by 11-inch size, if possible, unless otherwise specified.
 - 4. Complete forms on computer; handwriting not acceptable.
 - 5. Delete items or options not provided in the supplied equipment or system.
 - 6. Provide package control system annotated PLC code, if applicable.
- B. Hard copy requirements:
 - 1. Binders: 3-ring with rigid covers.
 - a. Break into separate binders as needed to accommodate large size.
 - 2. Utilize numbered tab sheets to organize information.
 - 3. Provide original and clear text on reproducible non-colored paper, 8-1/2 by 11-inch size, 24-pound paper.
 - 4. Drawings larger than 8-1/2 by 11-inch:
 - a. Fold drawings separately and place in envelope bound into the manual.
 - b. Label each drawing envelope on the outside regarding contents.
- C. Electronic requirements:
 - 1. File format:
 - a. Entire manual in PDF format.
 - 1) Include text and drawing information.
 - 2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
 - 3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
 - a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
 - b) Hard copy record drawing requirements:
 - (1) Provide a single multipage PDF file of each set of the scanned drawings.
 - (2) Page 1 shall be the cover of the drawing set.

- c) At file opening, display the entire cover.
 - (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
 - (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
 - 4) Pagination and appearance to match hard copy.
 - 5) Ensure that page numbers are included on every page of the document.
 - 6) Searchable.
 - 7) Scanned images are not acceptable.
 - 8) Bookmarks:
 - a) Shall match the table of contents.
 - b) Bookmark each Section (tab) and heading.
 - c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
 - d) At file opening, display all levels of bookmarks as expanded.
 - 9) Thumbnails optimized for fast web viewing.
 - b. Drawing requirements:
 - 1) Provide additional copy of drawings in most current version of AutoCAD format.
 - 2) Drawings shall have a white background.
 - 3) Drawing shapes shall not degrade when closely zoomed.
 - 4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
 - 5) Delete items or options not provided in the supplied equipment or system.
- 2. Media:
 - a. Upload to web-based construction management system.
 - b. USB flash drive (if approved by Owner).
 - c. Secure File Transfer Protocol (SFTP).
- 3. Label media with the following information:
 - a. Operation and Maintenance Manual.
 - b. Equipment name.
 - c. Specification Section number.
 - d. Equipment tag number.
 - e. Owner's name.
 - f. Project number and name.
 - g. Date.
- 4. If multiple Submittals are made together, each Submittal must have its own subdirectory that is named and numbered based on the Submittal number.

1.03 CONTENTS

- A. Table of Contents: General description of information provided within each tab section.
- B. Complete Attachment A - Equipment Summary Form.
- C. Description of system and components.

- D. Description of equipment function, normal operating characteristics, and limiting conditions.
- E. On-line resources.
- F. Telephone resources.
- G. Approved Submittals.
 - 1. Markup with any field changes.
 - 2. Final programming.
- H. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.
- I. Operating procedures:
 - 1. Step-by-step instructions, including, but not limited to, the following:
 - a. Safety precautions and applicable Safety Data Sheets.
 - b. Guidelines.
 - c. Other information as needed for safe system operation and maintenance.
- J. Preventative maintenance procedures:
 - 1. Recommended steps and schedules for maintaining equipment.
 - 2. Troubleshooting.
- K. Lubrication information: Required lubricants and lubrication schedules.
- L. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
- M. Manufacturer's technical reference manuals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - EQUIPMENT SUMMARY FORM

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM: _____
2. MANUFACTURER: _____
3. EQUIPMENT TAG NUMBER(S): _____
4. LOCATION OF EQUIPMENT: _____
5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS): _____

6. NAMEPLATE DATA:

Horsepower: _____

Amperage: _____

Voltage: _____

Service Factor (S.F.): _____

Speed: _____

ENC Type: _____

Capacity: _____

Other: _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE:

Name: _____

Address: _____

Telephone Number: _____

8. MAINTENANCE REQUIREMENTS:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in manufacturer's manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

9. LUBRICANT LIST:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 8 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

10. SPARE PARTS (recommendations): _____

11. COMMENTS: _____

12. GENERAL INFORMATION:

Date Accepted:* _____

Expected Life:* _____

Project Name & Number: _____

Design Engineer: _____

13. WARRANTY:

Start Date: _____

Expiration Date: _____

Prorated: _____

SECTION 01_78_36
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Warranty and bonds requirements.

1.02 SUBMITTALS

- A. For each item of material or equipment furnished under the Contract:
 - 1. Submit manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
 - 2. Submit manufacturer's special warranty when specified.
- B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion.
 - 1. Contents:
 - a. Organize warranty and bond documents:
 - 1) Include Table of Contents organized by Specification Section number and the name of the product or work item.
 - b. Include each required warranty and bond in proper form, with full information, certified by manufacturer as required, and properly executed by Contractor, or subcontractor, supplier, or manufacturer.
 - c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
 - 2. Hardcopy format:
 - a. Submit **1** copy.
 - b. Assemble in 3 D-side ring binders with durable cover.
 - c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
 - 3. Electronic copy in PDF format:
 - a. Submit 1 copy.

1.03 OWNER'S RIGHTS

- A. Owner reserves the right to reject warranties.
- B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

- A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.
- B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S 1 YEAR WARRANTY MINIMUM REQUIREMENTS

- A. Written warranty issued by item's manufacturer.
- B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Contractor.
- C. Covers all costs associated with the correction of the defect, including, but not limited to, removal of defective parts, new parts, labor, and shipping.
- D. Provides a timely response to correct the defect.
 - 1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
- E. Warranty commence running on the date of substantial completion.
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.
- F. Duration of warranty: 1 year.

1.06 MANUFACTURER'S SPECIAL WARRANTY

- A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements as specified in the Technical Section.
 - 1. Project-specific information and requirements.
 - 2. Properly executed by product manufacturer.
 - 3. Expressly states that its provisions are for the benefit of the Contractor or Owner.
 - 4. Manufacturer's special warranties commence on the date that the associated item is certified by Engineer as substantially complete.

1.07 WARRANTY WORK

- A. Contractor's responsibilities:
 - 1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

- B. Replacement cost:
 - 1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
 - a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.
- C. Related damages and losses:
 - 1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- D. Owner's recourse:
 - 1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.
- E. Reinstatement of warranty:
 - 1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
 - a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

- A. Warranty of title and intellectual rights:
 - 1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
 - 2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

- A. Equipment bond and other bond requirements as specified in the Technical Sections.
- B. Bonds commence running on the date of substantial completion.
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_81_50

DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Design criteria for use in the selection of equipment and appurtenances specified in Technical Sections of these Specifications and indicated on the Drawings.
 - 2. Criteria for design of systems, components and equipment fabricated off-site and shipped to the Work for installation.
 - 3. Criteria for design of anchors to connect equipment and appurtenances to supports and structures.
- B. The criteria in this Section apply throughout the Work, unless additional criteria, or more restrictive criteria, are indicated.
 - 1. Additional criteria and requirements relevant to specific locations, specific materials, and specific equipment are indicated on the Drawings, and in the Technical Sections.

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures. (ASCE 7).
- B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - 1. ASHRAE Fundamentals Handbook.
- C. International Code Council (ICC):
 - 1. International Energy Conservation Code (IECC).
 - 2. International Plumbing Code (IPC).
- D. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - 1. Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd edition 2008.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA - SITE INFORMATION

- A. Site name:
 - 1. Street address: As specified in Section 01_11_00 - Summary of Work.
 - a. Coordinates (approximate): Latitude 41.1096 degrees north; Longitude - 111.9144 degrees east.
 - 2. Site elevation (approximate):
 - a. 4,876.20 feet.

3. Groundwater elevation:
 - a. See Project geotechnical reports, listed in Structural General Notes, for information.
 - b. For design of buried and partially buried construction:
 - 1) Groundwater is expected to be below the level of construction.

2.02 DESIGN CRITERIA - REGULATORY REQUIREMENTS

- A. Requirements of authorities having jurisdiction over the Project are included in Section 01_41_00 - Regulatory Requirements.

2.03 DESIGN CRITERIA - OPERATING ENVIRONMENT

- A. Drawings and Technical Sections include additional criteria and requirements relevant to specific locations, materials, and equipment.
- B. Outdoor conditions:
 1. IECC: Climate Zone 5.
 2. ASHRAE site climatic data location.
 3. Temperature criteria: As specified in the following Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook.

Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook	
Condition	Criteria
Hottest Month DB Range:	[] degrees Fahrenheit.
Winter:	At or above this temperature 99.6 percent of the time: 20 degrees Fahrenheit dry-bulb.
Summer:	At or above this temperature 0.4 percent of the time: 110 degrees Fahrenheit dry-bulb.

4. Rainfall intensity:
 - a. Reference: International Plumbing Code (IPC):
 - 1) 1.3 inches per hour (100-year, 1-hour rainfall).
- C. Indoor conditions:
 1. HVAC:
 - a. As specified in Section 23_09_13 - Instrumentation and Control Devices for HVAC.

2.04 DESIGN CRITERIA - STRUCTURAL

- A. General:
 1. Criteria for structural design of:
 - a. Equipment at locations subject to seismic events.
 - b. Equipment exposed to outdoor environments.
 - c. Equipment supports and bracing, and anchorage of such items to building and non-building structures.
 - d. Structures provided for the Work through Delegated Design.

- e. Manufactured and prefabricated structures, and anchorage of such structures to foundations or other supporting elements.
- 2. Structural design criteria used by the Engineer of record and required by the building code to be indicated on the Drawings are included in "Design Criteria" notes on the Drawings for each structure.
- B. Delegated Design:
 - 1. As specified in Section 01_35_73 - Delegated Design Procedures.
 - 2. Structural engineering design shall be performed by a Civil or Structural Engineer licensed in the State of Utah.
- C. Structure risk category:
 - 1. Develop design loads and provide detailing in accordance with the provisions of ASCE 7 and the building code specified in Section 01_41_00 - Regulatory Requirements, based on the Structure Risk Category indicated in Table: Project Structures - Risk Category and Seismic Design Information.
- D. Seismic loads:
 - 1. Seismic design parameters: Basic parameters - ASCE 7:
 - a. Ground motion MCER, 5 percent damped:
 - 1) Short periods, $S_s = 1.35$ g.
 - 2) 1 second period, $S_1 = 0.48$ g.
 - 3) Shear wave velocity, $V_{s30} = 1040$ ft/s (317 m/s).
 - b. Peak ground acceleration, MCEG:
 - 1) Peak ground acceleration, $PGAM = 0.62$ g.
 - c. Mapped long-period transition period:
 - 1) $T_L = 8$ seconds.
 - 2. Structures - General:
 - a. Seismic Design Category (SDC): As indicated in the following Table: Project Structures - Risk Category and Seismic Design Information.

Table: Project Structures - Risk Category and Seismic Design Information						
Description: Water Treatment Facility						
Area	Description	Risk Category	Site Class	S_{DS}	S_{D1}	Seismic Design Category ⁽¹⁾
65	Sludge Pump Station	III	CD	0.967	0.60	D
67	Sludge Day Tanks	III	CD	0.967	0.60	D

Notes:

(1) Seismic Design Category for Delegated Design, and for seismic certification of electrical and mechanical equipment as required by ASCE 7.

- b. Structure response modification coefficient, R:
 - 1) In accordance with ASCE 7 and the requirements of the Technical Sections.
- 3. Structures - Tanks and vessels.
 - a. Includes: Tank structures, tank supports, and anchorage to structures or foundations.
 - b. Liquid storage structures (e.g., basins and tanks).
 - 1) Include impulsive and convective ("sloshing") effects.

- 2) Component response modification factor - impulsive effects, R_i : In accordance with ASCE 7, Table 15.4-2.
- 3) Component response modification factor - convective effects, $R_c = 1.0$.
- c. Dry material storage structures (e.g., silos, hoppers):
 - 1) Include effects of stored materials.
 - 2) Component response modification factor - impulsive effects, R_i : In accordance with ASCE 7, Table 15.4-2.
4. Non-structural components - General:
 - a. Includes:
 - 1) Mechanical and electrical equipment; anchorage of equipment to structures or supports; design of supports; and anchorage of supports to structures or foundations.
 - 2) Distribution systems associated with mechanical and electrical equipment such as piping, ductwork, conduits, cable trays, raceways, bus ducts, and similar items; anchorage of such systems to supports and structures; and bracing of such systems.
 - b. Seismic design requirements for non-structural components are based on the Seismic Design Category (SDC) of the structure or facility where the equipment is installed.
 - c. Design components, component anchorage, and component connections to piping and utilities in accordance with the requirements of ASCE 7, Table 13.2-1.
 - d. Component amplification factor (a_p), response factor (R_p), and overstrength factor for anchorage to concrete (Ω_o):
 - 1) Mechanical and electrical components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
 - 2) Architectural components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
 - e. Component importance factor, I_p :
 - 1) In accordance with the following Table: Component Importance Factor for Seismic Design, I_p .
 - 2) For items not listed in Table: Component Importance Factor for Seismic Design, I_p , designate importance factor in accordance with the provisions of ASCE 7, Chapter 13, and submit to the Engineer for review prior to developing calculations and details related to that component.

Table: Component Importance Factor for Seismic Design, I_p		
Structure Seismic Design Category	Components	I_p
All	Electrical: Items and distribution system components specified in Division 26 - Electrical.	1.5
All	Process Control and Instrumentation Systems: Components and distribution systems specified in Division 40 - Process Integration.	1.5
All	Equipment and components specified in Divisions 11 through 49, <u>except</u> HVAC and plumbing components listed below.	1.5

Table: Component Importance Factor for Seismic Design, I_p		
Structure Seismic Design Category	Components	I_p
N/A	Plumbing equipment specified in the following Sections:	N/A
All	HVAC equipment specified in the following Sections: 23_81_44 - Heat Pumps 23_83_01 - Heating Units 23_34_01 - Fans	1.0
All	Other equipment not listed above.	1.0

5. Non-structural components: HVAC ductwork.
 - a. Component importance factor, I_p : Determine in accordance with ASCE 7, Section 15.4.1.1.
 - b. Seismic design category:
 - 1) See Table: Component Importance Factor for Seismic Design, I_p (preceding).
 - c. SMACNA seismic hazard level.
 - 1) Seismic hazard level for design of heating, ventilating, and air conditioning ductwork in accordance with SMACNA Seismic Restraint Manual:
 - a) SMACNA Seismic hazard level = $[A][B][C][D]$.
- E. Wind loads:
1. Design structures and non-structural components that are exposed to wind to withstand design wind loads.
 - a. Reduction of wind loads based on shielding effects of surrounding structures or components is not allowed.
 - b. Design for wind loading is not required for non-structural components and for non-building structures located inside enclosed buildings.
 2. Design parameters:
 - a. Basic wind speed:
 - 1) 110 miles per hour (33 feet above ground, 3 second gust).
 - b. Exposure category: C.
 - c. Topographic factor, K_{zt} : 1.0.
 - d. Wind pressure for design of "components and cladding".
 - 1) "Components and cladding" includes doors, windows, siding panels, skylights, parapets and similar architectural elements.
 - 2) Minimum wind pressure for components and cladding, strength level:
 - a) Wall elements: Minimum 26 / -31 pounds per square foot, pressure or vacuum.
 - b) Roof elements: Minimum 16 / -97 pounds per square foot, pressure or vacuum.
 - c) Plus and minus signify pressures acting toward and away from surfaces, respectively.
 - d) For "allowable stress level" pressures, multiply strength level pressures by 0.625.

- F. Snow loads:
 - 1. Design for snow loading is not required for non-structural components and for non-building structures located inside enclosed buildings.
 - 2. Design parameters:
 - a. Ground snow load: $p_g = 48$ pounds per square foot.
 - b. Flat roof snow load: $p_f = 41$ pounds per square foot, minimum.
 - c. Rain-on-snow load surcharge: 5 pounds per square foot applied to balanced load case only.
 - d. Exposure factor, minimum: $C_e = 1.0$.
 - e. Thermal factor, minimum: $C_t = 1.1$.
 - f. Importance factor, minimum: $I_s = 1.1$.
 - g. Drifting:
 - 1) Consider effects of adjacent and nearby structures and equipment on drift loads.
 - 3. Ice build-up at eaves:
 - a. Minimum 108 pounds per linear foot along lower edges of roof.
- G. Rainfall loads:
 - 1. Determine rainfall loads using rainfall intensity specified in this Section and including effects of exposed surface slope, height above surface to discharge elevation, and deflection of ponded surfaces.
- H. Operational loads:
 - 1. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), surge or "water hammer," and other load conditions.
 - 2. Design for loads indicated by the equipment manufacturer.
 - 3. Design for loads indicated in the Technical Sections for equipment and appurtenances.
- I. Serviceability considerations: IBC & ASCE 7
 - 1. Deflection, unless otherwise indicated on the Drawings, or specified:
 - a. Beam deflection as fraction of span:
 - 1) Walkways and platforms: Total load = $L/240$; live load = $L/360$.
 - 2) Equipment supports: $L/450$.

PART 3 EXECUTION

3.01 GENERAL

- A. Design approach and criteria in accordance with:
 - 1. Regulatory requirements, including, but not limited to, the building code specified in Section 01_41_00 - Regulatory Requirements.
 - 2. Reference standards and project-specific design criteria listed in this Section.
 - 3. Specific requirements for individual elements and components of the Work as specified in subsequent Technical Sections.
- B. In the event of conflicts between design criteria, contact Engineer for interpretation.

- C. Where Owner-Delegated Design is required by the Specifications, prepare and submit designs as specified in Section 01_35_73 - Delegated Design Procedures.

3.02 DELEGATED DESIGN

- A. Where Delegated Design is required by the Technical Sections, prepare and submit designs as specified in Section 01_35_73 - Delegated Design Procedures.
- B. Calculations:
 - 1. Where submittal of calculations is required:
 - a. Provide complete calculations, including sketches to illustrate the design concepts being evaluated, and details to fully describe proposed construction.
 - 2. Requirements for seismic design calculations will be waived for the following:
 - a. Furniture and storage racks 6 feet in height or less.
 - b. Moveable equipment.
 - c. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category A or B.
 - d. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category C and where the component importance factor, I_p , is equal to 1.0.
 - 3. Requirements for wind design calculations will be waived for the following:
 - a. Equipment and components located inside structures, and away from the effects of wind loads.
- C. Shop Drawings:
 - 1. Describing components and manufacturer's requirements for connections.
 - a. Include details for connections of components to structures and supports.
 - b. Include details for anchoring bracing to structures where required.

3.03 DESIGN - ANCHORS FOR EQUIPMENT, COMPONENTS, AND BRACING

- A. General:
 - 1. Engineer's approval of anchor designs is required before placement of construction that supports or provides bracing for anchored equipment and components.
 - a. Prepare anchor designs after the Engineer's approval of the products and layout, and before placement of concrete or masonry that supports them.
 - 2. Adjust equipment pad sizes and add additional anchor confinement reinforcing to provide required strength at anchorage points between equipment and pad, and between pad and structure.
 - 3. Supports and bracing:
 - a. Design and install braces and anchors to transfer forces from equipment and components to the lateral force resisting system of the surrounding structure.
 - b. Anchor and brace piping, ductwork, and electrical distribution components so that lateral or vertical displacement does not result in damage to or failure of essential architectural, mechanical, or electrical equipment.
 - 1) Provide supplementary framing where required to transfer forces.
 - 2) Detail and locate braces and anchors to minimize differential movements between components and structure.

B. Preparation:

1. Obtain manufacturer's information:
 - a. Weight and dimensions of components.
 - b. Layout and location of anchors that connect to equipment base plates, sole plates, skids, or pads.
 - c. Sizes of holes for anchors that will be provided in equipment bases or support frames.

C. Analysis and design:

1. Perform and submit calculations to determine anchor designs at locations where equipment and equipment supports are connected to the supporting structure.
 - a. Indicate number, size, type, and material for anchors.
2. In determining forces at locations where equipment is anchored to structures, include effects of:
 - a. Equipment self-weight and operating weight.
 - b. Location of equipment center of mass.
 - c. Forces from equipment operation, including, but not limited to:
 - 1) Effects of internal contents, including weight and sloshing.
 - 2) Effects of thrust, surge, and water hammer where specified.
 - 3) Equipment reactions and operating torque.
 - 4) Equipment vibration.
 - 5) Thermal effects from equipment and from distribution systems connected to the equipment (piping, ducts, and electrical).
 - 6) Other load or displacement inducing conditions.
 - d. Forces on equipment from loads specified in this Section.
 - 1) Include effects of wind, snow, and icing loads where applicable.
 - 2) Design for load combinations indicated in ASCE 7, unless otherwise specified or indicated on the Drawings.
 - 3) Seismic and wind loads: For equipment and tanks with weight that varies based on the volume of contained material, determine anchor forces to accommodate the full range of filled, partially filled, and empty conditions.
3. Determine forces and overturning moments at equipment supports and at locations where supports are anchored to structures.
 - a. Indicate shear force and associated axial force at each anchor.
4. Do not use friction to resist sliding resulting from seismic or wind forces.
 - a. Resist sliding only by direct application of sliding loads to fasteners as bearing, shear, tension, or compression forces.
5. Use combined shears and axial forces at each anchor, design anchors and anchor groups for ductile failure.
 - a. Ductile failure: Anchor yield before failure of base material, typically concrete or masonry, at the anchor.
6. Anchor selection:
 - a. Provide anchor types as indicated on the Drawings.
 - b. Where anchors are not specifically indicated on the Drawings, select in accordance with the following:
 - 1) Anchors that resist seismic and wind forces:
 - a) Cast-in-place forged hex-head anchor bolt.
 - 2) Anchors loaded in sustained tension:
 - a) Cast-in-place forged hex-head anchor bolt.

- 3) Anchors for reciprocating, vibrating, and rotating equipment:
 - a) Cast-in-place forged hex-head anchor bolt.
- c. Do not use post-installed anchors, mechanical or adhesive, unless:
 - 1) Post-installed anchors are indicated on the Drawings, or
 - 2) Post-installed are approved by the Engineer prior to placement of the surrounding concrete or masonry.
- d. Anchor diameter:
 - 1) Select diameter so that hole in base plate is not greater than 125 percent of the nominal diameter of the anchor, nor greater than the diameter of the anchor plus 1/4 inch.
- 7. Determine number, size, layout, and minimum effective embedment for anchors.
 - a. Layout includes anchor spacing and required distance(s) from anchor to edge(s) of supporting concrete or masonry.
 - b. Anchors in concrete: Design based on minimum specified 28-day compressive strength, f'_c , as follows, unless otherwise indicated on the Drawings for the Work area:
 - 1) Concrete placed for this Work: $f'_c = 4,500$ pounds per square inch.
 - 2) Existing concrete in place prior to this Work: $f'_c = 4,000$ pounds per square inch.
 - c. Anchors in masonry: Design based on minimum specified compressive strength, f'_m , as follows, unless otherwise indicated on the Drawings for the Work area:
 - 1) Concrete masonry placed for this Work: $f'_m = 2,000$ pounds per square inch.
 - 2) Existing concrete masonry in place prior to this Work: $f'_m = 1,500$ pounds per square inch.
- 8. Prepare Drawings showing construction details of anchor designs.
- 9. Submit design calculations and Drawings prior to placement of anchors, and of the structural elements to which they will connect.

END OF SECTION

SECTION 03_11_07
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Concrete formwork.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.
- B. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- C. Underwriters Laboratories (UL).

1.03 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Information on proposed forming system:
 - 1. Submit in such detail as the Engineer may require to assure themselves that intent of the Specifications can be complied with by use of proposed system.
 - 2. Alternate combinations of plywood thickness and stud spacing may be submitted.
- C. Form release agent: NSF 61 certification prepared by NSF, UL, or other similar nationally recognized testing laboratory acceptable to the Engineer.

1.04 QUALITY ASSURANCE

- A. Qualifications of formwork manufacturers: Use only forming systems by manufacturers having a minimum of 5 years of experience, except as otherwise specified, or accepted in writing by the Engineer.
- B. Regulatory requirements: Install Work of this Section in accordance with local, state, and federal regulations.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Design requirements:
 - 1. Concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
 - 2. Forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.
- B. Performance requirements:
 - 1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
 - 2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
 - 3. Provide enough forms so that the Work may be performed rapidly and present uniform appearance in form patterns and finish.
 - 4. Use forms that are clean and free from dirt, concrete, and other debris.
 - a. Coat with form release agent if required, prior to use or reuse.

2.02 MANUFACTURED UNITS

- A. Forms:
 - 1. Built-up plywood:
 - a. May be substituted for prefabricated forming system, subject to the following minimum requirements:
 - 1) Size and material:
 - a) Use full size 4-foot by 8-foot plywood sheets, except where smaller pieces are able to cover the entire area.
 - b) Sheet construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
 - 2) Wales: Minimum 2-inch by 4-inch lumber.
 - 3) Studding and wales: No loose knots and free of warps, cups, and bows.
 - 2. Steel:
 - a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
 - b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
 - 3. Steel-framed plywood:
 - a. Provide forms that are rigidly constructed and capable of being braced.
 - b. Plywood paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

- B. Form release agent.
 - 1. Effective, non-staining, bond-breaking coating compatible with form surfaces and concrete mixes used.
 - 2. Certified for conformance to NSF 61 and leaving no taste or odor on the concrete surface.
- C. Form ties:
 - 1. General:
 - a. Provide form ties for forming system selected that are manufactured by a recognized manufacturer of concrete forming equipment.
 - b. Do not use wire ties or wood spreaders.
 - c. Provide ties of type that accurately tie, lock, and spread forms.
 - d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
 - e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
 - 2. Cone-snap ties:
 - a. Shall form a cone shaped depression in the concrete with minimum diameter of 1 inch at the surface of the concrete and minimum depth of 1-1/2 inches.
 - b. Provide neoprene waterseal washer that is located near the center of the concrete.
 - 3. Taper ties:
 - a. Neoprene plugs for taper tie holes: Size so that after they are driven, plugs are located in center third of wall thickness.
- D. Incidentals:
 - 1. External angles:
 - a. Where not otherwise indicated on the Drawings, provide with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
 - b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, and construction joints.
 - 2. Keyways: Steel, plastic, or lumber treated with form release agent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site verification of conditions:
 - 1. Do not place concrete until forms have been checked for alignment, level, and strength, and mechanical and electrical inserts or other embedded items for correct location.

3.02 INSTALLATION

A. Forms:

1. Built-up plywood:
 - a. Studding:
 - 1) Spaced at 16 inches or 24 inches on center.
 - 2) Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
 - 3) Install studs perpendicular to grain of exterior plys of plywood sheets.
 - b. Wales: Double lumber material with minimum size as specified in this Section.
 - c. Number of form reuses: Depends upon durability of surface coating or overlay used, and ability to maintain forms in condition such that they are capable of producing flat, smooth, hard, dense finish on concrete when stripped.
2. Steel:
 - a. Adequately brace forms for minimum deflection of finish surface.
3. Steel-framed plywood:
 - a. Rigidly construct and brace with joints fitting closely and smoothly.
 - b. Number of form reuses: Depends upon durability of surface coating or overlay used.
4. Built-up plywood forms may be used in conjunction with steel forms or steel-framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.

B. Form bracing and alignment:

1. Line and grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
2. Formwork:
 - a. Securely brace, support, tie down, or otherwise hold in place to prevent movement.
 - b. Make adequate provisions for uplift pressure, lateral pressure, and deflection of forms.
3. When second lift is placed on hardened concrete, take special precautions in formwork at top of old lift and bottom of new lift to prevent:
 - a. Spreading and vertical or horizontal displacement of forms.
 - b. Grout "bleeding" onto finish concrete surfaces.
4. Pipe stubs, anchor bolts, conduits, and other embedded items:
 - a. Set in forms, position, and secure prior to placement of concrete to maintain a minimum 1-1/2-inch clearance between the item and any concrete reinforcement.
 - b. Securing embedded items in position by wiring or welding to the reinforcement is not permitted.
5. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16 inch or larger by tightening forms or by filling with acceptable crack filler acceptable to the Engineer.

- C. Forming incidentals:
 - 1. Keyways: Construct as indicated on the Drawings.
 - 2. Reentrant angles: May be left square.
 - 3. Level strips: Install at top of wall concrete placements to maintain true line at horizontal construction joints.
 - 4. Inserts:
 - a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
- D. Form release agent:
 - 1. Apply in accordance with the manufacturer's instructions.
- E. Form ties:
 - 1. Cone-snap ties: Tie forms together at not more than 2-foot centers vertically and horizontally.

3.03 FORM REMOVAL

- A. Do not remove forms from concrete which has been placed when outside ambient air temperature is below 50 degrees Fahrenheit until the following conditions are satisfied:
 - 1. Concrete has sufficient strength to allow form removal without damage to surfaces.
 - 2. At least 48 hours have elapsed since the end of concrete placement.
 - 3. Provisions are in place to maintain moisture for curing concrete, and temperature at or above the required minimum curing temperature specified.
- B. Vertical forms:
 - 1. Retain in place for a minimum of 24 hours after concrete is placed.
 - 2. If concrete has sufficient strength and hardness to resist surface or other damage after 24 hours, forms may be removed.
- C. Other forms supporting concrete, and shoring: Retain in place as follows:
 - 1. Formed sides of footings: 24 hours minimum.
 - 2. Formed vertical sides of beams, girders, and similar members: 48 hours minimum.
 - 3. Forms below slabs, beams, and girders: Until concrete strength reaches specified strength f'_c or until shoring is installed.
 - a. Shoring for slabs, beams, and girders: Shore until concrete strength reaches minimum specified 28-day compressive strength.

3.04 SURFACE REPAIRS AND FINISHING

- A. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified in Section 03_30_00 - Cast-in-Place Concrete.
- B. Finish concrete as indicated on the Drawings and as specified in Section 03_35_29 - Concrete Finishes.

- C. Form ties:
1. Snap ties:
 - a. Break off ties and remove tie ends and forming cones from concrete.
 - b. Prepare cone-shaped tie holes:
 - 1) Roughen by heavy sandblast.
 - 2) Clean with compressed air to remove dust and debris.
 - c. Coat cone-shaped tie hole surfaces with epoxy bonding agent specified in Section 03_63_01 - Epoxies.
 - d. Fill cone-shaped tie holes with dry-pack mortar specified in Section 03_35_29 - Concrete Finishes.
 2. Taper ties:
 - a. Remove forms and taper ties from concrete.
 - b. Prepare taper tie holes:
 - 1) Roughen by heavy sandblast.
 - 2) Clean with compressed air to remove dust and debris.
 - c. After cleaning, drive a neoprene plug into each of taper tie holes.
 - 1) Final location of the neoprene plug: Center third of wall thickness.
 - 2) Locate steel rod in cylindrical recess and drive against middle of plug. Do not drive against the flat area outside cylindrical recess.
 - d. Coat taper tie hole surface with epoxy bonding agent specified in Section 03_63_01 - Epoxies.
 - e. Fill taper tie hole with dry-pack mortar specified in Section 03_35_29 - Concrete Finishes.
 - 1) Place dry-pack mortar in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
 - 2) Dry-pack hole on the outside of the face of the wall no sooner than 7 days after hole on the inside of the face of the wall has been dry packed.

3.05 CONCRETE TOLERANCES

- A. Finish concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.
- B. Construct Work within the tolerances in accordance with ACI 117, except as modified in the following paragraphs or as indicated on the Drawings.
1. General:
 - a. At certain locations, tolerances required for equipment placement and operation may be more restrictive than the general tolerance requirements in this Section.
 - b. Confirm equipment manufacturers' required tolerances for location and operation of equipment that will be installed, and construct concrete to satisfy those requirements.
 2. Slabs:
 - a. Slope: Uniformly sloped to drain when slope is indicated on the Drawings.
 - b. Slabs indicated to be level: Maximum vertical deviation of 1/8 inch in 10-foot horizontal length without any apparent changes in grade.
 3. Circular tank walls:
 - a. May deviate from finish line indicated on the Drawings by use of forms with chord lengths not to exceed 2 feet.

4. Inserts and embedments:
 - a. Set to tolerances required for proper installation and operation of equipment or systems to which insert pertains.
 - b. Maximum tolerances as follows:

Item	Tolerance
Sleeves and inserts	Plus 1/8 inch; minus 1/8 inch.
Anchor bolts:	
Projected ends	Plus 1/4 inch; minus 0.0 inch.
Axial alignment	Not more than 2 degrees off the axis indicated on the Drawings.
Setting location	Plus 1/16 inch; minus 1/16 inch.
All embedments	Minimum 1 inch clearance from reinforcing steel.

- c. Securing embedded items in formwork by wiring or welding to reinforcement is not permitted.

C. Remove and replace Work that does not conform to the required tolerances.

END OF SECTION

SECTION 03_15_00
CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Waterstops.
 - 2. Joint fillers.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D570 - Standard Test Method for Water Absorption of Plastics.
 - 2. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 3. D638 - Standard Test Method for Tensile Properties of Plastics.
 - 4. D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 5. D747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
 - 6. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - 7. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 8. D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 9. D2240 - Standard Test Method for Rubber Property - Durometer Hardness.
- B. American National Standards Institute (ANSI):
 - 1. A135.4 - Basic Hardboard.
- C. U. S. Army Corps of Engineers (USACE):
 - 1. CRD-C-572, Specification for Polyvinyl Chloride Waterstop.

1.03 SUBMITTALS

- A. Product data:
 - 1. Polyvinyl chloride waterstops: Complete physical characteristics.
 - 2. Preformed expansion joint material: Sufficient information on each type of material for review to determine conformance of material to requirements specified.

- B. Samples:
 - 1. Polyvinyl chloride waterstop.
- C. Laboratory test reports: Indicating that average properties of polyvinyl chloride waterstops material and finish conform to requirements specified in this Section.
- D. Quality control submittals:
 - 1. Certificates of Compliance:
 - a. Written certificates that polyvinyl chloride waterstops supplied on this Project meet or exceed physical property in accordance with USACE CRD-C-572 and the requirements of this Section.
 - 2. Manufacturer's instructions: For materials specified in this Section that are specified to be installed with such instructions.

1.04 QUALITY ASSURANCE

- A. Mock-ups:
 - 1. Welding demonstration:
 - a. Demonstrate ability to weld acceptable joints in polyvinyl chloride waterstops before installing waterstop in forms.
- B. Field joints:
 - 1. Polyvinyl chloride waterstops field joints: Free of misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of material to water pressure at any point. Replace defective joints. Remove faulty material from site and disposed of by Contractor at its own expense.
- C. Inspections:
 - 1. Quality of welded joints will be subject to acceptance of Engineer.
 - 2. Polyvinyl chloride waterstop: Following defects represent partial list that will be grounds for rejection:
 - a. Offsets at joints greater than 1/16 inch or 15 percent of the material thickness, at any point, whichever is less.
 - b. Exterior crack at joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 - c. Any combination of offset or crack that will result in net reduction in cross section of waterstop in excess of 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 - d. Misalignment of joint that will result in misalignment of waterstop in excess of 1/2 inch in 10 feet.
 - e. Porosity in welded joint as evidenced by visual inspection.
 - f. Bubbles or inadequate bonding.

PART 2 PRODUCTS

2.01 JOINT FILLERS

- A. General:
 - 1. Use specific type in applications as indicated on the Drawings.
 - 2. Do not use scrap or recycled materials to manufacture joint fillers.
- B. Preformed expansion joint materials:
 - 1. Bituminous fiber expansion joint material:
 - a. Properties:
 - 1) Thickness: To match joint width indicated on the Drawings.
 - 2) Asphalt-impregnated fiber in accordance with ASTM D1751.
 - b. Manufacturers: One of the following or equal:
 - 1) Durajoint.
 - 2) W.R. Meadows, SealTight Fibre Expansion Joint.
 - 2. Synthetic sponge rubber expansion joint material:
 - a. Properties:
 - 1) Thickness: As recommended for width indicated on the Drawings.
 - 2) Material in accordance with ASTM D1752, Type I.
 - b. Manufacturers: One of the following or equal:
 - 1) Williams Products Inc., Everlastic 1300.
 - 2) W.R. Meadows, SealTight Sponge Rubber.

2.02 WATERSTOPS

- A. Waterstops - polyvinyl chloride (PVC):
 - 1. Manufactured from prime virgin polyvinyl chloride plastic compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements as specified in this Section.
 - 2. Manufacturers: One of the following or equal:
 - a. Vinylex Corp.
 - b. Sika Corp., Greenstreak PVC Waterstop.
 - 3. Type: Ribbed waterstop:
 - a. Construction joints: 6-inch wide ribbed type.
 - b. Expansion joint for wall penetrations for concrete encased electrical duct banks: 6-inch ribbed type with hollow center bulb.
 - c. Expansion joints: 9-inch wide ribbed type with hollow center bulb.
 - d. Dumbbell-type waterstop will not be allowed unless otherwise specified or indicated on the Drawings.
 - e. No scrap or reclaimed material shall be used.
 - 4. Properties as indicated in the following table:

Physical Characteristics	Test Method	Required Results
Specific Gravity	ASTM D792	Not less than 1.3.
Hardness	ASTM D2240	70 to 90 Type A15 Shore durometer.
Tensile Strength	ASTM D638	Not less than 2,000 pounds per square inch.
Ultimate Elongation	ASTM D638	Not less than 300 percent.

Physical Characteristics	Test Method	Required Results
Alkali Extraction	CRD-C-572	Change in weight after 7 days: Between minus 0.1 percent and plus 0.25 percent. Change in hardness after 7 days: Not more than plus 5 points.
Low Temperature Brittle Point	ASTM D746	No sign of cracking or chipping at -35 degrees Fahrenheit.
Water Absorption	ASTM D570	Not more than 0.15 percent after 24 hours.
Accelerated Extraction Test	CRD-C-572	Tensile strength: Not less than 1,600 pounds per square inch. Elongation: Not less than 280 percent.
Stiffness in Flexure	ASTM D747	Not less than 600 pounds per square inch.
Tear Resistance	ASTM D624	Not less than 225 pounds per inch.
Thickness	-	3/8 inch.
Center Bulb		
6-inch Waterstops	-	7/8 inch or 1-inch nominal outside diameter.
9-inch Waterstops	-	For expansion joints 1 inch and narrower: 1-inch nominal outside diameter. For expansion joints wider than 1 inch: 2-inch nominal outside diameter.
Allowable Tolerances		
Width	-	Plus or minus 3/16 inch.
Thickness	-	Plus or minus 1/32 inch.

B. Waterstops - hydrophilic rubber:

1. As specified in Section 03_15_14 - Hydrophilic Rubber Waterstop.

PART 3 EXECUTION

3.01 INSTALLATION

A. Waterstops:

1. General:

- a. Store waterstops so as to permit free circulation of air around waterstop material and prevent direct exposure to sunlight.
- b. Install waterstops in concrete joints where indicated on the Drawings.
- c. Carry waterstops in walls into lower slabs and join to waterstops in slabs with appropriate types of fittings.
- d. In waterbearing structures: Provide all joints with waterstops, whether indicated on the Drawings or not.
- e. Provide waterstops that are continuous.
- f. Set waterstops accurately to position and line as indicated on the Drawings.
- g. Hold and securely fix edges in position at intervals of not more than 24 inches so that they do not move during placing of concrete.
- h. Position the waterstop so that symmetrical halves of waterstop are equally divided between concrete pours. Center axis of waterstop shall be coincident with centerline of the joint.
- i. Do not drive nails, screws, or other fasteners through waterstops in vicinity of construction joints.
- j. Use wires at not more than 24 inches on centers near outer edge of waterstop to tie waterstops into position.
- k. Special clips may be used in lieu of wires, at Contractor's option.
- l. Terminate waterstops 3 inches from top of finish surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
- m. When any waterstop is installed in concrete on one side of joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, take suitable precautions to shade and protect exposed waterstop from direct rays of sunlight during entire exposure and until exposed portion is embedded in concrete.
- n. When placing concrete at waterstops in slabs, lift edge of waterstop while placing concrete below the waterstop. Manually force waterstop against and into concrete, and then cover waterstop with fresh concrete.

2. Polyvinyl chloride waterstop:

- a. Install waterstops so that joints are watertight.
- b. Weld joints such as unions, crosses, ells, and tees, with thermostatically controlled equipment recommended by waterstop manufacturer:
 - 1) Do not damage material by heat sealing.
 - 2) Make joints by overlapping, then simultaneously cut ends of sections to be spliced so they will form smooth even joint. Heat cut ends with splicing tool until the plastic melts. Press 2 ends together until plastic cools.
 - 3) Maintain continuity of waterstop ribs and tubular center axis.
 - 4) The splices shall have tensile strength of not less than 60 percent of unspliced materials tensile strength.
- c. Butt joints of ends of 2 identical waterstop sections may be made while material is in forms.

- d. Prefabricate waterstop joints involving more than 2 butt ends to be joined together, including all joints that involve an angle cut, alignment change, or joining of 2 dissimilar waterstop sections, prior to placement in form.
 - 1) Provide not less than 24-inch long strips of waterstop material beyond joint.
 - 2) After inspection and acceptance, install such prefabricated waterstop joint assemblies in forms and butt-weld ends of 24-inch strips to straight run portions of waterstop in place in forms.
- e. Manufacturer shall factory prefabricate joints for crosses and tees.
- f. Split-type waterstops will not be permitted except where specifically indicated on the Drawings.

B. Joints:

- 1. Construct construction and expansion joints as indicated on the Drawings.
- 2. Preformed expansion joint material: Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

END OF SECTION

SECTION 03_15_14

HYDROPHILIC RUBBER WATERSTOP

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Hydrophilic rubber waterstop.

1.02 REFERENCES

- A. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

- A. General:
 - 1. Submit the following items for each type, style and size of hydrophilic waterstop to be installed.
 - 2. Product data:
 - a. Manufacturer's product data sheets.
 - 1) Include complete physical dimensions, expansion characteristics, and laboratory test reports indicating that average material properties conform to the requirements specified.
 - 2) Provide data sheets for all materials to be included in the waterstop system.
 - 3. Samples:
 - a. Minimum 6-inch long samples of each type of waterstop to be used if requested by the Engineer.
 - 4. Manufacturer's installation instructions:
 - a. Installation instructions and recommended installation details for the complete waterstop system, and for each component used in that system.

PART 2 PRODUCTS

2.01 HYDROPHILIC RUBBER WATERSTOP

- A. General:
 - 1. System composed of flexible hydrophilic urethane polymer with preformed strips, adhesives, paste, fasteners, and other accessories required for a complete and watertight installation.
 - a. To ensure compatibility of materials, a single manufacturer shall provide all products and accessories for the hydrophilic waterstop system.
 - b. Products incorporating bentonite are not acceptable under this Section.
 - c. Provide waterstop and accessories resistant to degradation under cyclic wetting and drying and to chemicals typically found in water treatment structures.

- B. Hydrophilic strip waterstop:
 - 1. Pre-formed strips of flexible hydrophilic rubber designed to undergo controlled expansion when exposed to moisture:
 - a. Strips manufactured to limit expansion in directions parallel to the plane of the joint, and to direct expansion against confining material perpendicular to that plane.
 - 2. Provide normal or low-expansion pressure as scheduled and as indicated on the Drawings.
 - 3. Manufacturers: One of the following or equal:
 - a. Hydrophilic strip:
 - 1) Adeka Ultra Seal USA, MC-2010MN.
 - 2) Sika Corp., Hydrotite CJ1020-2K.
 - b. Low expansion hydrophilic strip:
 - 1) Adeka Ultra Seal USA, KBA-1510FP.
 - 2) Sika Corp., Hydrotite CJ0725-3K.
- C. Hydrophilic paste waterstop.
 - 1. Single-component gun grade paste of hydrophilic rubber designed to undergo controlled expansion when exposed to moisture after initial curing.
 - 2. Manufacturers: One of the following or equal:
 - a. Adeka Ultra Seal USA: P-201.
 - b. Sika Corp., Leakmaster LV-Z.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and recommended details.
- B. Prepare concrete joint surfaces:
 - 1. Use wire brushing or scraping to expose an uncontaminated, solid surface.
 - 2. Clean prepared surface with high-pressure air or water to remove residue and debris.
 - 3. Confirm that prepared surfaces conform to manufacturer's recommendations for surface profile and moisture conditions before installing materials.
- C. Provide manufacturer's recommended lap, splice, and corner details for hydrophilic waterstops.
 - 1. Use hydrophilic paste at all corner joints and overlap splices of hydrophilic strips.
- D. Hydrophilic strip waterstop:
 - 1. Install primers and adhesives when recommended by the manufacturer before setting hydrophilic strips.
 - 2. Keep hydrophilic strip taut during the fastening process.
 - 3. Secure hydrophilic strip in place with concrete nails, screws, or adhesive.

4. Provide installation with no gap between the hydrophilic strip and the concrete to which it is attached. At rough or irregular surfaces, set hydrophilic strip waterstop strip in a bead of hydrophilic paste.
 - a. Fill all voids and rough areas under the hydrophilic strip with hydrophilic paste.
 - b. Allow hydrophilic paste to cure in accordance with manufacturer's recommendations before encapsulating paste in fresh concrete.

3.02 SCHEDULE

- A. At the following joint locations/conditions, use the hydrophilic strip waterstop configuration noted unless otherwise indicated on the Drawings.
- B. Concrete construction joints:
 1. Under all of the following conditions, use hydrophilic strip waterstop set in a bed of hydrophilic paste waterstop, and screw strip waterstop to concrete surface:
 - a. Slab or wall thickness is greater than 10 inches.
 - b. Waterstop is placed between 2 rows of steel reinforcement.
 - c. Concrete cover from waterstop to nearest concrete face is at least 4 inches.
 2. Under any one of the following conditions, use low-expansion hydrophilic strip waterstop set in bed of hydrophilic paste waterstop and screw strip to concrete surface:
 - a. Waterstop is placed on 1 side of a single row of steel reinforcement.
 - b. Concrete cover from waterstop to nearest concrete face is less than 4 inches.
- C. Pipe penetrations through concrete:
 1. Pipe diameter less than 4 inches: Not allowed.
 2. Pipe diameter of 4 to 24 inches: Continuous bead of hydrophilic paste waterstop, minimum 1/4-inch high by 1/2-inch wide, encircling pipe.
 3. Pipe diameter greater than 24 inches: Continuous hydrophilic strip waterstop around perimeter of pipe, with hydrophilic paste seal at lapped ends of strip.

END OF SECTION

SECTION 03_20_00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Reinforcing bars.
 - a. Carbon steel.
 - 2. Thread bars.
 - 3. Bar supports.
 - 4. Tie wires.
 - 5. Mechanical reinforcing bar couplers.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 2. SP-66 - ACI Detailing Manual.
- B. American Iron and Steel Institute (AISI).
- C. American Welding Society (AWS):
 - 1. D1.4 - Structural Welding Code - Reinforcing Steel.
- D. ASTM International (ASTM):
 - 1. A493 - Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
 - 2. A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - 3. A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 4. A1064 - Standard Specification of Carbon-Steel wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- E. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Manual of Standard Practice.
- F. ICC Evaluation Service (ICC-ES):
 - 1. AC133 - Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
1. Architectural concrete: Concrete surfaces that will be exposed to view in the finished work.
 - a. Additionally, for purposes of this Section, includes:
 - 1) Concrete surfaces that are designated to receive paints or coatings.
 - 2) Exposed concrete in open basins, channels, and similar liquid containing structures: Surfaces shall be considered exposed to view if located above a line 2 feet below the normal operating water surface elevation in that structure.
 2. Bars: Reinforcement or reinforcing bars as specified in this Section.
 3. Evaluation Report: Report prepared by ICC-ES, or by other testing agency acceptable to the Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and its acceptance for use under the Building Code specified in Section 01_41_00 - Regulatory Requirements.
 4. Give away bars: Reinforcing bars that are not required by the Contract Documents but are installed by the Contractor to provide support for the required reinforcing bars.
 5. Wire supports: Metal reinforcing supports constructed of steel wire as specified. Includes individual high chairs, continuous high chairs, bolsters and other similar configurations and shapes.

1.04 SUBMITTALS

- A. General:
1. Submit in accordance with Section 01_33_00 - Submittal Procedures.
 2. Changes to reinforcement in Contract Documents:
 - a. Indicate in a separate letter submitted with Shop Drawings any changes to reinforcement indicated on the Drawings or specified.
 - b. Such changes will not be acceptable unless the Engineer has accepted them in writing.
- B. Product data:
1. Bar supports:
 - a. Wire bar supports:
 - 1) Schedule of support materials to be provided and locations of use.
 - b. Precast concrete bar supports ("dobies"):
 - 1) Manufacturer's data indicating compression strength of concrete and confirming dimensions, thickness(es) and height(s) to be provided for each location where used.
 2. Mechanical reinforcing bar couplers. For each type and/or series to be provided:
 - a. Evaluation Report documenting compliance with the requirements of ICC-ES AC133.
 - b. Details, properties, and dimensions of couplers. Include type or size identification, and bar size(s) and grade(s) for which the coupler is suitable.
 - c. Manufacturer's installation and testing instructions.

- d. Manufacturer's statement that products installed in accordance with manufacturer's recommended procedures will develop strengths and limit slip as specified in this Section.
- C. Shop Drawings:
 - 1. Reinforcement Shop Drawings:
 - a. Submit Drawings showing bending and placement of reinforcement required by the Contract Documents.
 - b. Provide CAD generated Shop Drawings.
 - c. Clearly indicate structures or portions of structures covered by each Submittal.
 - 1) Submit reinforcement Shop Drawings for each structure as a complete package. Submittals addressing only a portion of a structure will be rejected and returned without review, unless such presentation is accepted by the Engineer in advance.
 - d. Shop Drawings shall conform to the recommendations of the CRSI Manual of Standard Practice and be in accordance with ACI SP-66.
 - e. Use the same bar identification marks on bending detail Drawings, placement Drawings, and shipping tags.
 - f. Submittals consisting solely of reinforcing bar schedules, without accompanying placement Drawings, will not be accepted unless accepted under prior written agreement with the Engineer.
 - 2. Reinforcement placement Drawings:
 - a. Clearly show placement of each bar listed in the bill of materials, including additional reinforcement at corners and openings, and other reinforcement required by details in the Contract Documents.
 - b. Clearly identify locations of reinforcement with coatings (e.g., galvanized or epoxy) and with yield strength other than ASTM A615, Grade 60.
 - c. Show anchor bolt locations based on anchor bolt templates for approved equipment.
 - d. Show splice locations.
 - e. Show locations of mechanical reinforcing couplers if used.
 - 3. Reinforcement fabrication Drawings:
 - a. If bend types or nomenclature differs from that recommended in the CRSI Manual of Standard Practice, provide details showing bend types and dimensional designations.
 - b. Clearly identify reinforcement with coatings and with yield strength other than ASTM A615, Grade 60.
- D. Samples (when requested by the Engineer):
 - 1. Bar supports/wire reinforcement supports: Samples of each type of chair and bolster proposed for use. Submit with letter stating where each type will be used.
 - 2. Precast concrete bar supports: Samples of each type of precast support proposed for use. Submit with letter stating where each will be used.
- E. Test reports:
 - 1. Certified copy of mill test for each steel used. Show physical properties and chemical analysis.
 - a. Mill test reports may be submitted as record documents at the time the reinforcement from that heat of steel is shipped to the site.

- b. In such cases, submit certificates under the Shop Drawing Submittal number with the letter "R" (for record date) appended to the end (e.g., if the reinforcement was submitted as 03_20_00-002-1, deliver the associated mill certificate as Submittal 03_20_00-002-1R).
 - 2. Mechanical reinforcing bar couplers:
 - a. Current Evaluation Report confirming that couplers provide specified tension and compression strength and conform to specified limits on total slip within the coupler.
 - b. Certified copy of mill tests for heat(s) of steel incorporated into the reinforcing bar couplers shipped.
 - c. For threaded sleeve type couplers, heat treatment lot numbers for each shipment.
- F. Manufacturer's instructions:
 - 1. Mechanical reinforcing bar couplers:
 - a. Manufacturer's installation instructions.
 - b. Manufacturer's instructions for confirmation testing of couplers after reinforcing bars have been inserted into the couplers.
- G. Special procedures:
 - 1. Welding procedures in accordance with AWS D1.4 for reinforcement to be field welded.
 - a. Procedures qualification record.
- H. Qualifications statements:
 - 1. Welder qualifications.
- I. Closeout documents:
 - 1. Field quality control and inspection reports.
 - 2. Field quality assurance special inspection and testing reports.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver bars bundled and tagged with identifying tags.
- B. Acceptance at site:
 - 1. Reinforcing bars: Deliver reinforcing bars lacking grade identification marks with letter containing manufacturer's guarantee of grade.

1.06 SEQUENCING AND SCHEDULING

- A. Bar supports:
 - 1. Do not place concrete until samples and product data for bar supports have been accepted by the Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Drawings contain notes describing the size and spacing of reinforcement and its placement, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete, and other related information.

2.02 MATERIALS

- A. Reinforcing bars:
 - 1. Provide reinforcement of the grades and quality specified, fabricated from new stock, free from excessive rust or scale, and free from unintended bends or other defects affecting its usefulness.
 - 2. ASTM A615 Grade 60 deformed bars, including the following requirements, or ASTM A706 Grade 60 deformed bars:
 - a. Actual yield strength based on mil tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
 - b. Ratio of actual ultimate tensile strength to actual tensile yield strength shall not be less than 1.25.
 - 3. Reinforcing bars designated or required to be welded:
 - a. Low-alloy, ASTM A706 Grade 60, deformed bars.
 - 4. Reinforcing bars that are required to resist earthquake-induced flexural and axial forces in concrete frame members and in concrete shear wall boundary members where indicated on the Drawings:
 - a. Low-alloy, ASTM A706 Grade 60, deformed bars.
- B. Bar supports:
 - 1. Wire supports:
 - a. All stainless steel bar supports:
 - 1) Conforming to CRSI Manual of Standard Practice recommendations for types and details, but custom fabricated entirely from stainless steel wire in accordance with ASTM A493, AISI Type 316.
 - b. Stainless steel protected bar supports:
 - 1) Conforming to CRSI Manual of Standard Practice Class 2, Type B, and consisting of bright basic wire support fabricated from cold-drawn carbon steel wire with stainless steel ends attached at the bottom of each leg.
 - 2) Stainless steel wire ends shall be in accordance with ASTM A493, AISI Type 316 and shall extend at least 3/4 inch inward from the formed surface of the concrete.
 - c. Bright basic wire bar supports.
 - 1) Conforming to CRSI Manual if Standard Practice, Class 3.
 - 2. Plastic supports:
 - a. Manufacturers: The following or equal:
 - 1) Aztec Concrete Accessories.
 - 3. Deformed steel reinforcing bar supports:
 - a. Fabricated of materials and to CRSI details recommended for typical reinforcement embedded in concrete and bent to dimensions required to provide specified clearances and concrete cover.

4. Precast concrete bar supports ("dobies"):
 - a. Pre-manufactured, precast concrete blocks with cast-in annealed steel wires, 16-gauge or heavier.
 - b. Compression strength of concrete: Equal to or exceeding the compression strength of the surrounding concrete.
 - c. Block dimensions:
 - 1) Height to provide specified concrete cover.
 - 2) Footprint not less than 3 inches by 3 inches, and adequate to support the weight of the reinforcement and maintain specified concrete cover without settling into the underlying surface.
- C. Tie wires:
 1. General use: Black annealed steel wire, 16-gauge or heavier.
- D. Welded wire fabric reinforcement:
 1. Material:
 - a. Carbon steel in accordance with ASTM A1064.
 2. Provide welded wire reinforcement in flat sheet form. Rolled wire fabric is not permitted.
 3. Fabric may be used in place of reinforcing bars if accepted by the Engineer:
 - a. Provide welded wire fabric having cross-sectional area per linear foot not less than the cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.
- E. Mechanical reinforcing bar couplers:
 1. General:
 - a. Only products in accordance with the requirements of ACI 318 for mechanical splices and holding a current Evaluation Report that documents the following performance characteristics, will be considered for use.
 - b. Strength of coupler: Capable of developing tension and compression strength not lower than the lesser of the following:
 - 1) ACI 318 "Type 2" units: In static tension and compression:
 - a) Minimum 125 percent of the ASTM-specified minimum yield strength of the reinforcement being spliced.
 - b) Minimum 100 percent of the ASTM-specified minimum ultimate strength of the reinforcement being spliced.
 - c. Slip of reinforcing bars within coupler: Total slip of the reinforcing bars within the splice sleeve limited as follows:
 - 1) For bar sizes #14 and smaller, elongation between gauge points measured clear of the splice sleeve not exceeding 0.010 inches after coupler has been loaded to a tension of 30,000 pounds per square inch and load relaxed to a tension of 3,000 pounds per square inch.
 - d. Fabrication:
 - 1) Threaded joints:
 - a) Provide threaded ends designed so that cross-threading of bars will not occur during assembly.
 - b) Fabricate male ends for female couplers using coupler manufacturer's bar threading equipment to ensure proper taper and thread engagement.

- 2) Mark each sleeve with heat treatment lot number.
2. Couplers: Threaded - Reinforcing bar splice at construction joints.
 - a. Steel sleeve butt splice with tapered internal threads in forged or swaged head and nailing flange for attaching to forms. Provide with matching, tapered male-threaded dowels for insertion and tightening into threaded sleeve after form removal.
 - 1) Provide sleeve with factory-installed plugs to prevent concrete mortar from entering internally threaded coupler.
 - 2) Provide optional clipped nailing flanges as required to maintain minimum specified concrete cover over surfaces of coupler.
 - b. Holding current Evaluation Report demonstrating acceptance under ICC-ES AC133.
 - c. Manufacturers: One of the following, or equal:
 - 1) Dayton Superior, DBDI Splice System.
 - 2) ERICO-Pentair, Lenton Form Saver.
3. Couplers: Threaded - reinforcing bar splice:
 - a. Steel sleeve butt splice with tapered internal threads at each end for joining to matching tapered male threads on reinforcing bars.
 - b. Holding current Evaluation Report demonstrating acceptance under ICC-ES AC133.
 - c. Manufacturers: One of the following, or equal:
 - 1) Dayton Superior: Taper-Lock System.
 - 2) ERICO-Pentair: Lenton Taper Threaded Splicing System.

2.03 FABRICATION

- A. Shop fabrication and assembly:
 1. Cut and bend bars in accordance with provisions of ACI 318 and the CRSI Manual of Standard Practice.
 2. Bend bars cold. Use bending collars to develop the recommended bend radius.
 3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.
 4. Circumferential and radiused reinforcement: Roll to the radius required for its location in the structure before installation.
 5. Bars to be fitted with mechanical couplers:
 - a. Fabricate threaded ends for connections in shop using manufacturer's recommended tools. Field fabrication is not allowed.
 - b. Cut ends square.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 1. Reinforcing bars and welded wire reinforcement:
 - a. Verify that reinforcement is new stock, free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings that will adversely affect bonding capacity when placed in the Work.
 2. Welded wire fabric:
 - a. Verify that sheets are not curled or kinked before or after installation.

3.02 PREPARATION

A. Surface preparation:

1. Reinforcing bars - uncoated:
 - a. Clean reinforcement of concrete, dirt, oil and other coatings that will adversely affect bond before embedding bars in subsequent concrete placements.
 - b. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean bars having rust scale, loose mill scale, or thick rust coat.
 - c. Partially embedded reinforcement: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placements.

3.03 INSTALLATION

A. Reinforcing bars: General:

1. Field-cutting of reinforcing bars is not permitted.

Table 1. Reinforcement Placing Tolerances		
Member	Tolerance on Reinforcement Location ⁽¹⁾	Tolerance on Minimum Concrete Cover ^(1,2)
Slabs, beams, walls and columns except as noted below:		
10 inches thick and less	$\pm 3/8$ inch	- 3/8 inch
More than 10 inches thick	$\pm 1/2$ inch	- 1/2 inch
Formed soffits	As noted above	- 1/4 inch
Longitudinal location of bends and ends of reinforcement:		
Conditions not listed below	± 2 inches	- 1/2 inch
At discontinuous ends of brackets and corbels	$\pm 1/2$ inch	- 1/4 inch
At discontinuous ends of other members	± 1 inch	- 1/2 inch
Notes:		
(1) $\pm$ indicates "plus or minus;" - indicates "minus;" + indicates "plus."		
(2) Tolerance on cover is limited as noted but decrease in cover shall not exceed one third of the minimum cover indicated on the Drawings.		

2. Field-bending of reinforcing bars, including straightening and rebending, is not permitted.

B. Placing reinforcing bars:

1. Accurately place bars to meet position and cover requirements indicated on the Drawings and specified. Secure bars in position.
2. Tolerances for placement and minimum concrete cover: As listed in Table 1.

3. Spacing between bars:
 - a. Minimum clear spacing between bars in a layer:
 - 1) As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
 - b. Minimum clear spacing between bars in 2 or more parallel layers:
 - 1) Place bars in upper layers directly above bars in lower layers.
 - 2) Minimum spacing between layers: As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
 - c. Limits on minimum clear spacing between bars also applies to the clear spacing between a lap splice and the adjacent bars and/or lap splices.
 4. Lap splices for bars:
 - a. Lap splice locations and lap splice lengths: As indicated on the Drawings. Where lap lengths are not indicated, provide in accordance with ACI 318.
 - b. Unless otherwise specifically indicated on the Drawings (and noted as "non-contact lap splice"), install bars at lap splices in contact with each other and fasten together with tie wire.
 - c. Where bars are to be lap spliced at concrete joints, ensure that bars project from the first concrete placement a length equal to or greater than minimum lap splice length indicated on the Drawings.
 - d. Stagger lap splices where indicated on the Drawings.
 - e. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318.
- C. Reinforcing supports:
1. Provide supports of sufficient numbers, sizes, and locations to maintain concrete cover, to prevent sagging and shifting, and to support loads during construction without displacement and without gouging or indentation into forming surfaces.
 - a. Quantities and locations of supports shall not be less than those indicated in ACI SP-66 and the CRSI Manual of Standard Practice.
 2. Do not use brick, concrete masonry units, concrete spalls, rocks, wood, or similar materials for supporting reinforcement.
 3. Do not use "give away bars" that have less cover than that required by the Contract Documents. Do not adjust the location of reinforcement required by the Contract Documents to provide cover for give away bars.
 4. Provide bar supports of height required to maintain the clear concrete cover indicated on the Drawings.
 5. Provide bar supports at formed vertical faces to maintain the clear concrete cover indicated on the Drawings.
 6. Schedule of reinforcement support materials: Provide bar supports as indicated in Table 2.

Table 2. Reinforcement Support Materials		
Case	Location	Material
a.	Concrete placed over earth and concrete seal slabs ("mud mats")	Precast concrete bar supports.
b.	Concrete placed against forms and exposed to water or wastewater process liquids (whether or not such concrete received additional linings or coatings)	All stainless steel bar supports.

Table 2. Reinforcement Support Materials		
Case	Location	Material
c.	Concrete placed against forms and exposed to earth, weather, frequent washdown, or groundwater in the finished work	All stainless-steel bar supports.
d.	Concrete placed against forms and exposed to interior equipment/piping areas in the finished work	All stainless-steel bar supports.
e.	Between mats of reinforcement, and fully embedded within a concrete member	Bright basic wire bars supports, or deformed steel reinforcing bars.

D. Tying of reinforcing:

1. Fasten reinforcement securely in place with wire ties.
2. Tie reinforcement at spacings sufficient to prevent shifting.
 - a. Provide at least 3 ties in each bar length. (Does not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity).
3. Tie slab bars at every intersection around perimeter of slab.
4. Tie wall bars and slab bar intersections other than around perimeter at not less than every fourth intersection, but at not more than the spacing indicated in Table 3:

Table 3. Maximum Spacing of Tie Wires for Reinforcement		
Bar Size	Slab Bar Spacing (inches)	Wall Bar Spacing (inches)
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

5. After tying:
 - a. Bend ends of wires inward towards the center of the concrete section. Minimum concrete cover for tie wires shall be the same as cover requirements for reinforcement.
 - b. Remove tie wire clippings from inside forms before placing concrete.

E. Welded wire fabric reinforcement:

1. Install only where indicated on the Drawings or accepted in advance by the Engineer.
2. Install necessary tie wires, spacing chairs, and supports to keep welded wire fabric at its designated position in the concrete section while concrete is being placed.
3. Straighten welded wire fabric to make sheets flat in the Work.
4. Do not allow wire fabric to drape between supports unless such a configuration is specifically indicated on the Drawings.
 - a. If fabric is displaced during placement of concrete, make provisions to restore it to the designated location using methods acceptable to the Engineer.
5. Bend welded wire fabric as indicated on the Drawings or required to fit Work.

6. Lap splice welded wire fabric as indicated on the Drawings.
 - a. If lap splice length is not indicated, splice in accordance with ACI 318, but not less than 1 1/2 courses of fabric or 8 inches minimum. Tie laps at ends and at not more than 12 inches on center.
- F. Welding reinforcing bars:
 1. Weld only where indicated on the Drawings or where acceptance is received from the Engineer prior to welding.
 2. Perform welding in accordance with AWS D1.4 and welding procedures accepted by the Engineer.
 - a. Conform to requirements for minimum preheat and interpass temperatures.
 3. Submit:
 - a. Welding procedures specification.
 - b. Procedures qualification record.
 - c. Welder qualification test record.
 4. Do not tack weld reinforcing bars except where specifically indicated on the Drawings.
- G. Reinforcing bar mechanical couplers:
 1. Install only at locations indicated on the Drawings or where prior approval has been obtained from the Engineer.
 2. Install in accordance with manufacturer's instructions and requirements of Evaluation Report.
 - a. Make splices using manufacturer's standard equipment, jigs, clamps, and other required accessories.
 - b. After assembly of the splice, tighten using torque load not less than that recommended by the manufacturer.
 3. Unless greater cover is indicated on the Drawings, provide clear cover from surface of concrete to outside face of couplers that is not less than the minimum concrete cover specified for typical reinforcement.
 - a. If cover is less than required, contact the Engineer for evaluation of conditions before modifying locations of bars or placing concrete.
 - b. Modifications to maintain or provide required concrete cover, such as addition of concrete ; re-positioning of stirrups, ties, etc., may be completed only after approval by the Engineer.

3.04 FIELD QUALITY CONTROL

- A. Provide quality control for the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Field inspections and testing:
 1. Submit records of inspections and testing to the Engineer in electronic format within 24 hours after completion.
- C. Manufacturer's services:
 1. Furnish manufacturer's technical representative to conduct jobsite training regarding proper storage, handling, and installation of mechanical reinforcing bar couplers for personnel who will perform the installation. Engineer may attend training session.

3.05 FIELD QUALITY ASSURANCE

- A. Provide quality assurance as specified in Section 01_45_00 - Quality Control.
- B. Special inspections and tests:
 - 1. Provide as specified in Section 01_45_24 - Regulatory Quality Assurance.
 - 2. Frequency of inspections:
 - a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Building Code specified in Section 01_41_00 - Regulatory Requirements.
 - 3. Preparation:
 - a. Review Drawings and Specification for the Work to be observed.
 - b. Review approved Submittals and Shop Drawings.
 - 4. Inspections: Special inspection shall include, but is not limited to, the following items:
 - a. Reinforcement: General:
 - 1) Type (material) and location of reinforcement supports.
 - 2) Bar material/steel grade and bar size.
 - 3) Location, placement, and spacing of bars.
 - 4) Clear concrete cover over reinforcement.
 - 5) Lap splice: Location and lap length. Bars within tolerances for contact (unless non-contact splice is indicated on the Drawings.)
 - 6) Bar hooks and development lengths embedded within concrete sections as indicated on the Drawings.
 - 7) Reinforcement tied in position and tie wire legs turned inward toward the center of the concrete section.
 - b. Reinforcement: Welding:
 - 1) Inspector qualification and inspections shall be in accordance with the requirements of AWS D1.4.
 - 2) Provide periodic inspection for:
 - a) Weldability of reinforcement other than ASTM A706.
 - b) Single pass fillet welds with thickness less than or equal to 5/16 inch.
 - 3) Provide continuous inspection for:
 - a) Other welds.
 - b) Welds at mechanical reinforcing bar couplers and end anchors.
 - 4) In addition to visual inspection, Owner may inspect reinforcing bar welds by other methods, including radiographic inspection.
 - 5. Mechanical reinforcing bar couplers:
 - a. Special inspection shall include, but is not limited to, the following items:
 - 1) Coupler model and identification.
 - 2) Couplers are installed in accordance with the requirements of the Engineering Report for each product.
 - 3) Confirmation of the following:
 - a) Grade and size of reinforcing bars.
 - b) Position of couplers.
 - c) Insertion length of reinforcement.
 - d) Tightening of bars in the couplers.
 - 6. Records of inspections:
 - a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.

- b. Submit electronic copies of inspection reports to the Engineer within 24 hours after completion of inspections.

3.06 NON-CONFORMING WORK

- A. Before placing concrete, adjust or remove and re-install reinforcement to conform to the requirements of the Contract Documents.

END OF SECTION

SECTION 03_21_17

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

- A. American Concrete Institute (ACI).
 - 1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.
- B. American National Standards Institute (ANSI):
 - 1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.
- C. ASTM international (ASTM):
 - 1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 2. E488 - Standard Test Method for Strength of Anchors in Concrete Elements.
- D. Concrete Reinforcing Steel Institute (CRSI).
- E. ICC Evaluation Service, Inc. (ICC-ES):
 - 1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- F. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- G. Society for Protective Coatings (SSPC):
 - 1. SP 1 - Solvent Cleaning.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Evaluation Service Report (ESR): Report prepared by ICC-ES or other testing agency acceptable to the Engineer and to the building official that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES acceptance criteria, and to document its acceptance for use under the building code specified in Section 01_41_00 - Regulatory Requirements.

1.04 SUBMITTALS

- A. Product data: Technical data for adhesives, including:
 - 1. Manufacturer's printed installation instructions (MPII).
 - 2. Independent laboratory test results indicating allowable loads in tension and shear for concrete of the types included in this Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
 - 3. Handling and storage instructions.
 - 4. Evidence of current listing under NSF-61 for use in contact with potable water.
- B. Quality Control Submittals:
 - 1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01_41_00 - Regulatory Requirements.
 - 2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of ICC-ES AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
 - 3. Installer qualifications:
 - a. Submit evidence of successful completion of the adhesive manufacturer's installation training program.
 - b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.
 - 4. Inspection and testing reports:
 - a. Field quality control: Reports of inspections and tests.
 - b. Field quality assurance: Reports of special inspections and tests.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installation requirements:
 - a. Have available at the Site and install anchors in accordance with the adhesive MPII.
 - 2. Installer qualifications:
 - a. Demonstrating successful completion of the adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
 - b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the building official.
 - 1) Organizations/certification programs deemed to be qualified are:
 - a) ACI-CRSI Adhesive Anchor Installer Certification Program.
 - b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the building official.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
 - 1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.

2. Control temperature to maintain storage within the manufacturer's recommended temperature range.
 - a. If products have been stored at temperatures outside the manufacturer's recommended range, test by methods acceptable to the Engineer to confirm acceptability before installing in the Work.
3. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.
- B. Seismic Design Category (SDC) for structures: As specified in Section 01_81_50 - Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

- A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.
- B. Adhesives shall have a current Evaluation Report documenting testing and compliance in accordance with ACI 355.4 and ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the seismic design category specified.
- C. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.
- D. For locations where adhesive will be in direct contact with potable water in the finished Work, provide documentation of testing and listing under NSF-61. Testing shall be by a nationally recognized agency acceptable to the Engineer.

2.02 EPOXY ADHESIVE

- A. Materials:
 1. In accordance with the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C, depending on Site conditions.
 2. 2-component, 100 percent solids, insensitive to moisture.
 3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.
- B. Packaging:
 1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through the manufacturer's static mixing nozzle.
 - a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into the prepared hole.

- b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.
- 2. Container markings: Include the manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
- C. Manufacturers: One of the following or equal:
 - 1. Hilti, Inc., HIT-RE 500-V3.
 - 2. Simpson Strong-Tie Co., Inc., SET-3G.

2.03 ALL THREAD RODS

- A. Materials: As specified in Section 05_12_00 - Structural Steel Framing for rods, nuts, and washers.

2.04 REINFORCING BARS

- A. As specified in Section 03_20_00 - Concrete Reinforcing.

2.05 REPAIR MATERIALS

- A. Dry-pack mortar: As specified in Section 03_35_29 - Concrete Finishes.
- B. Epoxy grout: As specified in Section 03_60_00 - Grouting.

PART 3 EXECUTION

3.01 GENERAL

- A. Execution of this Work is restricted to installers who have personally completed the adhesive manufacturer's on-site training for the products to be installed, and who are personally certified through a qualified certification program described under the Quality Assurance article and accepted by the Engineer and the building official.
 - 1. Do not install holes or adhesive until training is complete.
- B. Perform Work in compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.
- C. Install reinforcing bars and all thread rods to embedment depth and at spacing and locations indicated on the Drawings.
 - 1. If embedment depth is not indicated, contact the Engineer for requirements.
 - 2. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined or overhead applications unless accepted in advance by the Engineer.

3.02 PREPARATION

- A. Do not begin installation of adhesive bonded anchors until:
 - 1. Concrete has achieved an age of at least 21 days after placement.
 - 2. On-site training in installation of adhesive bonded anchors by the manufacturer's technical representative is complete. Do not drill holes in concrete or install adhesive and embeds in holes.

- B. Review the MPII and “Conditions of Use” stipulated in the Evaluation Report before beginning work.
 - 1. Bring to the attention of the adhesive manufacturer’s technical representative any discrepancies between these documents and resolve before proceeding with installation.
- C. Install adhesive bonded anchors in full compliance with the MPII using personnel who have successfully completed the manufacturer’s on-site training for products to be used and who hold certifications specified in this Section.
- D. Confirm that adhesive and substrate receiving adhesive are within the manufacturer’s recommended range for temperature and moisture conditions and will remain so during the curing time for the product.

3.03 HOLE SIZING AND INSTALLATION

- A. Drilling holes:
 - 1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device and mark locations with construction crayon on the surface of the concrete.
 - 2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by the Engineer.
- B. Hole-drilling equipment:
 - 1. Electric or pneumatic rotary impact type with medium or light impact.
 - a. Installation of anchors in cored holes is not permitted.
 - b. Set drill to “rotation only” mode, or to “rotation plus hammer” mode in accordance with the manufacturer’s installation instructions and the requirements of the Evaluation Report.
 - c. Where edge distances are less than 2 inches and “rotation plus hammer” mode is permitted, use lighter impact equipment to prevent micro-cracking and concrete spalling during the drilling process.
 - 2. Drill bits: Carbide-tipped in accordance with ANSI B212-15, unless otherwise recommended by the manufacturer or required as a condition of use in the Evaluation Report.
 - a. Hollow drill bits with flushing air systems are preferred. Air supplied to drill bits shall be free of oil, water, or other contaminants that will reduce bond.
- C. Hole diameter: As recommended in the manufacturer’s installation instructions and the Evaluation Report.
- D. Hole depth: As recommended in the manufacturer’s installation instructions to provide minimum effective embedment indicated on the Drawings.
- E. Obstructions in drill path:
 - 1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by the Engineer, stop drilling. Prepare and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth.
 - a. Obtain the Engineer’s acceptance of distance between abandoned and relocated holes before proceeding with the relocation.

- b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.
 - c. Epoxy grout may be substituted for dry-pack mortar when accepted by the Engineer.
 - 2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the member and endanger the stability of the structure.
 - 3. When existing reinforcing steel is encountered during drilling and when specifically accepted by the Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
 - 4. Bent bar reinforcing bars: Where edge distances are critical and interference with existing reinforcing steel is likely, if acceptable to the Engineer, drill hole at 10-degree (or less) angle from axis of reinforcing bar or all thread rod being installed.
- F. Cleaning holes:
- 1. Insert air nozzle to bottom of hole and blow out loose dust.
 - a. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
 - b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
 - 2. Using a stiff bristle brush with diameter that provides contact around the full perimeter of the hole, vigorously brush hole to dislodge compacted drilling dust.
 - a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
 - b. Repeat at least 4 times.
 - 3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and in the number of cycles required by the MPII and the Evaluation Report.
 - 4. Leave prepared holes clean and dry.
 - 5. Protect prepared and cleaned holes from contamination and moisture until adhesive is installed.
 - 6. Re-clean and dry previously prepared holes if, in the opinion of the Engineer, the hole has become contaminated after initial cleaning.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

- A. Clean and prepare inserts reinforcing bars and all thread rods:
 - 1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
 - 2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC-SP 1. Provide an oil and grease free surface for bonding of adhesive to steel.
- B. Fill holes with adhesive:
 - 1. Fill hole with adhesive only when dry. Do not fill when the hole is filled with water or damp, except with written authorization by the Engineer.
 - 2. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.

3. Fill hole as nozzle is withdrawn without creating air voids.
 4. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
 5. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.
- C. Installing reinforcing bars and all thread rods.
1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
 2. Insert reinforcing bars and all thread rods into adhesive in accordance with the manufacturer's recommended procedures.
 3. Confirm that insert has reached the designated embedment in the concrete and that adhesive completely surrounds the embedded portion.
 4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
 5. Clean excess adhesive from the mouth of the hole.
- D. Curing and loading.
1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.
 2. Do not disturb or load bonded embeds until the manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

3.05 POST-INSTALLATION ACTIVITIES

- A. Do not bend bars or all thread rods after bonding to the concrete, unless accepted in advance by the Engineer.
- B. Attachments to all thread rods:
1. After assemblies to be connected are placed, install nuts and washers for threaded rods as indicated on the Drawings.

3.06 FIELD QUALITY CONTROL

- A. Provide field quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Do not allow Work described in this Section to be performed by individuals who do not hold the specified certifications and who have not completed the specified jobsite training.
- C. Manufacturer's services:
1. Before beginning installation, adhesive manufacturer's technical representative to conduct on-site training in proper storage and handling of adhesive, drilling

and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.

- a. Provide notice of scheduled training to the Engineer and to special inspector(s) not less than 10 working days before training occurs.
Engineer and special inspector may attend training sessions.
 2. Submit record, signed by the manufacturer's technical representative, listing the Contractor's personnel who completed the training. Only qualified personnel who have completed the manufacturer's on-site training shall perform installations.
- D. Field inspections and testing:
1. Hole drilling and preparation.
 2. Results: Submit records of inspections and testing to the Engineer by electronic copies within 24 hours after completion.

3.07 FIELD QUALITY ASSURANCE

- A. Provide field quality assurance over the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Special inspections, special tests, and structural observation:
1. Provide as specified in Section 01_45_24 - Regulatory Quality Assurance.
 2. Frequency of inspections:
 - a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Evaluation Report for the product installed.
 - b. Provide continuous inspection for the initial installation of each type and size of adhesive bonded reinforcing bar and all thread rod. Subsequent installations of the same anchor may be installed with periodic inspection as defined in subsequent paragraphs.
 - c. Provide continuous inspection of drilling, cleaning and bonding activities for bars and rods installed in horizontal and upwardly inclined positions.
 3. Preparation:
 - a. Review Drawings and Specifications for the Work to be observed.
 - b. Review the adhesive manufacturer's MPII and recommended installation procedures.
 - c. Review Evaluation Report "Conditions of Use" and "Special Inspection" requirements.
 4. Inspection: Periodic:
 - a. Initial inspection. Provide an initial inspection for each combination of concrete and reinforcing bar strength or concrete strength and all thread rod material being installed. During initial inspection, observe the following for compliance with the installation requirements.
 - 1) Concrete: Class (minimum specified compressive strength) and thickness.
 - 2) Environment: Temperature conditions at the work area and moisture conditions of concrete and drilled hole.
 - 3) Holes: Locations, spacing, and edge distances; verification of drill bit compliance with requirements; cleaning equipment and procedures; cleanliness of hole. Before adhesive is placed, confirm that depth and preparation of holes conforms to the requirements of the

Contract Documents, the MPlI, and the "Conditions of Use" listed in the Evaluation Report.

- 4) Adhesive: Product manufacturer and name, lot number and expiration date, temperature of product at installation, installation procedure. Note initial set times observed during installation.
- 5) Reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment provided.
- b. Subsequent inspections: Subsequent installations of the same reinforcing bars or all thread rods may be performed without the presence of the special inspector, provided that:
 - 1) There is no change in personnel performing the installation, the general strength and characteristics of the concrete receiving the inserts, or the reinforcing bars and all thread rods being used.
 - 2) For ongoing installations, the special inspector visits the Site at least once for every 4 hours of work during each day of installation to observe the Work for compliance with material requirements and installation procedures.
5. Inspection: Continuous.
 - a. Make observations as described under "Inspection - Periodic, Initial Inspection" during drilling, cleaning, and bonding activities for all bars and rods installed.
6. Records of inspections:
 - a. Provide a written record of each inspection using forms acceptable to the Engineer and to the building official.
 - b. Submit electronic copies of inspection reports to the Engineer within 24 hours after completion of inspection.

END OF SECTION

SECTION 03_30_00

CAST-IN-PLACE CONCRETE

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ATTACHMENT A - MENZEL FORMULA AND NOMOGRAPH

ATTACHMENT B - COARSENESS FACTOR CHART

ATTACHMENT C - COMBINED AGGREGATE GRADATION CHART

ATTACHMENT D - CONCRETE PLACEMENT CHECKLIST

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cast-in-place concrete.
- B. The requirements of this Section require advance planning for preparation and testing of trial batches. Review the mix design and testing requirements carefully and schedule preparations and testing with sufficient time to complete tests, to obtain the Engineer's review of mixes and testing results, and to complete revisions and re-testing if required.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. CODE-318 - Building Code Requirements for Structural Concrete and Commentary.
 - 2. CODE-350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 3. PRC-212.3 - Report on Chemical Admixtures for Concrete.
 - 4. PRC-302.1 - Guide to Concrete Floor and Slab Construction.
 - 5. PRC-305 - Guide to Hot Weather Concreting.
 - 6. PRC-306 - Guide to Cold Weather Concreting.
- B. ASTM International (ASTM):
 - 1. C29 - Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.
 - 2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 3. C33 - Standard Specification for Concrete Aggregates.
 - 4. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 5. C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 6. C42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 7. C88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - 8. C94 - Standard Specification for Ready-Mixed Concrete.
 - 9. C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.
 - 10. C117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
 - 11. C123 - Standard Test Method for Lightweight Particles in Aggregate.
 - 12. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 13. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 14. C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

15. C142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.
16. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
17. C150 - Standard Specification for Portland Cement.
18. C156 - Standard Test Method for Water Loss from a Mortar Specimen Through Liquid Membrane-Forming Curing Compounds for Concrete.
19. C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
20. C171 - Standard Specifications for Sheet Materials for Curing Concrete.
21. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
22. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
23. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
24. C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
25. C295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
26. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
27. C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
28. C494 - Standard Specification for Chemical Admixtures for Concrete.
29. C595 - Standard Specification for Blended Hydraulic Cements.
30. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
31. C702 - Standard Practice for Reducing Samples of Aggregate to Testing Size.
32. C856 - Standard Practice for Petrographic Examination of Hardened Concrete.
33. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
34. C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
35. C1260 - Standard Test Method of Potential Alkali Reactivity of Aggregates (Mortar Bar Method).
36. C1293 - Standard Test Method for Determination of Length Change of Concrete due to Alkali-Silica Reaction.
37. C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
38. C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
39. D75 - Standard Practice for Sampling Aggregates.
40. D2103 - Standard Specification for Polyethylene Film and Sheeting.
41. D3665 - Standard Practice for Random Sampling of Construction Materials.
42. D4791 - Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

C. National Ready-Mixed Concrete Association (NRMCA).

D. NSF International (NSF):

1. 61 - Drinking Water System Components - Health Effects.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
1. Alkali: The sum of sodium oxide and potassium oxide calculated as sodium oxide.
 2. Alkali load: Amount of alkalis contributed by the portland cement in a concrete mixture, expressed in pounds per cubic yard (lb/yd³) and calculated by multiplying the portland cement content of the concrete in lb/yd³ by the alkali content of the portland cement, or the portland cement portion of a blended cement, divided by 100.
 3. Architectural concrete: Concrete surfaces that will be exposed to view in the finished Work.
 - a. For purposes of this Section, includes only those surfaces that receive paint or coatings.
 - b. Exposed concrete surfaces in open basins, channels, and similar liquid containing structures: Surfaces will be considered exposed to view if located above the water line as defined in Section 03_35_29 - Concrete Finishes.
 - c. Exterior concrete surfaces with portions above and below grade: Surface will be considered exposed to view if located above the grade line as defined in Section 03_35_29 - Concrete Finishes.
 4. Average daily temperature: Calculated by summing hourly measurements of air temperature in the shade at the face of the concrete and dividing that sum by 24. In calculating the sum of the temperatures recorded, any measurement less than 50 degrees Fahrenheit shall be recorded as 0 degrees Fahrenheit and included in the sum.
 5. Cementitious materials: Portland cement or blended cement and supplementary cementitious materials.
 6. Class of concrete: Refers to a mix with characteristics, proportions, and constituents (including a specific combination of admixtures) as specified in this Section.
 - a. Any change in the source or characteristics of constituent materials, in the proportions of materials, or in the admixtures included in a mix shall be considered as creating a new and separate class of concrete.
 - b. Any mix to be placed by pumping shall be considered as creating a new and separate class of concrete.
 7. Cold weather: Includes one or more of the following conditions:
 - a. Current air temperature is 45 degrees Fahrenheit and falling.
 - b. Air temperature during the first 24 hours after placement is expected to fall into the range of 45 degrees Fahrenheit to 40 degrees Fahrenheit.
 - c. A period when, for more than 3 consecutive days, the following conditions exist:
 - 1) The average daily air temperature drops below 40 degrees Fahrenheit.
 - 2) The air temperature is not greater than 50 degrees Fahrenheit for more than one-half of any consecutive 24-hour period.
 8. Cold weather concreting: Operations for placing, finishing, curing, and protecting concrete during cold weather.
 9. Green concrete: Concrete that has not yet achieved 100 percent of the minimum specified compressive strength, f'c, for that mix.

10. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch (0.004 inches).
11. Hot weather: Any combination of ambient temperature, concrete temperature, relative humidity, wind speed, and solar radiation intensity that creates conditions that will evaporate water from a free concrete surface at a rate equal to or greater than 0.2 pounds per square foot per hour as determined by the Menzel Formula and nomograph published in ACI PRC-305 and in this Section, Attachment A - Menzel Formula and Nomograph.
12. Hot weather concreting: Operations for placing, finishing, curing, and protecting concrete during hot weather.
13. Paste content: The total concrete volume minus the volume of aggregate, expressed as a percentage of total volume. Paste volume includes volume of cementitious materials, water, air, admixtures materials, and any fibers.
14. Supplemental cementitious material: Inorganic material such as fly ash, natural pozzolans, silica fume, or slag cement that reacts pozzolanically or hydraulically.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Concrete mix designs.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. General:
 1. Data for concrete mixes and mix constituents supplied to the Work shall be coordinated through a single supplier.
 2. A maximum of 2 mix designs will be reviewed by the Engineer for each class of concrete required.
 - a. Review of additional mix designs shall be at the expense of the Contractor.
- C. Product data:
 1. Data for all products in the mix for each class of concrete shall be submitted concurrently with that mix design.
 2. Where products conforming to NSF 61 are required, submit evidence of testing and listing under NSF 61 for use in direct contact with potable water. Testing and listing shall be by a nationally recognized agency acceptable to the Engineer.
 3. Admixtures:
 - a. For each admixture included in concrete mixes, submit manufacturer's product data demonstrating compliance with standards specified.
 - b. If air entraining admixture requires test method other than ASTM C173 to accurately determine air content, make special note of requirements in Submittal.
 4. Curing compound: Submit complete data on proposed compound.

D. Delegated Design Submittals:

1. Concrete mix designs:

- a. Submit full details, including mix design calculations and plots, for concrete mixes proposed for use for each class of concrete.
- b. Include mix design calculations of proportions by both weight and volume.
- c. Determine and include the alkali load of the proposed mix.
- d. Include information on correction of batching for varying moisture contents of fine aggregate.
- e. Submit source quality test records with mix design Submittal.
- f. Provide calculations demonstrating that the mixes proposed provide the required average compression strength of concrete (f'_{cr}) based on source quality test records.
- g. For each Class A mix design submitted, plot the mix design Attachment B - Coarseness Factor Chart and submit.
- h. For each Class A mix design submitted, plot the combined aggregate gradation on the chart Attachment C - Combined Aggregate Gradation Chart and submit.

E. Concrete mixes - Trial batches:

1. Drying shrinkage test results.
 - a. Submit results of testing.
2. Compression strength test results.
 - a. Submit results of testing. Provide data for each cylinder tested.
 - b. Submit data indicating trial batch mix designator, slump, and specimen number for each test cylinder.
3. If there is any change in suppliers or in quality of concrete mix constituents, submit new test data.

F. Test reports:

1. Dated not more than 24 months prior to the date of Submittal.
2. Aggregate:
 - a. Submit certified copies of commercial laboratory tests proposed for use in concrete.
 - b. Sieve analyses:
 - 1) During construction, submit sieve analyses of coarse, intermediate, fine, and combined aggregates used any time there is a change in supplier or a significant change in the character and/or grading of materials, and when requested by the Engineer.
 - c. Aggregates - coarse:
 - 1) Physical properties:
 - a) Sieve analysis.
 - b) Percentage of particles having flat and/or elongated characteristics.
 - c) Abrasion loss.
 - d) Soundness.
 - 2) Deleterious substances:
 - a) Clay lumps and friable particles content.
 - b) Materials finer than No. 200 sieve (percentage).
 - c) Shale and chert content.
 - d) Coal and lignite content.
 - 3) Alkali reactivity.

- d. Aggregates - Intermediate:
 - 1) Physical properties:
 - a) Sieve analysis.
 - b) Percentage of particles having flat and/or elongated characteristics.
 - c) Abrasion loss.
 - d) Soundness.
 - 2) Deleterious substances:
 - a) Clay lumps and friable particles content.
 - b) Chert and shale content.
 - c) Coal and lignite content.
 - d) Materials finer than No. 200 sieve.
 - 3) Alkali reactivity.
 - e. Aggregates - Fine:
 - 1) Physical properties:
 - a) Sieve analysis and fineness modulus.
 - b) Soundness.
 - 2) Deleterious substances:
 - a) Clay lumps and friable particles (percentage).
 - b) Materials finer than No. 200 sieve (percentage).
 - c) Coal and lignite (percentage).
 - d) Shale and chert.
 - e) Organic impurities ("Color" as determined by ASTM C40).
 - 3) Alkali reactivity.
 - f. Aggregates - Combined:
 - 1) Test combined gradation for the following sieve sizes: 1.5 inches, 1 inch, 3/4 inch, 1/2 inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, No. 100, No. 200.
 - 2) Bulk density in accordance with ASTM C29.
 - 3) Void content in accordance with ASTM C29.
 - 4) Submit at:
 - a) Initial mixture design Submittal.
 - b) Intervals of not more than 4 weeks.
 - c) Any time there is a change in character or grading of constituent materials.
 - d) When requested by the Engineer.
3. Cement:
- a. Mill tests, including alkali content measured as equivalent alkalies, for each shipment of cement included in the Work.
 - 1) During construction, submit mill certificates for cement being used at intervals of not more than 90 days, any time there is a change in supplier or a significant change in the character of the materials, and when requested by the Engineer.
4. Supplemental cementitious material:
- a. Fly ash: Identify source and provide testing results to demonstrate compliance with requirements of ASTM C618 and this Section.
 - 1) Include the Supplier's report certifying the total alkali content of the material, expressed as equivalent percentage of sodium oxide (Na_2Oe).
 - b. Slag cement: Identify source and provide testing results to demonstrate compliance with requirements of ASTM C989 and this Section.

- c. Silica fume: Identify source and provide testing results to demonstrate compliance with requirements of ASTM C1240 and this Section.
- G. Certificates:
 - 1. Current NRMCA certification for all plants and trucks that will be used to supply concrete.
- H. Source Quality Control Submittals:
 - 1. Truck batch tickets for each load of concrete delivered to the Site, whether accepted or rejected.
 - 2. Concrete supplier's quality control plan. Include the following elements, at a minimum:
 - a. Names and qualifications of key quality control personnel:
 - 1) Quality control manager.
 - 2) Testing and inspection personnel.
 - b. Names and qualifications of testing laboratories:
 - 1) Each laboratory shall hold current accreditation from the AASHTO Accreditation Program, or other accreditation program acceptable to the Engineer, for each test performed.
 - c. Example forms for: Inspection reports, certificates of compliance, and test results.
 - d. Quality control procedures: Method and frequency of performing each procedure, including inspections and materials testing. At a minimum, the plan shall include:
 - 1) Daily testing of aggregate gradation.
 - 2) Monthly testing of cement quality.
 - 3) Monthly testing of fly ash quality.
 - e. Procedures to control quality characteristics, including standard procedures to address properties outside the specified operating limits, and example reports to document non-conformances and corrective actions taken. Include procedure for notifying the Contractor and Engineer of non-conformances.
 - f. Procedures for verifying that:
 - 1) Materials are properly stored during concrete batching operations.
 - 2) Batch plants have the ability to maintain concrete consistency during periods of extreme heat and of low temperatures.
 - 3) Admixtures are dispensed in the correct dosages within the accuracy requirements specified.
 - 4) Delivery trucks have a valid NRMCA certification card.
 - g. Procedures for verifying that weighmaster certificate for each load of concrete shows:
 - 1) Cement and supplementary materials are from sources designated in the approved Submittals.
 - 2) Concrete as-batched complies with the constituent weights designated in the approved Submittals.
 - 3) Corrections for aggregate moisture are being correctly applied.
 - 4) Any mix water withheld from the batch.
 - h. Procedures for visually inspecting concrete during discharge.
- I. Field Quality Control Submittals:
 - 1. Contractor's notifications of readiness for concrete placement.

2. Contractor's reports of field quality control testing.
 - a. Include with each report the concrete batch ticket number and identification numbers for associated cylinders used for compressive strength testing.
 - b. Testing results for slump, temperature, unit weight, and air entrainment.
 - c. Testing results for compressive strength at 7 and 28 days, and for any compressive strength tests after 28 days.
 - d. Note on batch ticket the amount of water that was withheld and the maximum amount that can be added on site as "Max add water." Record on the batch ticket the volume of water actually added at the Site.
 - e. Note on the batch ticket the concrete mix classification as defined in Table 3 of this Section.
- J. Special procedure Submittals:
 1. Sequence of concrete placing:
 - a. Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements. Submittal shall include plans sections and details to address all pours.
 2. Cold weather concreting plan.
 3. Hot weather concreting plan.
 4. Repair of defective concrete: Submit mix design for repair materials to be used.

1.06 QUALITY ASSURANCE

- A. Pre-installation meetings:
 1. Schedule and conduct pre-installation meeting at least 10 days prior to batching and placing of concrete.
 - a. Provide additional meetings if necessary, to discuss specific concrete Submittals, mixes, or placing and curing conditions.
 - b. Notify the Engineer of location and time of each conference.
 2. Required attendees:
 - a. Contractor, including Contractor's superintendent and key personnel.
 - b. Concrete supplier.
 - c. Technical representative(s) of supplier(s) of concrete admixtures.
 - d. Subcontractor(s) providing pumping, placing, finishing, and curing.
 - e. Subcontractor(s) providing embedded items (structural embedded plates, electrical conduit).
 - f. Sampling and testing personnel.
 - g. Engineer.
 - h. On-site inspectors representing the Engineer.
 - i. Other persons deemed by the Engineer and the Contractor to be critical to the quality and efficiency of the Work.
 3. Agenda:
 - a. Review of requirements of Drawings and Specifications.
 - b. Project and product safety requirements.
 - c. Discussion of points of interface and coordination between various trades or products to be used in the Work.
 - d. Contractor's schedule for cast-in-place concrete work.
 - e. Mix designs, mix tests, and Submittals.
 - f. Admixture types, dosing, performance, requirements for monitoring, and limits on dosing or re-dosing at the Site.

- g. Placement and consolidation methods, techniques, and equipment and the effects of those methods on form pressures.
 - h. Slump and limits on placing time or conditions to maintain placeability.
 - 1) Field adjustment of slump and air content.
 - i. Procedures for finishing, curing, and retention of moisture during these operations.
 - j. Procedures and protection for hot and cold weather conditions.
 - k. Requirements and coordination for inspections.
 - 1) Responsibility for test specimen curing and storage.
 - 2) Distribution of test reports.
 - l. Other Specification requirements requiring coordination between parties to the Work.
4. Prepare and submit minutes of the pre-installation meeting as specified in Section 01_31_19 - Project Meetings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver, store, and handle concrete materials in a manner that prevents damage and inclusion of foreign substances.
 - 2. Deliver and store packaged materials in original containers until ready for use.
 - 3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.
 - 4. For Class M concrete:
 - a. Store coarse and fine aggregate in covered area. Shade aggregates to prevent heating by direct sunlight.
 - b. Store cementitious materials in covered, shaded silos to prevent heating by direct sunlight.
- B. Acceptance at Site:
 - 1. Reject material containers or materials showing evidence of water or other damage.
 - 2. Concrete mixes: Do not accept or incorporate into the Work concrete mixes that do not comply with the specified requirements for water content, slump, temperature, and air content.

1.08 PROJECT CONDITIONS

- A. Cold weather concreting: During periods of cold weather as defined in this Section, implement cold weather concreting procedures in this Section.
- B. Hot weather concreting: During periods of hot weather as defined in this Section, implement hot weather concreting procedures in this Section.

1.09 SEQUENCING AND SCHEDULING

- A. Schedule placing of concrete in a manner that completes all placing operations from one construction, contraction, or expansion joint to another construction, contraction, or expansion joint.

- B. Joints at each end of the placement shall be as indicated on the Drawings, or as identified and accepted in advance by the Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Provide concrete with a homogeneous mixture, that, when hardened, will have required strength, watertightness, and durability.
- B. Provide a workable, low-shrinkage concrete mix that maximizes aggregate content and minimizes paste content.
- C. Performance requirements:
 - 1. General:
 - a. Except as otherwise specified, provide concrete composed of portland cement or blended cement, supplemental cementitious materials, aggregate, admixtures and water, proportioned and mixed to produce a plastic, workable mixture in accordance with requirements of this Section, and suitable to specific conditions of placement.
 - b. Proportion aggregates to produce an optimized gradation of aggregate that combines fine, intermediate, and coarse aggregate in well-graded proportions that maximizes the aggregate content and minimizes the paste content of the mix. Gradation should maximize long-term durability and strength of the concrete mixture.
 - c. Durability requirements will be deemed to be satisfied when:
 - 1) Mixture is proportioned with a well-graded combined aggregate.
 - 2) Specified water-cement ratio is satisfied.
 - 3) Concrete contains the specified range of air content.
 - 4) Maximum specified paste content is satisfied.
 - d. Proportion materials in a manner that will secure the lowest cement content, water-cementitious materials ratio, and paste volume that is consistent with good workability that provides a plastic and cohesive mixture, and that provides a slump that is within the specified range.
 - e. Construction and expansion joints have been positioned in structures as indicated on the Drawings, and curing methods have been specified, for purpose of to reduce the number and size of cracks, resulting from normal expansion and contraction expected from the concrete mixes specified.
 - f. Remove and replace, or repair as specified in this Section, non-conforming work and surfaces with cracks, voids and honeycombs, or surface wetness.
 - 2. Workmanship and methods: Provide concrete work, including detailing of reinforcing, in accordance with best standard practices and as set forth in ACI CODE-318 and ACI CODE-350.

2.02 MATERIALS - GENERAL

- A. Water and ice:
 - 1. Water for concrete mixes, for washing aggregate, and for curing concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.

2. Do not use water from concrete production operations, or combined water from concrete production operations as defined in ASTM C1602.

2.03 MATERIALS - CONCRETE MIX CONSTITUENTS

- A. Water and ice:
 1. As specified in the preceding paragraphs.
- B. Cementitious materials:
 1. Portland cement:
 - a. In accordance with ASTM C150.
 - 1) Type II.
 - b. Single source: To provide uniformity of appearance, for each structure use only one source, type, and brand of portland cement for walls and slabs that will be exposed in the finished Work.
 - 1) Confirm adequate supply of cement over duration of the Project before making trial batches or beginning concrete placements.
 - c. Cement for finishing: Provide cement from the same source and of the same type as concrete to be finished or repaired.
 - d. In accordance with NSF 61.
 2. Blended hydraulic cement:
 - a. In accordance with ASTM C595:
 - 1) Type IP (MS).
 - 2) Type IL (MS).
 - b. Single source: To provide uniformity of appearance and quality, for each structure use only one source, type, and brand of cement.
 - c. Confirm adequate supply of cement over duration of the Project before making trial batches or beginning concrete placements.
 - d. Cement for finishing: Provide cement from same source and of same type as concrete to be finished or repaired.
 - e. In accordance with NSF 61.
- C. Supplementary cementitious materials:
 1. Fly ash:
 - a. Class C or Class F fly ash in accordance with the requirements of ASTM C618, except as modified in this Section.
 - 1) Class C may be used in concrete made with Type II portland cement.
 - 2) Class F required if used in concrete mixes containing aggregates classified as potentially reactive based on ASTM C1293 or ASTM C1260.
 - a) CaO content: Less than 18 percent.
 - b. Loss on ignition: Not exceeding 3 percent.
 - c. In accordance with NSF 61.
 - d. Replace portland cement at ratio of 1.0 pound fly ash for each pound of cement, up to minimum and maximum replacement as specified in Requirements for mix proportioning.

D. Admixtures:

1. General:

- a. Do not include admixtures, other than those specified, unless written acceptance has been obtained from the Engineer during Submittal of mix designs.
- b. Compatible with concrete constituents and with other admixtures.
 - 1) All admixtures in a given mix shall be products of the same manufacturer to ensure compatibility.
 - 2) Manufacturers: One of the following or equal.
 - a) Euclid Chemical.
 - b) GCP Applied Technologies (formerly W.R. Grace).
 - c) Master Builders Solutions/Sika.
 - d) Sika Corp.
- c. Tested and listed under NSF 61 for use in direct contact with potable water.
- d. Do not use admixtures containing chlorides, calculated as chloride ion, in excess of 0.5 percent by weight of cement.
- e. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.
- f. Admixtures used shall be the same products used in concrete trial batches, or the same products used in concrete represented by submitted field test records.

2. Air entraining admixture (AEA):

- a. In accordance with ASTM C260 and dosed to provide entrained air percentages specified in this Section.
- b. Provides entrained air as bubbles, evenly dispersed at the time of placement and during curing.

3. Water reducing admixture (WRA):

- a. May be used at the Contractor's option.
- b. In accordance with ASTM C494, Type A (water-reducing).
 - 1) ASTM C494, Type D (water-reducing and retarding) may be used during periods of hot weather with prior acceptance by the Engineer.
- c. Not containing air-entraining agents.
- d. Liquid form before adding to the concrete mix.

4. High-range water-reducing admixture (superplasticizer) (HRWR):

- a. In accordance with ASTM C494, Type F (high-range, water-reducing).
 - 1) ASTM C494, Type G (high-range, water-reducing and retarding) may be used during periods of hot weather with prior acceptance by the Engineer.
- b. Producing non-segregating, plasticized concrete with little bleeding and the physical characteristics of low water/cement ratio concrete.
- c. Admixture shall maintain treated concrete in a plasticized state for not less than 1 hour.
 - a)

5. Shrinkage reducing admixture (SRA):

- a. May be used at the Contractor's option.
 - 1) Provide shrinkage reducing admixture in sufficient dosage so as to produce shrinkage within the limits specified.
- b. Not containing expansive agents.
- c. In accordance with ASTM C494, Type S (specific performance).

- d. One of the following or equal:
 - 1) Euclid Chemical: Eucon SRA Series.
 - 2) GCP Applied Technologies: Eclipse Series.
 - 3) Master Builders Solutions/Sika: SRA Series.
 - 6. Set-controlling admixtures:
 - a. Shall not be used without prior acceptance from the Engineer.
 - b. Retarders, when permitted:
 - 1) In accordance with ASTM C494, Type B, D, or G.
 - c. Accelerating admixtures, when permitted:
 - 1) In accordance with ASTM C494, Type C or E.
- E. Coloring admixtures:
 - 1. Conduit encasement coloring agent:
 - a. Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
 - b. Manufacturers: One of the following or equal:
 - 1) Davis Co., #100 Utility Red.
 - 2) Euclid Chemical Co., Increte Division, Colorcrete Brick Red.
 - 3) I. Reiss Co., Inc., equivalent product.
 - c. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.
- F. Aggregate:
 - 1. General:
 - a. Provide concrete aggregates that are sound, graded as specified, and free of deleterious material in excess of allowable amounts specified.
 - b. Provide aggregates to produce in place concrete with unit weight as follows:
 - 1) Normal weight concrete: Not less than 140 pounds per cubic foot.
 - c. Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, and other construction materials.
 - d. Do not use aggregate recycled from fresh concrete returned to the batching facility.
 - e. In accordance with NSF 61.
 - 2. Alkali-silica reactivity:
 - a. Provide aggregate classified as aggregate-reactivity class of R0 in accordance with ASTM C1778 with expansion not greater than 0.10 percent at 14 days when tested in accordance with ASTM C1260, and not greater than 0.04 percent at 1 year when tested in accordance with ASTM C1293.
 - 3. Fine aggregate:
 - a. Material graded such that 95 to 100 percent of material passes the No. 4 (4.75 mm) sieve, when sampled in accordance with ASTM D75 and ASTM D3665, and tested in accordance with ASTM C136.
 - b. Provide fine aggregate consisting of clean, natural sand, or sand prepared from crushed stone or crushed gravel.

- c. In accordance with ASTM C33 requirements for grading, deleterious substances, soundness, and alkali reactivity, except as modified in the following paragraphs:
- 1) Grading: For sieve sizes listed in ASTM C33 for fine aggregate, not more than 45 percent passing any sieve and retained on the next consecutive sieve.
 - 2) Deleterious substances: Not in excess of the percentages by weight specified in Table 1 of this Section.

Table 1. Fine Aggregate, Limits on Deleterious Substances

Item	Test Method	Percent (maximum)
Materials finer than No. 200 sieve ⁽²⁾	ASTM C117	3.00 ⁽²⁾
Clay lumps and friable particles	ASTM C142	1.00
Lightweight particles (SG < 2.40) Chert or shale ⁽¹⁾	ASTM C123	1.00
	ASTM C295	1.00 ⁽¹⁾
Coal and lignite	ASTM C123	0.50

Notes:

- (1) ASTM C123 tests for particles in the sample having a specific gravity less than 2.40. ASTM C295 is used to identify which of those lightweight particles are chert, shale, or coal and lignite. If testing under ASTM C123 indicates a combined percentage of lightweight particles (sum of shale, chert, coal and lignite) not greater than 1.00, testing under ASTM C295 will not be required.
- (2) For manufactured sand, if material finer than the No. 200 sieve consists of crusher dust and the aggregate is essentially free of clay or shale, maximum percentage may be increased to 5.0 percent.

- 3) Organic impurities: Free of injurious amounts of organic matter and producing a supernatant liquid with color not darker than "standard color" when tested in accordance with ASTM C40.
- 4) Soundness: In accordance with requirements of ASTM C33 when tested in accordance with ASTM C88 using sodium sulfite solution.
4. Intermediate aggregate:
 - a. Material graded such that 90 to 100 percent of material passes the 3/8-inch sieve, and not more than 5 percent of material passes the No. 50 (300 µm) sieve, when sampled in accordance with ASTM D75 and ASTM D3665 and tested in accordance with ASTM C136.
 - b. Requirements for maximum percentage of impurities, abrasion loss, and soundness: As specified for coarse aggregate.
5. Coarse aggregate:
 - a. Materials graded such that not more than 10 percent of material passes the 3/8-inch sieve, when sampled in accordance with ASTM D75 and ASTM D3665 and tested in accordance with ASTM C136.
 - b. Consisting of gravel, crushed gravel, crushed stone, or a combination of these materials having clean, hard, durable particles free from calcareous coatings, organic matter, or other deleterious substances.

- c. Conforming to the requirements of ASTM C33, Class 4S for physical properties, deleterious substances, and alkali reactivity, except as modified in the following paragraphs:
 - 1) Grading:
 - a) Size number as specified in ASTM C33, and as indicated in Table 3 of this Section, except as otherwise specified or accepted by the Engineer.
 - b) Weights of flat or elongated particles (particles having a length greater than 3 times average width or thickness) not exceeding 15 percent when tested in accordance with ASTM D4791.
 - 2) Deleterious substances: Not in excess of the percentages by weight specified in Table 2 of this Section and having total of all deleterious substances exceeding 2 percent.

Table 2. Coarse Aggregate, Limits on Impurities		
Item	Test Method	Percent (maximum)
Clay lumps and friable particles	ASTM C142	0.50
Lightweight particles (SG < 2.40) Chert or shale ⁽¹⁾	ASTM C123	1.25
	ASTM C295	1.00 ⁽¹⁾
Materials finer than No. 200 sieve	ASTM C117	0.50 ⁽²⁾
Coal and lignite	ASTM C123	0.25
Notes: (1) ASTM C123 tests for particles in the sample having a specific gravity less than 2.40. ASTM C295 is used to identify which of those lightweight particles are chert, shale, or coal and lignite. If testing under ASTM C123 indicates a combined percentage (sum of shale, chert, coal and lignite) not greater than 1.25, testing under ASTM C295 will not be required. (2) When material finer than No. 200 sieve consists of crusher dust, maximum percentage may be increased to 1.00 percent. When mix design complies with provisions of ASTM C33, Table 4, footnote C, the maximum percentage may be increased in accordance with the equation in footnote C, up to a maximum of 1.5 percent.		

- 3) Abrasion loss: Loss not greater than 45 percent after 500 revolutions when tested in accordance with ASTM C131.
- 4) Soundness: Loss not greater than 10 percent when tested in accordance with ASTM C88 using sodium sulfate solution.

2.04 MATERIALS FOR PLACING AND CURING

- A. General:
 1. Materials shall be compatible with concrete and with other materials.
 2. Materials for placing, curing and finishing concrete that will be in contact with potable water:
 - a. Non-toxic and shall not impart taste or odor to the water.
 - b. Listed under NSF 61 for use in contact with potable water.
- B. Neat cement grout:
 1. Use: For spreading over surface of construction and cold joints in concrete before placing additional concrete above those joints.
 2. As specified in Section 03_60_00 - Grouting.

- C. Concrete sealer:
 - 1. As specified in Section 03_35_29 - Concrete Finishes.
 - 2. Not for use in water-containment structures.
- D. Evaporation retardant:
 - 1. Tested and listed under NSF 61 for use direct contact with potable water.
 - 2. Use: For mitigating surface moisture evaporation from freshly placed concrete during rapid drying conditions. Placed after screeding.
 - 3. Waterborne, monomolecular, spray-applied compound, with fugitive dye to indicate coverage.
 - 4. Manufacturers: One of the following or equal:
 - a. Euclid Chemical Co., Eucobar.
 - b. Master Builders Solutions/Sika, MasterKure ER 50.
- E. Nonslip abrasive:
 - 1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
 - 2. Manufacturers: One of the following or equal:
 - a. Abrasive Materials, Inc.
 - b. Exolon Co.
- F. Plastic membrane for curing:
 - 1. Polyethylene film: In accordance with ASTM C171.
 - 2. Properties:
 - a. Color: White.
 - b. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inches when measured in accordance with ASTM D2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inches.
 - c. Loss of moisture: Not exceeding 0.055 grams per square centimeter of surface when tested in accordance with ASTM C156.
- G. Sprayed membrane curing compound:
 - 1. Tested and listed under NSF 61 for use direct contact with potable water.
 - 2. Combination curing and sealing products (cure and seal) will not be permitted.
 - 3. Properties:
 - a. Clear type with fugitive dye conforming with ASTM C309, Type 1D and containing no wax, paraffin, or oils.
 - b. For concrete placed or cured during hot weather, curing compound shall be as specified, except that:
 - 1) It shall include a white, reflective fugitive dye.
 - 2) Moisture loss during a 72-hour period shall not exceed 0.55 kg/square meter when tested in accordance with ASTM C156.
- H. Surface-applied crystalline coating:
 - 1. Tested and listed under NSF 61 for use direct contact with potable water.
 - 2. Manufacturers: One of the following or equal:
 - a. Euclid Chemical Co., Vandex Super.
 - b. Kryton International, Inc., Krystol T1.
 - c. Xypex Chemical Corp., Xypex Concentrate.

3. Where surface-applied crystalline coating is placed over concrete containing permeability reducing admixture for concrete exposed to hydrostatic conditions (PRAH), provide products of same manufacturer providing the admixture.

2.05 EQUIPMENT

A. General:

1. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material into mixers.

B. Batching equipment, or batch plant.

1. Capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.

C. Mixing equipment:

1. Mixers may be of stationary plant, paver, or truck mixer type, as appropriate to the Work.
2. Capable of combining aggregates, water, and cementitious materials, and admixtures within specified time into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation.
 - a. Maintain concrete mixing equipment in good working order and operate at loads, speeds, and timing recommended by the manufacturer or as specified.
 - b. Proportion cementitious materials and aggregate by weight.
3. If bulk cementitious materials are used, weigh them on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
4. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
5. Procedure of mixing cementitious materials with sand or with sand and coarse aggregate for delivery to the Project Site, for final mixing and addition of mixing water will not be permitted.
6. Retempering of concrete will not be permitted.
7. Discharge entire batch before recharging.
8. Volume of mixed material per batch: Not to exceed manufacturer's rated capacity of mixer.
9. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
10. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing:
 - a. Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.
11. Transit-mixed concrete:
 - a. Mix and deliver in accordance with ASTM C94.
 - b. Total elapsed time between addition of water at batch plant and discharging completed mix.
 - c. Not to exceed 90 minutes.
 - d. Elapsed time at the Project Site shall not exceed 30 minutes.
 - e. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the Engineer.

- f. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish device that is capable of counting number of revolutions of drum.
 - 12. Continuously revolve drum after it is once started until it has completely discharged its batch:
 - a. Do not add water until drum has started revolving.
 - b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. Contractor will not be entitled to additional compensation because of such increase or decrease.
- D. Other types of mixers: For other types of mixers, mixing shall be as follows:
 - 1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
 - 2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
 - 3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than 1 cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.06 CONCRETE MIXES

- A. General:
 - 1. Develop and provide mix designs for each concrete class listed in Table 3 of this Section.
 - 2. Select and proportion mixes and document properties using one of the 2 methods that follow. Procedures and requirements for use of each alternative are specified in subsequent paragraphs of this Section.
 - a. Field experience method.
 - b. Trial batch method.
 - 3. Organize and submit mix designs with data on all constituent materials and products for that mix for the Engineer's review.
 - 4. Do not place concrete until the mix design for that concrete class has been accepted by the Engineer.
 - 5. After acceptance, do not modify accepted mixes or provide new mixes without the Engineer's prior review and acceptance of the proposed alternative.
 - a. Exception: At all times, adjust batching of water to compensate for free moisture content of the fine aggregate used.
 - b. For any change to approved mixes, the Engineer may require new trial batching and testing program as specified in this Section before acceptance and use.
 - c. For any change to approved mixes, make modifications within limits set forth in this Section.
 - d. If there is change in source or quality of any constituent of the concrete class or mix, the revised mix will be considered a new class of concrete and shall require full re-submittal of all data describing mix constituents, design, and testing.
 - 6. Material sampling, mix designs, trial batch preparation and testing, modifications to mix designs, and any re-testing required to satisfy the requirements of this Section or to obtain satisfactory performance shall be at the Contractor's expense and shall not be considered cause for delay.

- B. Measurements of materials:
1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
 2. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
 3. Accuracy of weighing devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within 1 percent of desired amount of that material.
 4. Measuring or weighing devices: Subject to review by the Engineer. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
 5. Weighing cementitious materials:
 - a. Weigh cementitious materials separately.
 - b. Cement in unbroken standard packages (sacks): Need not be weighed.
 - c. Weigh bulk cementitious materials and fractional packages.
 6. Measure mixing water by volume or by weight.
- C. Requirements for mix proportioning:
1. Develop and provide mixes that:
 - a. Can be readily worked into corners and angles of forms and around reinforcement, without excessive vibration, and without permitting materials to segregate or free water to collect on surface.
 - b. Prevent unnecessary or haphazard changes in the consistency of the concrete supplied.
 2. Constituent materials:
 - a. Provide concrete mixes composed of portland cement or blended cement, blended aggregates, admixtures and water.
 - 1) Admixtures required for each concrete class are indicated in Table 3 of this Section. Admixtures not specifically required by that table for a specific concrete class are optional and may be included at the discretion of the Contractor based on the Contractor's planned means and methods of construction.
 - b. In no case shall returned fresh concrete or its constituents be incorporated into concrete batched for the Work.
 3. Minimum specified compressive strength:
 - a. Minimum specified compressive strength is designated at 28 days, unless otherwise indicated in Table 3 of this Section.
 - b. For locations where the placed concrete is adequately protected and is not subjected to loads for an extended period during construction, the Contractor may request that the period for achieving the minimum specified compressive strength be extended to 56 days.
 - 1) If accepted by the Engineer, provide mixes that achieve at least 75 percent of their minimum specified compressive strength after 28 days.
 4. Proportions and consistency:
 - a. Ratio of water to cementitious materials, and cementitious materials content:
 - 1) Conform to maximum and minimum cementitious material content requirements specified in Table 3 of this Section.
 - 2) Cementitious materials content: Consisting of portland cement or blended cement as indicated in Table 3 of this Section, plus

supplemental cementitious materials if aggregate testing indicates potentially reactive aggregates:

- a) Fly ash content:
 - (1) Minimum: 15 percent of the total weight of cementitious materials.
 - (2) Maximum: 25 percent of the total weight of cementitious materials.
 - (3) Class M: Provide 20 to 25 percent by weight of the total cementitious content as Class F fly ash.
- b. Aggregate size and content:
 - 1) Blend aggregates to produce an optimized gradation that combines well-graded coarse, intermediate, and fine aggregates in proportions that maximize the aggregate content of the mix, and that minimize the cement paste content of the mix.
 - a) Percentage of individual fractions of the combined aggregate gradation retained on individual sieve sizes: Within the range shown in Attachment C - Combined Aggregate Gradation Chart (Tarantula Curve).
 - b) Sum of the percentages of individual fractions retained on the No. 8, No. 16, and No. 30 sieves: Greater than 20 percent.
 - c) Sum of the percentages of individual fractions retained on the No. 30, No. 50, No. 100, and No. 200 sieves: Within the range of 25 percent to 40 percent.
- c. Determine bulk density and void content of the combined gradation of aggregates in accordance with ASTM C29. Results for combined aggregates shall not be the summation of results of testing of the individual gradations.
 - 1) Sample the combined aggregate from a flowing aggregate stream or conveyor in accordance with ASTM D75. Take care to ensure that the sample is representative of the proportions of the combined aggregate of the proposed mix.
 - 2) Reduce sample of combined aggregate to test sample size in accordance with ASTM C702, Method A - mechanical splitter or Method B - quartering.
 - 3) Perform bulk density test of combined aggregate in accordance with ASTM C29, Procedure A - rodding.
 - 4) Determine void content of the combined aggregate in accordance with ASTM C29, Procedure A - rodding. Specific gravity of the combined aggregate shall be determined in accordance with ASTM C136.
- d. Paste content: Limited to the following:
 - 1) Class A mixes without air entrainment: Maximum 28 percent measured by volume.
 - 2) Class A mixes with air entrainment: Maximum 28 percent measured by volume plus the target air content.
 - 3) Paste content shall be limited to 175 percent of the void content of the combined aggregate gradation determined by ASTM C29.
- e. Total water content:
 - 1) Not exceeding the water to cementitious material ratio specified in Table 3 of this Section.

- f. Coarseness/workability (Shilstone Method):
- 1) Proportion mixes to fall into the "Optimal" zone (Zone II) when plotted on the Coarseness Factor Chart ("Coarseness Factor" versus "Workability Factor") included as Attachment B - Coarseness Factor Chart to this Section. Provide plot for each Class A mix to be used in the Work.
 - 2) Coarseness factor (CF) for each mix shall be calculated as the percent of the combined aggregate gradation retained on the 3/8-inch sieve, divided by the percent of the combined aggregate gradation retained on the No. 8 sieve, multiplied by 100, or:

$$CF = \frac{(\% \text{ retained on } 3/8\text{-in sieve})}{(\% \text{ retained on No. 8 sieve})} \times 100$$

- 3) Workability factor (WF) for each mix shall be the percent of the combined aggregate gradation retained on the No. 8 sieve, adjusted for cement content in the mix.
 - a) Determine volume of total cementitious material in the mix.
 - b) For each 94 pounds of cement content above 564 pounds per cubic yard, increase workability factor by 2.5 units.
 - c) For each 94 pounds of cement below 564 pounds per cubic yard, decrease workability factor by 2.5 units.
 - d) Proportion adjustment factor by linear interpolation for each fraction of 94 pounds above or below the 564 pound basis.
 - e) Example:
 650 pounds per cubic yard = 564 pounds + 86 pounds.
 Adjustment = (86 lb / 94 lb) x 2.5 = + 2.28.

D. Concrete classes for use in the Work:

1. Provide concrete classes listed in Table 3 of this Section.
2. Provide normal weight concrete, having minimum weight of 140 pounds per cubic foot, unless otherwise noted.
3. Pumped concrete:
 - a. Provide pumped concrete that complies with all requirements of this Section.
 - b. Mixes placed by pumping shall be considered a sub class of each concrete class listed in Table 3 of this Section. Prepare and submit a separate mix design for each mix to be placed by pumping.
4. Class PM concrete: In addition to the requirements of Table 3 of this Section, conform to the following:
 - a. Minimum 28 day flexural strength: 650 psi when tested in accordance with ASTM C293.
 - b. Cementitious materials content: 75 percent portland cement plus 25 percent Class F fly ash (by weight), blended cement conforming to Type IP(25), or 75 percent Type IL blended cement plus 25 percent Class F fly ash (by weight).
 - c. Aggregate:
 - 1) Minimum 55 percent coarse aggregate conforming to ASTM C33 size number 357 or size number 467.
 - 2) Substitute ASTM C33 size number 57, or size number 67 if mechanical paving equipment is not used.

5. Class M concrete: In addition to the requirements of Table 3 of this Section, conform to the requirements for Class A concrete.

Table 3. Concrete Classes									
Concrete Class⁽¹⁾	Minimum Specified Compressive Strength at 28 days, f'_c⁽²⁾ (pounds per square inch)	Ratio of water to cementitious materials⁽³⁾ (minimum - maximum)	Cementitious Materials Content (pounds per cubic yard of concrete by weight)⁽⁴⁾	Cement Type	Maximum Chloride Content (percent by weight of cement)	Maximum Size of Coarse Aggregate (ASTM C33)	Air Entrainment (percent), (n/a: not applicable)	Admixtures required^(4,5,6)	Slump Range (inches)
A	4,500	0.40 to 0.42	535 to 575	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)(MS) or IP(20)(MS)	0.10	#57	6±1.5	AEA WRA	2 to 4
A-NA	4,500	0.40 to 0.45	535 to 575	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)(MS) or IP(20)(MS)	0.10	#57	n/a	WRA	2 to 4
C	2,500	0.62 max.	423 min.	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)(MS) or IP(20)(MS)	No limit	#57	6±1.5	AEA WRA	3 to 6
CE	3,000	0.62 max.	423 min.	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)(MS) or IP(20)(MS)	No limit	#8	5±1.5	AEA WRA	3 to 6
PM	5,000	0.40	535 to 575	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)(MS) or IP(20)(MS)	0.15	#57	6±1.5	AEA WRA	3 to 6
M	4,500 at 56 days	0.40 to 0.42	535 to 575	ASTM C150, Type II(MH) or ASTM C595, Type IL(<15)(MS) or IP(25)(MS)	0.10	#4	6±1.5	AEA WRA	2 to 4
Notes: (1) Sub classes within major concrete classes are designated as follows: NA: Without air entrainment.									

Table 3. Concrete Classes

Concrete Class ⁽¹⁾	Minimum Specified Compressive Strength at 28 days, f'c ⁽²⁾ (pounds per square inch)	Ratio of water to cementitious materials ⁽³⁾ (minimum - maximum)	Cementitious Materials Content (pounds per cubic yard of concrete by weight) ⁽⁴⁾	Cement Type	Maximum Chloride Content (percent by weight of cement)	Maximum Size of Coarse Aggregate (ASTM C33)	Air Entrainment (percent), (n/a: not applicable)	Admixtures required ^(4,5,6)	Slump Range (inches)
(2) At locations where concrete will not be subjected to load from other elements of the structure or from the Contractor's placing and/or backfilling operations, maximum time period for achievement of specified compressive strength may be extended to 56 days when accepted by the Engineer. (3) W/C Ratio = Ratio of water to cementitious materials by weight. Include weight of admixtures in the water content of the mix when the quantity of the admixtures exceeds 10 ounces per 100 pounds of cement. (4) Cementitious material includes portland cement plus supplemental cementitious materials. If trial batch testing demonstrates that the required strength cannot be met at 28 or 56 days with the specified combined aggregate gradation and the paste content limits, cementitious material content may be increased with the Engineer's approval if Class M concrete is provided and Thermal Control Plan and Temperature Monitoring Program in accordance with Section 03_70_30 - Thermal Control of Concrete is provided for cast-in-place concrete elements. Cement content and/or threshold for the thermal control requirement may be adjusted by the Engineer based on the Equivalent Cement Content (ECC) of the approved Class M concrete mix. (5) Admixtures are designated as follows: AEA: Air entraining admixture. HRWR: High-range water-reducing admixture. PRAH: Permeability-reducing admixture for concrete exposed to hydrostatic conditions. SFR: Synthetic fiber reinforcement. SRA: Shrinkage-reducing admixture. WRA: Water-reducing admixture. (6) At the Contractor's option, each concrete class may include a high-range water reducing admixture (HRWR). Designate such mixes as the "class" specified followed by "SP" (e.g., A-SP, A-NA-SP, P-SP, etc.). Submit as separate mixes for review. Slump range after addition of HRWR: 4 to 6 inches.									

- E. Install concrete classes in accordance with the following requirements, unless otherwise indicated on the Drawings.
1. Class A concrete: Structural concrete.
 - a. Use at all locations unless other Classes are specified or indicated on the Drawings.
 2. Class A-NA concrete: Structural concrete without air entrainment.
 - a. May be used in lieu of Class A at indoor slabs (not subject to freezing and thawing) where inclusion of an air-entraining admixture makes it difficult to achieve the specified concrete finish.
 3. Class C concrete: Miscellaneous concrete fill and encasement.
 - a. May be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.

4. Class CE concrete: Use for electrical conduit encasements.
 5. Class PM concrete: Use for concrete pavement, cart paths, curbs, gutters, and sidewalks.
 6. Class M concrete: Use at placements when the minimum dimension exceeds 36 inches or when the maximum specified cementitious material exceeds the limit in Table 3 and the minimum dimension exceeds 24 inches.
- F. Concrete mix design documented by field experience:
1. Mix design:
 - a. Prepare preliminary mix design for each concrete class. Submit mix design with product and testing data for materials to be used in the mix for the Engineer's review.
 2. Historical records for similar mix.
 - a. Determinations of similarity of materials and proportions between historical and proposed mixes shall be by the Engineer, and that shall be final.
 - b. Historical record - Materials:
 - 1) Submit with each mix design the following data for a previously-supplied concrete mix similar to that proposed for this Work.
 - 2) Records demonstrating that the previously supplied mix included similar materials and proportions as those of the proposed mix.
 - a) Documentation that the same concrete supplier will provide both mixes.
 - b) Documentation that the materials used was from the same suppliers and had essentially the same properties, demonstrated by test data, as those proposed.
 - c) Documentation that proportions of materials in the record mix are essentially the same as those proposed and that the specified compressive strength of the record mix is within 1,000 pounds per square inch of that required by this Section.
 - d) Concrete supplier's statement describing any changes made to production of the record mix during the time period reported.
 - e) Concrete supplier's statement that preparation and quality control procedures for the record mix were essentially the same as those to be employed for this Work.
 - c. Historical record - Testing:
 - 1) Submit with each record mix, corresponding test data for slump, compressive strength (with relationships for rate of strength gain between testing ages), and drying shrinkage.
 - 2) Only records satisfying the following requirements will be accepted.
 - a) All tests were conducted within a period of 1 year preceding the date of the Submittal.
 - b) All tests were conducted over a period including not less than 45 days.
 - c) Record of compressive strength testing includes at least 30 tests for slump and 28-day compressive strength.
 - d) Record of compressive strength tests is consecutive. In other words, it includes all tests conducted on the subject mix within the 1-year time period described above (not just selected tests during that period).
 - e) Submit concrete supplier's sworn statement confirming that all tests for the record mix have been reported.

- f) Tests for drying shrinkage are described in subsequent paragraphs of this Section for “concrete mix design documented by trial batch preparation and testing”.
 - g) Provide supplementary testing if requested by the Engineer.
 - d. For mixes determined to be similar and to have an acceptable test history, acceptance criteria shall be as follows:
 - 1) Acceptance criteria:
 - a) Slump: All tests within limits specified for record mix.
 - b) Compressive strength: Average compression strength for tests, as determined by ACI CODE-350 not less than minimum required average strength.
 - c) Drying shrinkage: Within limits stated in subsequent paragraphs of this Section for “concrete mix design documented by trial batch preparation and testing”.
- G. Concrete mix design documented by trial batch preparation and testing:
 - 1. Mix design and trial batches:
 - a. Prepare preliminary mix design for each concrete class. Submit mix design with product and testing data for each combination of materials and proportions to be used for the Engineer’s review.
 - 1) Determine water content of the mix based on curves showing the relation between water-cementitious materials ratio and the 7- and 28-day compressive strength of the concrete.
 - 2) Determine each curve using 4 or more points, each representing the average compressive strength value of at least 3 specimens tested at each age.
 - b. After materials and proposed mix designs have been accepted by the Engineer, have trial batches for each concrete mix design prepared by the Contractor’s testing laboratory.
 - 1) Prepare trial batches using the cementitious materials, aggregates, and admixtures proposed to be used for the Work.
 - 2) Provide batches of sufficient quantity to determine slump, workability, consistency, and finishing characteristics, and to provide sufficient specimens for testing.
 - c. For each trial batch, make and test specimens to determine and report slump, compressive strength (with relationships for rate of strength gain between testing ages), and drying shrinkage.
 - 1) If trial batches do not produce concrete conforming to the specified requirements for slump, strength, workability, consistency, drying shrinkage, restrained shrinkage, and finishing, change mix proportions and, if necessary, sources of materials.
 - 2) Make additional trial batches and perform additional tests until a batch that conforms to requirements of this Section is produced.
 - 2. Testing - Slump:
 - a. Determine slump in accordance with ASTM C143.
 - b. Acceptance criterion: Slump within range specified.
 - 3. Testing - Compressive strength:
 - a. Prepare 4-inch diameter by 8-inch long cylinders in accordance with ASTM C31 for tests specified in this Section.

- b. Determine average compressive strength:
 - 1) Test at least 12 cylinders from each trial batch for compressive strength in accordance with ASTM C39.
 - 2) Test 4 cylinders at 7 days, another 4 at 28 days, and another 3 at 56 days.
 - 3) Calculate average compression strength for 7-day tests, for 28-day tests, and for 56-day tests.
 - 4) Calculate ratios for:
 - a) Average 7 day strength to average 28 day strength.
 - b) Average 28 day strength to average 56 day strength.
- c. Determine the required average compressive strength for each mix, f'_{cr} , as described in the following paragraphs:
 - 1) Calculate required average compressive strength (f'_{cr}) based on the minimum specified 28-day compressive strength, f'_c , plus a standard deviation determined from the test history available for that mix.
 - 2) Determine f'_{cr} as specified in ACI CODE-350, except as modified in the following paragraphs:
 - a) Where 15 or more 28-day compressive strength tests are available, calculate standard deviation as described in the preceding paragraphs for "concrete mix design documented by field experience". Add this standard deviation to the specified minimum compressive strength to determine the required average compressive strength (f'_{cr}) for the mix.
 - b) Where fewer than 15 compressive strength tests at 28 days are available, determine minimum required compressive strength, (f'_{cr}) from Table 4 of this Section.

Table 4. Required Average Compressive Strength, Fewer than 15 Tests Available	
Minimum Specified Compressive Strength, f'_c (pounds per square inch)	Required Average Compressive Strength, f'_{cr} (pounds per square inch)
Less than 3,000	$f'_c + 1,000$
3,000 to 5,000	$f'_c + 1,200$
Over 5,000	$f'_c + 1,400$

- d. Acceptance criterion: Average compressive strength of the 4 cylinders tested at 28 days, or of the 4 cylinders tested at 56 days when permitted by the Engineer, shall equal or exceed the required average compression strength, f'_{cr} for that concrete mix design.
4. Testing - Chloride content:
 - a. Submit test results showing that the concrete mix contains water-soluble chloride ion content contributed from the constituents, including water, aggregates, cementitious materials, and admixtures is less than the limit specified in Table 3 of this Section. Test shall be performed in accordance with ASTM C1218 at age between 28 and 42 days.

5. Testing - Drying shrinkage - Prism specimens:
 - a. Class A (including A, A-NA, A-SP, and A-NA-SP), Class M, and Class PM: From trial batch for each mix, prepare 10 drying shrinkage specimens in accordance with ASTM C157.
 - 1) Divide specimens into 2 groups of 5 specimens each: 1 group including shrinkage-reducing admixture and 1 group without shrinkage-reducing admixture.
 - b. Prepare, cure, and test both groups in accordance with ASTM C157, except as modified in the following paragraphs.
 - 1) Remove drying shrinkage specimens from molds at age of 23 hours, plus or minus 1 hour, after trial batching.
 - a) Immediately place them in lime-saturated water maintained at 73 degrees Fahrenheit, plus or minus 3 degrees, for at least 30 minutes.
 - b) Remove specimens from the water and wipe with a damp cloth.
 - c) Measure to nearest 0.0001 inch to determine original length.
 - d) Record measurements and re-submerge specimens in lime-saturated water at 73 degrees Fahrenheit, plus or minus 3 degrees, for moist curing.
 - 2) Maintain submerged curing conditions at 73 degrees Fahrenheit, plus or minus 3 degrees, for 7 days. 7 days after batching, remove specimens from water and repeat measuring procedures.
 - 3) Immediately store specimens in a humidity controlled room maintained at 73 degrees Fahrenheit, plus or minus 3 degrees, and at 50 percent relative humidity plus or minus 4 percent for remainder of the test.
 - 4) At periods of 14, 21, 28, and 56 days after batching, remove specimens from curing room and repeat measurements.
 - c. Drying shrinkage test report:
 - 1) Report measurements of all specimens at 1, 7, 14, 21, 28, and 56 days after batching.
 - 2) Using measured length at 7 days as base length for drying shrinkage, calculate the following for each measuring period:
 - a) Drying shrinkage of each specimen. Determine as difference between the 7-day base length and measured length for each period.
 - b) Average of these differences. If drying shrinkage of any specimen departs from the average of the measurements for each period by more than 0.0004 inch, disregard results obtained from that specimen.
 - c) Percentage of drying shrinkage from batching to date of measurement.
 - d. Drying shrinkage acceptance criteria:
 - 1) Average shrinkage of trial batch concrete specimen group at 28 days after batching, when measured and cured as indicated, shall not exceed 0.035 percent.
 - e. Mixes accepted by the Engineer:
 - 1) Retain drying shrinkage test specimens. Bag in re-sealable plastic bags and submit to the Engineer.
 - 2) Indicate trial batch identifier, specimen number, and date of final measurements on each specimen bag.

2.07 SOURCE QUALITY CONTROL

- A. Sample and test materials in accordance with the following requirements:
 - 1. Sampling, testing, and reporting frequency:
 - a. In preparation for mix design submittals and trial batch tests.
 - b. Whenever there is a change in source of the material, or a significant change in the characteristics or quality of materials from the same source.
 - c. For each 10,000 cubic yards of concrete mix produced.
 - d. At intervals not exceeding 90 calendar days, unless otherwise specified in the following paragraphs.
 - 2. Supplemental cementitious materials.
 - a. Sample and test fly ash in accordance with ASTM C311.
 - 3. Aggregate:
 - a. Sample combined aggregate in accordance with ASTM D75 and ASTM D3665, and test for gradation in accordance with ASTM C136.
 - b. At least once every 30 days, and when requested by the Engineer.
 - c. Submit test results.
 - 4. Cementitious materials:
 - a. Sample and test cementitious materials and provide mill certificates demonstrating compliance with ASTM C150 and additional requirements of this Section.
 - 1) Determine alkali content by method set forth in ASTM C114.
 - b. At least once every 90 days, and when requested by the Engineer.
 - c. Submit test results.
- B. Batch materials in accordance with the following requirements:
 - 1. Concrete batch weights: Control and adjust so as to secure maximum yield, and at all times maintain proportions of concrete mix within specified limits.
 - 2. Aggregates:
 - a. Obtain aggregate from a source capable of providing uniform quality, moisture content, and grading during any single day's operation.
 - b. Furnish satisfactory means at batching plant for checking moisture content of fine aggregate for each batch.
 - 3. Admixtures:
 - a. Batch solutions using mechanical batcher capable of accurate measurement.
 - b. Air entraining admixture: Add to batch in portion of the mixing water, unless otherwise recommended by the admixture manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prepare and submit mix designs for each concrete class indicated in Table 3 of this Section.

- B. Submit proposed sequence of concrete placements. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested by the Contractor and accepted by the Engineer.
 - 1. Use construction methods and sequence work to allow concrete placement to reach adequate strength and to be constructed with required support to prevent overstress of the concrete structure during construction.
- C. Make provisions for monitoring weather conditions:
 - 1. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments accurate to within 2 degrees Fahrenheit, 5 percent relative humidity, and 1 mile per hour wind speed.
 - 2. Monitor the weather forecast beginning at least 48 hours prior to any concrete placement and make provisions for cold weather concreting or hot weather concreting if those conditions exist or are forecast to exist during the period of placement, finishing, and curing.
 - a. Record temperature, relative humidity, and wind speeds for each placement beginning at least 24 hours before scheduled delivery of concrete.
- D. Place no concrete without the Engineer's prior acceptance of conditions.
- E. Notify the Engineer in writing that preparations are complete and ready for placement of concrete. Such notification shall indicate readiness - not just intention - to place concrete for the designated portion of the Work.
 - 1. Submit notification to the Engineer on forms provided by or acceptable to the Engineer and bearing the signature of the Contractor's superintendent.
 - a. Sample form is included at the end of this Section, see Attachment B - Coarseness Factor Chart.
 - 2. Submittal of notification will be the Contractor's certification that preparations are complete and in accordance with the Contract Drawings and Specifications.
 - 3. Provide notification for the Engineer to make final observations at the locations of concrete placements not less than 24 hours before commencing placement of concrete.

3.02 CONCRETE JOINTS

- A. Locations of joints are indicated on the Drawings.
 - 1. In order to preserve strength and watertightness of structures, make no other joints, except as authorized by the Engineer.
 - 2. Construct joints where indicated, and as indicated on the Drawings.
 - 3. Where joint locations are not indicated on the Drawings, submit the Contractor's proposed locations for the Engineer's review and acceptance. Provide construction joints in slabs and walls at intervals not greater than 35 feet.
- B. Time between placements of adjacent concrete separated by joints.
 - 1. Provide not less than 3 days (72 hours) between placement of adjacent sections for the following:
 - a. Slabs.
 - b. Walls.

2. Provide not less than 7 days (168 hours) between placement of the lower and upper pours for the following:
 - a. Walls over slabs.
 - b. Slabs over walls.
 - c. Slabs keyed into the sides of walls.
 3. For the following structures, provide not less than 14 days between placements of concrete in adjacent concrete wall placements. Place concrete for slabs in accordance with ACI PRC-302.1, Figure 10.1.1.1b with not less than 14 days between placements of strips cast first and infill strips.
 - a. All water-bearing structures.
- C. Edges of joints:
1. Provide joints have edges detailed as indicated on the Drawings.
 2. Protect wall and slab surfaces at edges from concrete splatter. Thoroughly clean adjacent surfaces after completion of each placement.
- D. Joint construction:
1. Preparation of forms:
 - a. Provide cleanout holes at base of each wall and column for inspection and cleaning.
 - b. Wash forms and adjacent joint surfaces of sawdust, chips, and other debris after forms are built, and immediately before concrete or grout placement.
 - c. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use a vacuum cleaner for their removal and then flush cleaned surfaces with water.
 2. Before placing concrete against previously placed concrete, thoroughly clean the prior placement of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of pressure washing.
 3. Provide and install waterstops, expansion joint material, and other similar materials as indicated on the Drawings and as specified.
 - a. Take special care to ensure that waterstops are secured in proper position.
 - b. Take special care to ensure that concrete is well consolidated around and against waterstops during placement.
 4. Horizontal joints:
 - a. As initial placement over cold joints, thoroughly spread bed of neat cement grout.
 - 1) Thickness: Not less than 1/2 inch or more than 1 inch.
 - b. For wall placements above planned cold joints, placement of neat cement grout will not be required for locations where the wall mix includes high-range water-reducing admixture (superplasticizers), and the Contractor can demonstrate dense concrete joints without voids or honeycomb after the forms are removed.

3.03 MEASURING AND BATCHING MATERIALS

- A. Measurements of materials:
1. Proportion and measure cementitious materials and aggregates by weight.
 - a. Weigh cementitious materials separately.

- b. If bulk cementitious materials are used, weigh them on separate visible scale that will accurately register scale load at any stage of weighing operation from zero to full capacity.
 - c. Cement in unbroken standard packages (sacks) need not be weighed.
 - 2. Mixing water: Measure by volume or by weight.
 - 3. Other mix constituents: Measure by weight, except as otherwise specified or accepted by the Engineer.
 - 4. Weighing and measuring devices:
 - a. Use equipment designed and constructed specifically for that purpose.
 - b. Furnish devices capable of weighing successive quantities of individual material measured to within 1 percent of desired weight of that material.
 - c. Bearing valid seal of the department of weights and measures for the authority having jurisdiction over the Work.
 - 5. Measurements and measuring devices:
 - a. Subject to review by the Engineer.
- B. Batching:
 - 1. Admixtures shall be added at the concrete batch plant.
 - 2. Addition of admixtures in the field is permitted only with prior acceptance by the Engineer, and only when the following conditions are satisfied:
 - a. Dosage and mixing is personally overseen by the concrete supplier's trained technologist.
 - b. Adequate mixing is provided after addition.
 - c. Maximum time to placement of concrete remains 90 minutes after water added to mix - not 90 minutes after any field additions/adjustments.
 - d. Slump at discharge after additions/modifications conforms to the requirements of Table 3 of this Section.

3.04 MIXING AND TRANSPORTING

- A. Machine mixing:
 - 1. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer and ready for complete mixing with all mixing water.
 - 2. Procedure of mixing cementitious materials with sand, or with sand and coarse aggregate, for delivery to the Project Site for final mixing and addition of mixing water is not permitted.
 - 3. Remixing of concrete that has started to take its initial set (retempering) is not permitted.
 - 4. Discharge entire batch before recharging.
 - 5. Volume of mixed material per batch: Not exceeding manufacturer's rated capacity of mixer.
- B. Transit-mixed concrete:
 - 1. Mix and deliver in accordance with ASTM C94, except as modified in this Section.
 - 2. Total elapsed time between addition of water at batch plant and discharging completed mix:
 - a. Not to exceed 90 minutes or 300 revolutions of the mixing drum.
 - b. Under conditions contributing to rapid setting, total elapsed time permitted may be reduced by the Engineer.

3. Temperature - minimum and maximum allowable during mixing and transporting:
 - a. Minimum: 50 degrees Fahrenheit.
 - b. Maximum: 90 degrees Fahrenheit.
 4. Continuously revolve drum after it is started until it has completely discharged its batch.
 - a. Do not add water until drum has started revolving.
 - b. Engineer reserves the right to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. Contractor will not be entitled to additional compensation because of such increase or decrease.
- C. Concrete delivery:
1. Furnish to the Engineer a delivery ticket for each batch of ready mixed concrete within 24 hours after delivery. Include the following information on each ticket:
 - a. Time of day concrete was batched, and time of day that discharge from the truck is complete.
 - b. Printed record of the individual weight of each of the following constituents in the batch: Fine aggregate, coarse aggregate, cement, pozzolan, and water.
 - c. Concrete class as defined in Table 3 of this Section.
 - d. Type, brand, and quantity of each admixture in the batch.
 - e. Total volume of water allowed in the mix, volume of mixing water added at the batch plant, volume of mixing water withheld from the mix during batching, and total volume of any water added to the mix after leaving the batch plant.
 - 1) In no case shall volume of mixing water withheld result in a water/cementitious materials ratio less than the minimum values specified in Table 3 of this Section.
 - f. Number of revolutions of transit truck at arrival on site, and total number of revolutions when discharge is complete.
 - g. Volume of concrete delivered in the batch.
 - h. Numerical sequence of the batch delivered for that placement.
 2. Additional water may only be added to the mix when the following conditions are fully satisfied:
 - a. Batch ticket showing total volume of water already added and maximum volume of water that may be added is available for the Engineer's observation before any additional water is added.
 - b. Total volume of water in the mix after the addition will be less than the maximum allowable volume of water indicated on the ticket.
 - c. Full concrete load is still within the truck's mixing drum and truck has not begun to discharge the load. Under no conditions shall water be added in the field to a partial truckload of concrete.
 - d. Volume of water added and time of addition are clearly marked for record on the batch ticket delivered to the Engineer.
 3. Addition of admixtures in the field is permitted only with prior approval by the Engineer, and when the following conditions are satisfied:
 - a. Dosage and mixing is personally overseen by the concrete supplier's trained technologist and the admixtures supplier's representative.
 - b. Adequate mixing time is provided after addition of admixtures.

- c. Maximum time to placement of concrete remains 90 minutes after water is added to the mix - not 90 minutes after any field additions/adjustments.
 - d. Slump at discharge after additions/modifications conforms to the requirements of Table 3 of this Section.
- D. Conveying concrete:
 - 1. Convey concrete from mixer to location of final deposit by methods that prevent separation or loss of materials.
 - 2. Use equipment for chutes, pumps, and conveying of concrete of such size and design as to ensure practically continuous flow of concrete, from delivery to the point of placement, without separation of materials.
 - 3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
 - 4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of any day's placement.

3.05 PLACING AND CONSOLIDATING

- A. Preparation:
 - 1. Obtain the Engineer's acceptance of completed preparations before placing concrete.
 - a. Notify the Engineer in writing that all preparations are complete and ready for placement of concrete. Such indication shall indicate readiness, not just intention, to place concrete for the designated portion of the Work.
 - b. Submit completed Attachment D - Contractor's Concrete Placement Checklist Form.
 - 2. Confirm completeness of the following before notification of readiness is given to the Engineer:
 - a. Place forms, reinforcement, screeds, anchors, ties, and inserts in final position.
 - b. Reinforcement is secure and properly fastened in its correct position.
 - c. Loose form ties at construction joints have been retightened.
 - d. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored to maintain a minimum 2-inch clearance between the item and any concrete reinforcement.
 - 1) Securing embedded items in position by wiring or welding to the reinforcement is not permitted.
 - e. Forms have been cleaned of debris and form release agents are applied as specified.
 - 3. Preparation for placement of footings and slabs on grade:
 - a. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the Engineer.
 - b. If necessary, sprinkle subgrade with water not less than 6 or more than 20 hours in advance of placing concrete.
 - c. If subgrade surface becomes dry prior to actual placing of concrete, sprinkle again, without forming pools of water.
 - d. Do not place concrete if subgrade is muddy or soft.

4. Keep sufficient protective coverings on hand at all times for protection of concrete during and after placement.
 - a. Protect concrete placed before rain to prevent water from coming in contact with such concrete.
 - b. Protect concrete placed before winds to prevent excessive drying or embedment of debris in the finished surfaces.
- B. Concrete placement:
 1. Do not place concrete:
 - a. With slump outside the limits specified in Table 3 of this Section.
 - b. In which initial set has occurred, or that has been retempered.
 - c. During rainstorms or high velocity winds.
 2. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
 - a. Do not deposit concrete in large quantities in one place, and then work material along forms with vibrator or by other methods.
 3. Do not drop concrete freely into place from height greater than 5 feet. Use tremies for placing concrete where drop is over 5 feet.
 4. Place concrete on slopes starting from bottom of slope and working upward.
 5. Place concrete in horizontal lifts not exceeding 24 inches in depth and bring up evenly in all parts of forms.
 6. After concrete placement begins, continue in a continuous operation without significant interruption until the end of the placement. Plan and implement precautions to prevent any delay, between layers or adjacent volumes, from exceeding 20 minutes.
 7. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of neat cement grout over surface before placing additional concrete. Provide grout layer thickness of not less than 1/2 inch or more than 1 inch.
 8. Placement of concrete for slabs, beams, or walkways:
 - a. If cast monolithically over walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
 - b. Allow set time of not less than 1 hour for shrinkage.
 - 1) During waiting time, keep top surface of concrete moist, but not wet.
 - 2) Do not permit water to pond or stand on the surface.
 - 3) Do not coat surface with evaporation retarders or curing agents.
 - c. Start placement above wall or column with layer of neat cement grout as described in the preceding paragraph.
- C. Consolidating concrete:
 1. Consolidate concrete with aid of acceptable mechanical vibrators.
 2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the Work.
 3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
 4. Vibrators:
 - a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
 - b. In addition to vibrators in actual use while concrete is being placed, have on hand a minimum of 1 spare vibrator in operable condition.
 - c. Do not place concrete until it has been confirmed that all vibrating equipment, including spares, are in operable condition.

5. Place concrete solidly against forms and concrete surfaces, leaving no voids or honeycomb.
6. Make concrete solid, compact, and smooth. If for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the Engineer.
7. Do not over-vibrate so as to produce segregation.

3.06 FINISHING CONCRETE

- A. Provide concrete finishes in accordance with Section 03_35_29 - Concrete Finishes, unless otherwise indicated on the Drawings.
- B. Liquid evaporation retardant:
 1. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, coat the surface of the concrete with a liquid evaporation retardant immediately after screeding.
 2. Conditions that result in rapid evaporation of moisture are defined as any combination of ambient temperature, concrete temperature, relative humidity, wind speed, and solar radiation intensity that creates conditions that will evaporate water from a free concrete surface at a rate equal to or greater than 0.1 pounds per square foot per hour as determined by the Menzel Formula and nomograph published in ACI PRC-305 and included as Attachment A - Menzel Formula and Nomograph to this Section.
 3. Apply evaporation retardant again after each finishing operation as necessary to prevent drying shrinkage cracks.
 4. Do not work evaporation retardant into the surface of the concrete.
 5. Do not use evaporation retardant as finishing aid (to rehydrate surface a creamy state for finishing).
- C. Concrete sealer:
 1. Floors and slabs to receive concrete sealer: See Room Finish Schedule on the Drawings, and Section 03_35_29 - Concrete Finishes.
- D. Surface-applied crystalline coating:
 1. Apply surface-applied crystalline coating in accordance with the manufacturer's directions.
 2. Spray, squeegee or roll on liquid to clean, dry concrete surface at 225 square feet per gallon.
 - a. Scrub liquid into the surface with a mechanical scrubber.
 - b. Keep surface wet for a minimum of 30 minutes with the surface-applied crystalline coating during application.
 - c. When the product thickens, but not more than 60 minutes after initial application, squeegee or vacuum the surface to remove all excess liquid.
 - d. Do not leave any residue on surface.
 - e. Do not track material on to untreated surfaces.
 3. Where concrete continues to sweat or leak, apply additional coats of surface-applied crystalline coating until the sweating or leaks stop.

3.07 CURING

- A. Cure concrete by methods specified in this Section.
- B. For placements of Class M concrete, as specified in Section 03_70_30 - Thermal Control of Concrete for additional requirements.
- C. Cure period: Keep concrete continuously moist and at an average daily temperature of at least 50 degrees Fahrenheit for a minimum of 7 days after placement.
 - 1. If hourly temperatures at any surface of a concrete placement drop below 50 degrees Fahrenheit during the curing period, count the period below 50 degrees Fahrenheit as zero degrees, and extend the curing time to compensate.
- D. Schedule of curing methods:
 - 1. Cure the following concrete surfaces using water curing or plastic membrane curing:
 - a. Floor surfaces of water containment structures.
 - b. Surfaces where additional concrete will be placed over or against the surface, including concrete joints.
 - c. Surfaces where grout or other toppings will be placed over the surface.
 - d. Slabs scheduled to receive concrete sealer, or other bonded or adhered architectural finishes.
 - e. Formed surfaces scheduled to receive coatings, paint, adhered masonry, cementitious materials, or other similar finishes, and where formwork is removed within the specified cure period after concrete placement.
 - f. Horizontal concrete surfaces at tops of walls.
 - 2. Cure the following concrete surfaces by water curing, plastic membrane curing, or sprayed curing membrane. Selection of methods shall be at the Contractor's option:
 - a. Surfaces not listed in the preceding paragraph.
- E. Water curing:
 - 1. Keep surfaces of concrete constantly and visibly wet, day and night, for not less than the specified cure period.
 - a. Each day forms remain in place will be counted as 1 day of water curing.
 - b. Do not loosen form ties during period when concrete is cured by leaving forms in place. No further curing credit will be allowed for forms remaining in place after contact has been broken between concrete surface and forms.
 - 2. Begin water curing as soon as concrete attains initial set.
 - 3. Maintain a wet surface by ponding, continuous sprinkling, covering with saturated burlap, or otherwise saturating the surface by means acceptable to the Engineer.
 - a. Flood top of walls with water at least 3 times per day and keep surfaces moist at all times during the curing period.
 - b. Provide plastic sheet material over surfaces if required to maintain a wet surface during arid or windy conditions. See plastic membrane curing requirements for additional details.

4. Use water having a temperature within 20 degrees Fahrenheit of the temperature of concrete, and not lower than the minimum temperature allowed for the concrete surface during curing.
- F. Plastic membrane curing:
1. Install plastic membrane as soon as concrete is finished and can support limited pedestrian traffic without damage.
 2. Cover entire surface of finished concrete with membrane.
 3. Anchor membrane to prevent uplift from wind or air trapped below the sheet.
 4. Fully seal joints and edges to provide full seal around perimeter.
 5. Keep concrete under plastic membrane moist, regularly monitoring surfaces and adding supplemental moisture if necessary. Add water as specified for water curing.
- G. Sprayed membrane curing compound:
1. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
 - a. If more than 1 hour elapses after removal of forms, do not use membrane curing compound. Instead, provide water curing for not less than the specified cure period.
 - b. Do not remove sprayed membrane curing compound from concrete before the end of the specified cure period.
 - c. When application of curing compound at concrete joints is accepted by the Engineer, take care to apply curing compound to all surfaces along full profile of joints.
 2. Apply curing compound by mechanical, power operated sprayer with mechanical agitator that will uniformly mix all pigment and compound.
 - a. Apply curing compound in at least 2 coats. Each coat shall be applied at the manufacturer's recommended application rate.
 - b. Apply each coat in direction turned 90 degrees from application direction of the preceding coat.
 - c. Apply curing compound in sufficient quantity so that concrete has uniform appearance and its natural color is effectively and completely concealed immediately after spraying. This requirement may require additional coats and/or application rates than indicated above.
 - d. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
 3. Thickness and coverage of curing compound:
 - a. Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
 - b. Contractor is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and is more than is customary in the trade. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
 4. If the Contractor desires to use a curing compound other than specified product, coat sample areas of concrete wall with proposed curing compound, and also coat similar adjacent area with the specified compound in the manner specified, for comparison:
 - a. If proposed sample is not equal or better, in the opinion of the Engineer, the proposed substitution will not be allowed.

5. Removal of curing compound.
 - a. After curing period is complete, remove curing compound placed on surfaces that will receive additional concrete, including all concrete joint surfaces, by heavy sandblasting or by other means acceptable to the Engineer. Complete removal and cleanup prior to placing any new concrete against the surface.
 - b. Where additional finishes will be applied over concrete surfaces, unless otherwise recommended by the manufacturer of the finish to be applied, remove curing compound by sandblasting. Provide blasting as necessary to fully remove curing compound.
6. Prior to final acceptance of the Work, remove, by sandblasting or by other method acceptable to the Engineer, any curing compound on surfaces exposed to process water or exposed to view, so that only natural color of finished concrete is visible and uniform over the entire surface.

3.08 PROTECTION

- A. General:
 1. Keep forms in place, as specified in Section 03_11_07 - Concrete Formwork, to provide curing and to protect concrete surfaces and edges from damage.
 2. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified.
- B. Loading of concrete members:
 1. Placement of loads on or against green concrete is not permitted.
 2. Do not place soil against walls, or fill over the top of concrete until conditions designated in the following paragraphs are satisfied:
 - a. Walls have been cast to their full height in the structure and have achieved their minimum specified 28-day compressive strength.
 - b. Connecting slabs and beams that brace the walls are in place, are complete, and (in the case of concrete) have achieved their minimum specified 28-day compressive strength.

3.09 COLD WEATHER CONCRETING

- A. Implement cold weather concreting procedures during periods of cold weather as defined in this Section.
 1. Comply with the recommendations of ACI PRC-306 and this Section.
- B. Prepare a cold weather concreting plan. Maintain at least 1 copy of the plan on site. Provide plan for review if requested by the Engineer.
 1. Include procedures for batching, delivery, placement, curing, protection, and for monitoring and recording the temperature of the concrete and the surrounding environment.
 2. Describe procedure to be implemented in the event of abrupt changes in weather conditions or of equipment failure.
 3. Review cold weather concreting plan during pre-construction meeting. Make provisions to address any concerns expressed by the Engineer before beginning concrete placements.

- C. Preparation:
1. Do not place concrete over frozen subgrade materials. Provide insulating material and supplementary heat if required to maintain a thawed surface.
 2. Do not place concrete around metallic elements whose temperature is less than 40 degrees Fahrenheit. If heating is required, use processes that do not alter the metallurgical properties of the elements.
 3. Remove snow, ice, and frost from reinforcement, embedments and forms. Schedule such removal immediately before concrete placement so that surfaces do not refreeze.
- D. Batching, delivery, placement and finishing:
1. Accelerating admixtures will not be permitted.
 2. Based on temperature of the environment and the surfaces where concrete will be placed, select and maintain mix temperature as recommended in ACI PRC-306.
 - a. Make provisions for temperature loss during delivery and placing.
 - b. Place concrete at or slightly above the minimum recommended batch temperatures. Do not exceed these minimum values by more than 20 degrees Fahrenheit.
 3. Heating: If temperature of water or aggregates is below 35 degrees Fahrenheit, heat the materials.
 - a. Mixing water: Do not heat above 140 degrees Fahrenheit.
 - b. Aggregates:
 - 1) Heat uniformly to eliminate ice, snow, and frozen lumps of material.
 - 2) Avoid overheating.
 - 3) Do not exceed average temperature of 140 degrees Fahrenheit or spot temperature of 200 degrees Fahrenheit.
- E. Protection and curing:
1. Protect concrete to provide continuous warm moist curing immediately after placement and during protection period.
 2. Minimum protection period: 7 days reaching 65% the specified minimum compressive strength based on an average rate of strength gain.
 3. For placements of Class M concrete, do not use steam or other concrete heating methods that will increase concrete temperature outside the limits of Section 03_70_30 - Thermal Control of Concrete.
 4. During and immediately after the protection period, maintain temperature in accordance with Table 5 of this Section. Provide record of temperature during placement and curing as specified in the following paragraphs.
 - a. Furnish and locate maximum/minimum temperature recording thermometers in sufficient numbers to confirm concrete.

Table 5. Concrete Temperatures - Normal Weight Concrete			
Section Thickness (inches)	<12	12 to <36	36 to <72
During Protection Period: As maintained (minimum)	55°F	50°F	45°F
After Protection Period: Gradual drop during first 24 hours (maximum)	50°F	40°F	35°F

5. Provide plastic sheeting, polystyrene foam sheets, insulating blankets, and supplemental heating if required to maintain moisture and the specified temperatures during protection.
 - a. Protect insulating blankets from moisture in the concrete and from rain or snow using impermeable sheeting.
 - b. Supplemental heating units:
 - 1) Vent units to outside atmosphere. Do not exhaust heater flue gasses into the enclosed and protected area.
 - 2) Make provisions to heat the flow freely within protected area and to maintain a uniform temperature throughout the space.
 - 3) Locate units to avoid local drying or uneven heating of concrete surfaces.
 - c. Pay particular attention to maintaining required temperature and moisture at edges and corners.
6. At the end of the protection period, allow concrete to cool gradually to the ambient temperature.
 - a. Maximum temperature drop over the first 24-hour period shall be as specified above.
 - b. Where temperature of concrete exceeds ambient by 20 degrees Fahrenheit or more, loosen forms and leave in place for at least 24 hours before removal.
 - c. If water curing has been used, maintain concrete temperature as specified in the following paragraphs for at least 24 hours after water curing is terminated. Allow water-cured concrete to air dry for at least 3 days before exposure to freezing temperatures.

F. Temperature records:

1. For each area of concrete placed or cured during cold weather, record the temperature of concrete and the ambient environment.
 - a. Maintain temperature records on site and make records available for review by the Engineer upon request.
 - b. Deliver a final copy of each record to the Engineer for Project files not more than 14 calendar days after the date concrete was placed.
2. Concrete delivered for placement.
 - a. Measure and record temperature at the point of discharge in accordance with ASTM C1064.
 - b. Note temperature on the batch ticket.
3. Concrete during the protection period:
 - a. Furnish and locate self-recording thermometers (maximum/minimum) around each placement. Number and location of thermometers shall be sufficient to represent temperatures around the entire concrete placement.
 - b. Position thermometers to record the temperature at each edge or corner and at the middle of the placement area.
4. Include in the temperature record of each placement the following information, recorded legibly on a single sheet.
5. In the event that evaluations of the efficacy of concrete protection and curing are required, the lowest temperature recorded in any placement during each 24-hour period will be assumed to be the temperature at which the entire placement was maintained. Protection periods with any temperature records will be assumed to have provided no protection or curing, and the protection period will be extended by 2 days for each day without protection.

3.10 HOT WEATHER CONCRETING

- A. Implement hot weather concrete procedures during periods of hot weather as defined in this Section.
 - 1. Comply with the recommendations of ACI PRC-305 and this Section.
- B. If placements during hot weather are expected, and when requested by the Engineer, prepare a hot weather concreting plan.
 - 1. Maintain at least 1 copy on site.
 - 2. Provide plan for review if requested by the Engineer.
 - a. Include procedures for batching, delivery, placement, curing, protection, and monitoring and recording the temperature of the concrete and the surrounding environment.
 - b. Describe procedures to be implemented in the event of abrupt changes in weather conditions, or in the event of equipment failure.
 - c. Review hot weather concreting plan during pre-construction meeting. Make provisions to address any concerns expressed by the Engineer before beginning concrete placements.
- C. Preparation:
 - 1. Do not place concrete against forms, reinforcement, or embedments with a surface temperature greater than 120 degrees Fahrenheit.
 - a. If necessary, to maintain maximum concrete temperature during placing, cool forms and reinforcement to temperature below 90 degrees Fahrenheit using water or shades.
 - b. Do not allow water to puddle in forms or placement areas.
 - 2. Moisten forms or subgrade to maintain a saturated surface without standing water or soft spots.
 - 3. Provide windbreaks, shades, fog spray, sprinkling, wet cover, or other means required to protect concrete from premature loss of moisture and rapid temperature gain.
- D. Batching and delivery:
 - 1. Retarding admixtures will not be permitted.
 - 2. Temperature of concrete delivered for placement shall not exceed 90 degrees Fahrenheit.
 - a. Maintain uniform temperature in the mix below this level during batching, delivery, placing, and consolidation.
 - b. Temperature of mix, even if below the maximum allowable temperature specified, shall be maintained at a level to avoid loss of slump, flash setting, or cold joints in placements.
 - 3. If necessary:
 - a. Mix water may be chilled or replaced with ice to maintain mix temperature. Where mix water is replaced with ice, provide replacement at a 1-to-1 ratio by weight.
 - b. Shade transit mixed concrete trucks, or cool mixing outside of container with water to control temperature of concrete.
- E. Placing and finishing:
 - 1. Place and finish concrete promptly. Place so that vertical lift lines will not be visible in exposed concrete surfaces.

2. Provide plastic sheeting, fog nozzles, shades or other means to reduce concrete temperature and protect from moisture loss.
 3. For placements of Class M concrete, use fog sprayers to reduce ambient air temperature and increase humidity during concrete placement.
- F. Protection and curing:
1. Furnish and locate maximum/minimum temperature recording thermometers in sufficient numbers to confirm concrete temperatures over full area and edges of concrete.
 2. Flatwork: Protect and cure using water curing methods as specified in this Section.
 - a. Water curing:
 - 1) Keep concrete continuously wet and make provisions for runoff.
 - 2) For sprinkling or soaker hoses, maintain temperature of water as close as possible to the temperature of the concrete to minimize effects of thermal shock.
 3. Formed surfaces: Protect and cure using forms left in place or membrane curing methods as specified in this Section.
 - a. Cover forms and keep continuously moist for at least 24 hours after placement.
 - b. Loosen forms as soon as this can be accomplished without damaging the concrete.
 - c. Maintain continuously moist surfaces by fogging or spraying with water, or by application of curing compound as specified.

3.11 FIELD QUALITY CONTROL BY CONTRACTOR

- A. Provide quality control over the Work of this Section as required by Section 01_45_00 - Quality Control.
- B. Temperature monitoring program:
1. For placements of Class M concrete, execute temperature monitoring program required in Section 03_70_30 - Thermal Control of Concrete.
- C. Field tests:
1. During progress of construction, provide testing to determine whether the concrete, as being produced, complies with requirements specified.
 2. Sampling and testing shall be performed by the Contractor's testing laboratory. See Section 01_45_24 - Regulatory Quality Assurance - Special Tests and Inspections for requirements.
 - a. Cooperate in testing by allowing free access to the Work for testing laboratory to sample and test materials.
 - b. Provide full access for the Engineer to observe concrete sampling and testing at any time.
 - c. Contractor is responsible for providing care of and curing conditions for test specimens in accordance with ASTM C31 until specimens are collected by testing laboratory.
 - d. Provide 4 firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold 10 specimens. Include cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication through shipment to the Owner's testing laboratory.

3. Testing shall include:
 - a. Sampling of concrete in accordance with ASTM C172.
 - b. Temperature of concrete at delivery in accordance with the requirements of ASTM C1064 and as specified in this Section.
 - c. Slump of concrete using slump cone in accordance with requirements of ASTM C143. Test slump at the following intervals:
 - 1) At the beginning of each placement.
 - 2) As often as necessary to keep slump within the specified range, but not less than every 6th truck.
 - 3) When requested to do so by the Engineer.
 - 4) Observe concrete during slump test for signs of segregation.
 - a) Observe concrete to see if mortar or moisture flows from slumped concrete.
 - b) Reject concrete if mortar or moisture flows out of mix.
 - d. Unit weight of concrete in accordance with ASTM C138.
 - e. Air entrainment in accordance with ASTM C173. Test air content at the following intervals:
 - 1) At beginning of each placement.
 - 2) As often as necessary to keep entrained air within specified range, but not less than every 6th truck.
 - 3) When requested to do so by the Engineer.
 - 4) Test air entrainment in concrete in accordance with ASTM C173. If air entraining admixtures used for the Work require alternate testing procedures, advise the independent testing laboratory well in advance of the dates of testing, and confirm that appropriate equipment and personnel are provided for the test.
 - 5) Make air test at point of delivery (discharge from mixer). For pumped concrete, make air tests at point of delivery and at point where expelled after pumping for placement.
 - f. Compressive strength in accordance with ASTM C39. Required number of cylinders is as follows:
 - 1) Not less than 6 cylinder specimens, 4 inches in diameter by 8 inches long, will be tested for each 100 cubic yards of each class of concrete or 5,000 square feet of slab or wall, with minimum of 6 specimens for each class of concrete placed; not less than 6 specimens for each half day's placement; and not less than 2 sets of 6 specimens for each structure.
 - 2) 1 cylinder will be broken at 7 days, 1 at 14 days, and 3 at 28 days. 6th cylinder may be used to evaluate strength after 28 days if requested by the Engineer.
 - 3) Retain and store 6th cylinders (tested and untested) at testing laboratory until 56 days. Break 6th cylinder when directed by the Engineer.
 - g. Provide full access for the Engineer to observe concrete sampling and testing at any time.
- D. Test completed liquid containment structures listed in Section 01_75_19 - Water Leakage Test for Concrete Structures for watertightness.

3.12 FIELD QUALITY CONTROL BY OWNER

- A. As specified in Section 01_45_00 - Quality Control.
- B. Special tests and inspections: As specified in Section 01_45_24 - Regulatory Quality Assurance.
- C. Field inspections:
 - 1. Observe construction for conformance to the Contract Documents and the accepted submittals.
 - 2. Records of inspections:
 - a. Provide a record of each inspection.
 - b. Submit copies to the Contractor upon request.
- D. Field tests:
 - 1. Engineer may request, at any time, additional testing to confirm materials being delivered and placed conform to the requirements of the Contract Documents.
 - a. If such additional testing shows that the material do not conform to the specified requirements, the Contractor shall pay the cost of these tests.
 - b. If such additional testing shows that the materials do conform to the specified requirements, the Owner will pay the cost of these tests.

3.13 NON-CONFORMING WORK

- A. Remove and replace or repair non-conforming and defective work.
 - 1. Provide repairs having strength equal to or greater than specified concrete for areas involved.
 - 2. Provide replacement or repair of non-conforming work by means acceptable to the Engineer and at no additional cost to the Owner.
 - 3. Project schedule will not be extended based on work to address non-conforming concrete.
- B. Concrete not conforming to the specified requirements for properties of plastic concrete: Remove from the Site and replace with conforming materials at no additional cost to the Owner.
 - 1. Temperature: Do not use concrete having a temperature above or below the limits specified in this Section.
 - 2. Slump: Do not place concrete that does not conform to requirements for slump.
 - 3. Air entrainment: Do not use concrete that does not conform to requirements for percentage of entrained air.
- C. Concrete not conforming to the specified requirements for compressive strength:
 - 1. Concrete is expected to reach a compressive strength equal to or greater than the minimum specified compressive strength f'c in Table 3 of this Section.
 - 2. Strength of concrete will be considered acceptable if the following conditions are satisfied.
 - a. Averages of all sets of 3 consecutive strength test results is greater than or equal to the specified compressive strength f'c.
 - b. No individual strength test (average of 3 cylinders) falls below the strength specified in Table 6 of this Section.

- c. Where relationships between 7-day and 28-day compressive strength, or between 28-day and 56-day compressive strength, have been provided as part of the mix design submittals:
 - 1) 7-day strength may be considered as an indication of 28-day strength provided effects of temperature and humidity between 7 days and 28 days are taken into account.
 - 2) 28-day strength may be considered as indication of 56-day strength provided effects of temperature and humidity between 28 days and 56 days are taken into account.

Table 6. Strength Compliance Requirements	
Minimum Specified Compressive Strength, f'_c (pounds per square inch)	Lower Bound of an Individual Compressive Strength Test (pounds per square inch)
Less than 5,000	$f'_c - 500$
Over 5,000	$f'_c - (0.10 \times f'_c)$

- 3. Non-compliant strength tests.
 - a. Mark non-compliant strength test reports to highlight the non-complying results and immediately forward copies to all parties on the test report distribution list.
 - b. Initial treatment may consist of additional curing of affected portion(s) followed by not less than 3 cores at each affected area, taken in accordance with ASTM C42 and ACI CODE-318. Obtain the Engineer's acceptance of proposed coring locations before proceeding with that work.
 - c. Submit report of compressive strength testing for the Engineer's review.
 - d. If requested by the Engineer, provide additional cores, and obtain petrographic testing in accordance with ASTM C856. Submit results for the Engineer's review.
 - e. If additional curing does not bring the average strength of 3 cores taken in affected area to at least specified compressive strength f'_c , designate such concrete in affected area will be considered defective.
 - f. Engineer may require the Contractor to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all at the Contractor's expense.
- D. Concrete sections or surfaces with honeycombing and voids:
 - 1. Provide repairs having surface appearance and finish consistent with that of the surrounding work and acceptable to the Engineer.
 - 2. Do not patch, repair, or cover defective work without prior inspection by the Engineer.
 - 3. Preparation of concrete for repair:
 - a. Make no repair until the Engineer has accepted methods for preparing surfaces and for making and curing repairs.
 - b. Chip out and key-in imperfections in the Work to make them ready for repair.
 - c. Coat bonding surfaces and edges of repair area with one of the following bonding agents as accepted by the Engineer.
 - 1) Epoxy bonding agent as specified in Section 03_63_01 - Epoxies; or,

- 2) Epoxy resin/portland cement bonding agent as specified in Section 03_63_02 - Epoxy Resin/Portland Cement Bonding Agent.
- 4. Methods of repair:
 - a. Dry pack mortar method:
 - 1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
 - 2) Smooth holes: Clean and roughen by heavy sandblasting before repair.
 - 3) Install dry-pack mortar as specified in Section 03_35_29 - Concrete Finishes.
 - b. Cement mortar method:
 - 1) Use for holes too wide to dry pack and too shallow for concrete replacement; and for comparatively shallow depressions, large or small, that extend no deeper than nearest surface reinforcement.
 - 2) Install cement mortar as specified in Section 03_35_29 - Concrete Finishes.
 - c. Concrete replacement:
 - 1) Use when holes extend entirely through the concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.
 - 2) Form, place, consolidate, and cure concrete of same mix as the surrounding work.
- E. Leaking construction joints and cracks in concrete walls and slabs:
 - 1. Repair cracks that develop in walls or slabs, and repair cracks that show any signs of leakage until all leakage is stopped.
 - 2. Pressure inject visible cracks in the following areas, other than hairline cracks and crazing, with repair products and methods acceptable to the Engineer.
 - a. Floors and walls of water bearing structures.
 - b. Walls and overhead slabs of passageways and occupied spaces where the opposite face of the member is exposed to weather or may be washed down and where the opposite face does not receive a separate waterproofing membrane.
 - c. Other items not specified to receive separate waterproofing membrane, including slabs over water channels, wet wells, reservoirs, and other similar surfaces.
 - 3. Continue pressure injection of cracks as specified until structure is watertight and remains watertight for not less than 1 year after date of Substantial Completion or date of final repair, whichever occurs later in time.
- F. Leaking expansion joints in concrete walls or slabs that include waterstops:
 - 1. Repair any signs of leakage until all leakage is stopped.
 - 2. Pressure inject visible leaks with hydrophilic polyurethane foam resin as specified in Section 03_64_25 - Hydrophilic and Hydrophobic Foam Polyurethane Resin Injection System.
 - 3. Continue pressure injection along joints lines as specified until structure is watertight and remains watertight for not less than 1 year after date of Substantial Completion or date of final repair, whichever occurs later in time.

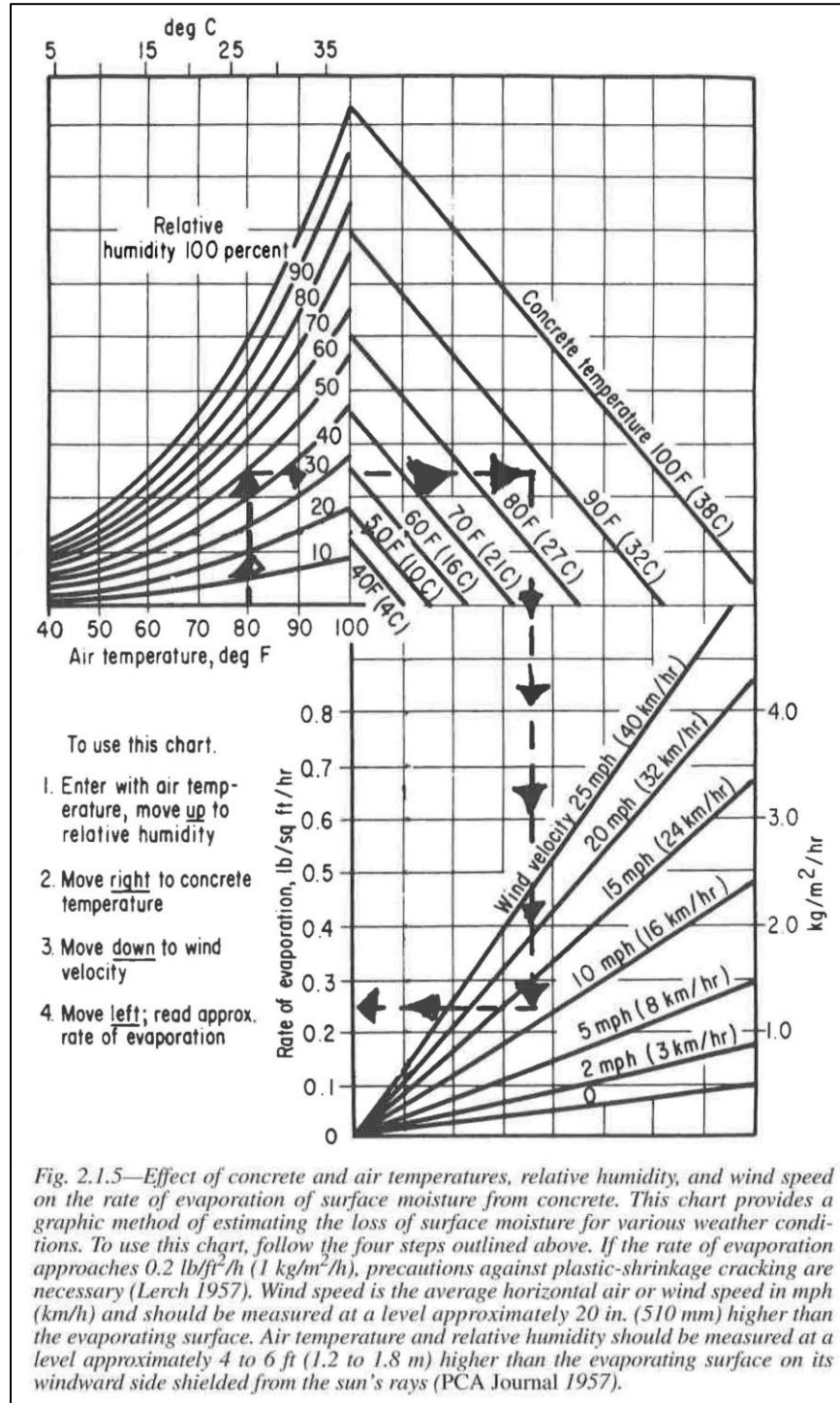
- G. Walls and slabs at overhead channels that leak or sweat because of porosity or cracks too small for successful pressure injection with epoxy.
 - 1. Seal on water or weather side by coating using surface-applied crystalline coating as specified in this Section.
 - 2. Apply as recommended by manufacturer published instructions. Where concrete continues to sweat or leak, apply additional coats of surface-applied crystalline coating until the sweating or leaks stop.
 - 3. Continue application of surface-applied crystalline coating until structure is watertight and remains watertight for not less than 1 year after date of Substantial Completion, or date of final repair, whichever occurs later in time.

END OF SECTION

ATTACHMENT A - MENZEL FORMULA AND NOMOGRAPH

MENZEL FORMULA AND NOMOGRAPH

Source: ACI PRC-305



ATTACHMENT B - COARSENESS FACTOR CHART

COARSENESS FACTOR CHART

Source: ACI PRC-302.1-15, Figure 8.9.2.2.

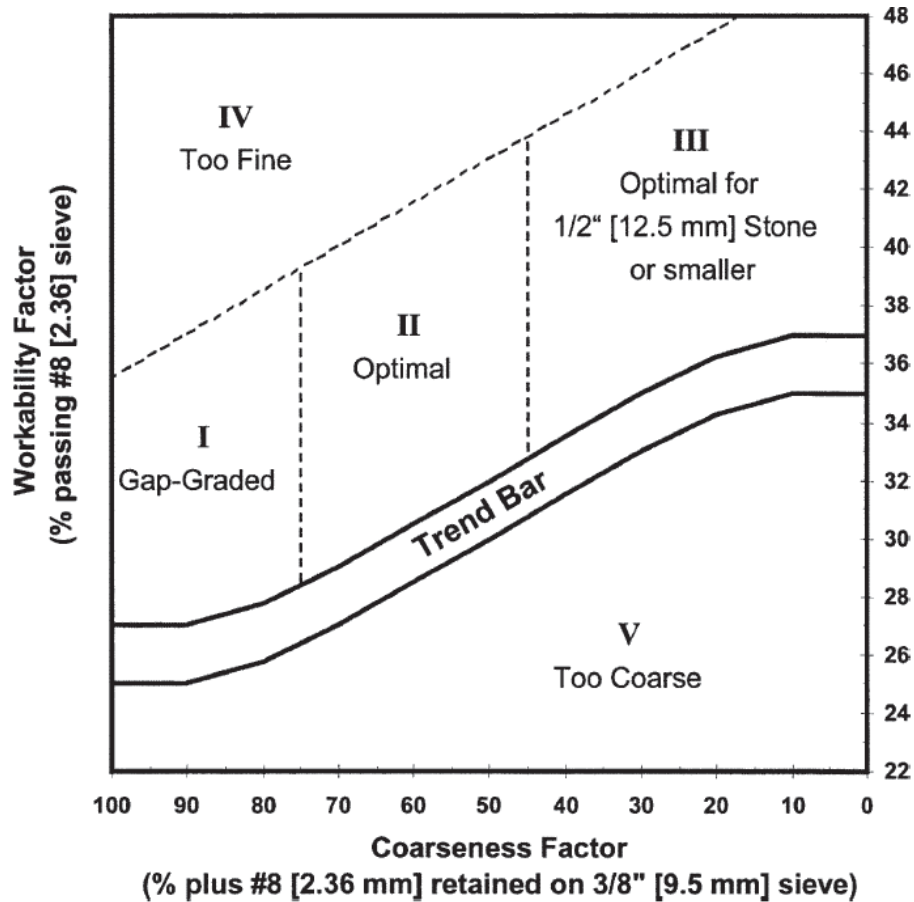
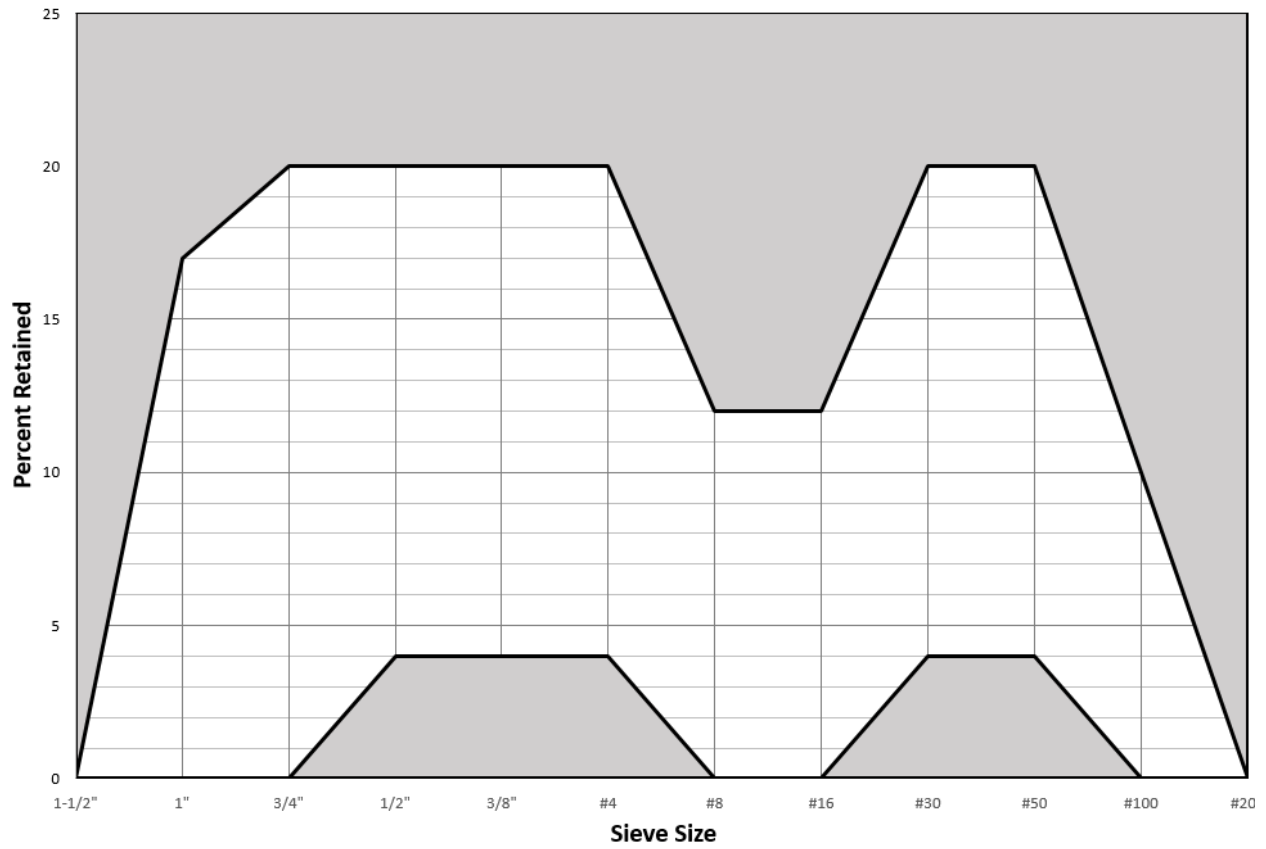


Fig. 8.9.2.2—Coarseness factor chart for evaluating potential performance of mixture.

ATTACHMENT C - COMBINED AGGREGATE GRADATION CHART

COMBINED AGGREGATE GRADATION CHART



ATTACHMENT D - CONCRETE PLACEMENT CHECKLIST

CONCRETE PLACEMENT CHECKLIST

Project: _____ Class of Concrete: _____

Project No: _____ Test Cylinders Taken? Yes: _____ No: _____

Preparation Slab	Contractor	N/A
Compaction Subgrade		
Filter Fabric/Drain Rock-ABC/Separator Fabric		
Drain Rock, Pea Gravel and Void Form		
Starter Wall Forms		
Reinforcing Steel		
Screeds		

Embedded Items	Contractor	N/A
A. Anchor Bolts		
B. Water Stop		
C. Rebar		
D. Electrical		
E. Plumbing Rough-in		
F. Mechanical		
G. HVAC		

Concrete Placement Equip.	Contractor	N/A
A. Crane		
B. Buckets		
C. Hoppers		
D. Vibrators		
E. Elephant trunks		
F. Floodlights		
G. Pump Truck		

Building Department Notification
Date: _____ Time: _____

Prep Wall Concrete	Contractor	N/A
Access To Work		
Ladders Secured		
Clean up and Washed Out		
Reinforcing Steel		

Forms	Contractor	N/A
A. Alignment and Grade		
B. Scaffolding		
C. Sleeves and Wall Castings		
D. Embedded Items		
E. Electrical		
F. Plumbing Rough-in		
G. Piping		

Record of Curing Conditions During Placement
Start: _____ Finish: _____
Date: _____
Time: _____
Weather: _____
Temperature: _____
Comments: _____

Location of Placement _____

The Contractor certifies the above-proposed concrete placement is prepared as indicated and is in accord with the Contract Drawings and Specifications. The Contractor requests permission to begin placement of concrete on the date of _____ at _____. The estimated number of yards is _____. The estimated duration of the placement is _____.

By: _____
Contractor

Released for placement by: _____
Engineer

SECTION 03_35_29

CONCRETE FINISHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Concrete finishes.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117-10 - Specification for Tolerances for Concrete Construction and Materials and Commentary.
- B. ASTM International (ASTM):
 - 1. C404 - Standard Specification for Aggregates for Masonry Grout.
 - 2. C1059 - Standard Specification for Latex Bonding Agents for Bonding Fresh to Hardened Concrete.
- C. International Concrete Repair Institute (ICRI):
 - 1. Guideline No. 301.2: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Grade line: A reference line that separates surfaces considered to be above grade from those considered to be below grade. Located 12 inches below finished grades at the perimeter of the structure.
 - 2. Water line: A reference line that separates surfaces considered to be above the water level (and visible in the finished work) from those considered to be below the water level (and not visible in the finished work). For each water-bearing cell of a structure, defined as a line located 2 feet below the normal operating water level in that cell.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Finishing personnel:
 - a. Use qualified flatwork finishers.

- b. Finishing supervisor must have at least 5 years of experience finishing concrete.
- B. Mockups:
 - 1. Construct mockup panels showing finishing of formed surfaces for review by the Engineer.
 - a. Demonstrate concrete finishes for vertical surfaces:
 - 1) Construct mockup panels for F4 and F5 finishes and tie-hole repairs.
 - 2. Construct mockup slabs showing finishing of unformed surfaces for review by the Engineer.
 - a. Demonstrate concrete finishes for horizontal surfaces:
 - 1) Construct mockup slabs for S1, S2, S4, and S5 finishes.
 - 3. Include the following elements in mockup panels and slabs.
 - a. Concrete joints:
 - 1) Horizontal and vertical joints of the types included in the Work.
 - b. Concrete repairs:
 - 1) Repairs using materials and procedures proposed for the Work.
 - 4. Construct mockup panels and slabs at the beginning of the Project for review by the Engineer.
 - 5. Panels and portions thereof accepted by the Engineer will serve as the standard of quality and workmanship for the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 FINISHING MORTAR

- A. Materials for mortar:
 - 1. As specified in Section 03_30_00 - Cast-in-Place Concrete, unless otherwise noted.
 - a. Where surfaces will be visible in the finished work, use same cement and aggregates used for concrete batches in that area.
 - b. Add white cement if required to match color of cured mortar(s) to surrounding concrete.
 - 2. Bonding agent:
 - a. Acrylic latex bonding agent/admixture for portland cement concrete in accordance with ASTM C1059, Type II (Non-redispersable).
- B. Cement mortar (M1 mortar):
 - 1. Constituent materials: Portland cement, fine aggregate (sand), water.
 - 2. Proportions:
 - a. Ratio of sand to cementitious materials: Same as that used in the surrounding concrete.
 - b. Ratio of water to cementitious materials: Not greater than that used in the surrounding concrete, and not less than that required for hydration of the cement.

- C. Dry-pack mortar (M2 mortar):
 - 1. Constituent materials: Portland cement, fine aggregate (sand), water.
 - 2. Proportions:
 - a. By volume: 1 part portland cement and 2 parts sand.
 - b. Water: Only enough that the resulting mix, after being hand-formed into a ball, will not crumble when touched.
- D. Mortar mix for F4 finish (M4 mortar):
 - 1. Constituent materials: Portland cement, sand, water, and bonding agent.
 - a. Sand: In accordance with ASTM C404 and with not less than 90 percent by weight passing the No. 100 screen.
 - b. Bonding agent: Acrylic latex.
 - 2. Proportions:
 - a. By volume: 1 part portland cement and 1-1/2 parts fine sand.
 - b. Water: Enough water and emulsified bonding agent for the resulting mix to have the consistency of thick paint.
- E. Mortar mix for F5 finish (M5 mortar):
 - 1. Constituent materials: Portland cement, sand, water, and bonding agent.
 - a. Sand: In accordance with ASTM C404 and with not less than 90 percent by weight passing the No. 16 screen.
 - b. Bonding agent: Acrylic latex.
 - 2. Proportions:
 - a. By volume: 1 part portland cement and 1-1/2 parts fine sand.
 - b. Water: Enough water and emulsified bonding agent for the resulting mix to have the consistency of thick paint. Adjust consistency if required.

2.02 EVAPORATION RETARDANT

- A. As specified in Section 03_30_00 - Cast-in-Place Concrete.

2.03 NON-SLIP ABRASIVE

- A. Type: Aluminum oxide abrasive of size 8/16, having structure of hard aggregate. Homogeneous, non-glazing, rust-proof, and unaffected by freezing, moisture, and cleaning compounds.
- B. Manufacturers: One of the following or equal:
 - 1. Abrasive Materials Incorporated, Hillsdale, MI.
 - 2. Exolon Company, Tonawanda, NY.

2.04 CONCRETE SEALERS

- A. Floor sealer and dust-proofer:
 - 1. Non-membrane forming, breathable, non-yellowing, penetrating sealer designed to densify and seal a cured concrete surface.
 - 2. Low odor, VOC content of 0 grams per liter, and stable when exposed to ultraviolet radiation from sunlight.
 - 3. Manufacturers: One of the following or equal:
 - a. Dayton Superior, Day-Chem Sure Hard Densifier (J-17).
 - b. Euclid Chemical Company, Euco Diamond Hard.

- c. L&M Construction Chemicals, Seal Hard.
- d. W.R. Meadows, Liqui-Hard.

PART 3 EXECUTION

3.01 CONCRETE FINISHING - FORMED SURFACES

- A. Scope:
 - 1. Finish formed surfaces with one of the finishes specified in the following paragraphs and as indicated in the Schedule of Concrete Finishes in this Section.
 - 2. Formed surfaces are those surfaces that the plastic concrete is placed against a temporary containment surface that will be removed after the concrete sets and takes its final form.
- B. General:
 - 1. Provide setting and curing time from casting of concrete to removal of forms as specified in Section 03_30_00 - Cast-in-Place Concrete.
 - 2. Provide curing after removal of forms as specified in Section 03_30_00 - Cast-in-Place Concrete.
 - 3. Materials and mixes for finishes:
 - a. Surfaces visible in the finished work, including surfaces above the water line as specified in this Section.
 - 1) Match the color of cured mortar(s) to the surrounding concrete. Adjust mixes as specified in Part 2 of this Section until the match acceptable to the Engineer is obtained.
 - 4. Surface preparation for finishing:
 - a. Filling form tie holes: As specified in Section 03_11_07 - Concrete Formwork.
 - b. Grinding:
 - 1) Where grinding of concrete surfaces is permitted:
 - a) Perform grinding using an iron-free wheel, such as an aluminum oxide wheel, to avoid entrapment of particles that produce rust stains.
 - b) At locations where plastic-protected reinforcing bar supports are used, limit grinding to a maximum depth of 1/16 inch.
 - c. Mortar fill at depressions:
 - 1) Unless otherwise specified, moisture condition depressions and surrounding surfaces prior to, during, and after filling.
 - a) Thoroughly wet surface and maintain visible water for at least 30 minutes.
 - b) Just before placing grout, remove visible water to provide "saturated surface dry" condition.
 - c) Provide and maintain moist curing conditions for at least 7 days after placement.
- C. F1 finish: "Rough Form Finish":
 - 1. Repair defective work.
 - 2. Remove fins and other projections larger than 1 inch.
 - 3. Fill tie holes using plastic M2 (dry-pack) mortar.

4. After removal of any form release agents and curing compounds, fill voids and depressions larger than 1-1/2 inch wide or 1/2 inch deep using M2 (dry-pack) mortar.
 5. Surface irregularity: Not exceeding a 1-inch gap when measured over the length of a 5-foot straightedge.
- D. F2 finish: "Form Finish":
1. Repair defective work.
 2. Remove fins and other projections larger than 1/4 inch.
 3. Fill tie holes using M2 (dry-pack) mortar.
 4. After removal of any form release agents and curing compounds, fill voids and depressions.
 - a. Larger than 3/4 inch wide or 1/2 inch deep: Fill using M1 mortar.
 - b. Larger depressions: Fill using M2 (dry-pack) mortar.
 5. Surface irregularity: Not exceeding a 1/4-inch gap when measured over the length of a 5-foot straightedge.
- E. F3 finish: "Smooth Form Finish":
1. Repair defective work.
 2. Remove fins and other projections larger than 1/8 inch. Grind offsets and rough spots to a height not exceeding 1/8 inch.
 3. Fill tie holes using M2 (dry-pack) mortar.
 4. After removal of any form release agents and curing compounds, fill depressions:
 - a. Larger than 3/4 inch wide or 1/4 inch deep: Fill using M1 mortar.
 - b. Larger depressions: Fill using M2 (dry-pack) mortar.
 5. Top coat tie holes and fill depressions with M1 mortar to provide a uniform appearance.
 6. Leave surfaces with texture that is generally smooth and uniform in appearance.
 7. Surface irregularity: Not exceeding a 1/8-inch gap when measured over the length of a 5-foot straightedge.
- F. F4 finish: "Rubbed Finish":
1. As specified for F3 finish, except prepare surfaces and fill depressions 1/16 inch or larger in depth or width as follows.
 2. Fill depressions.
 - a. "Brush-off" sandblast surfaces to expose depressions and voids near the surface of the concrete.
 - b. Thoroughly wet surfaces and begin filling depressions while surfaces are still damp.
 - c. Use clean burlap, sponge rubber floats, or trowels to rub plastic M4 mortar over the entire surface to be finished. Fill pits, holes, and depressions.
 - d. Wipe surfaces clean. Do not leave any mortar on the surface, except that within the depressions.
 - e. Cure: Moist cure surfaces.
- G. F5 finish: "Stoned Finish":
1. As specified for F3 finish, except add stoned finish as follows:
 2. Fill depressions:
 - a. Wet surfaces thoroughly with brush.

- b. Rub wetted surfaces with a hard wood float dipped in water containing 2 pounds of portland cement per gallon of water.
- c. Rub surfaces until form marks and projections are removed.
- d. Using a brush, spread plastic grindings from the rubbing operation uniformly over the surface. Work the material in to fill pits and small voids.
- e. Cure: Moist cure brushed surfaces for at least 72 hours.
- 3. Finish surfaces:
 - a. After curing, obtain final finish by rubbing with a No. 50 grit carborundum stone.
 - b. Continue rubbing until entire surface has a smooth texture and is uniform in color.
 - c. Cure: Continue curing for remainder of specified time.
- 4. If surfaces have become too hard to finish as specified in the preceding paragraphs, the following alternative procedure may be used:
 - a. Sandblast and wash related surfaces exposed to view, whether finished or not.
 - b. While surfaces are still damp, rub surface with M5 mortar.
 - c. Finish by rubbing surface with No. 60 grit carborundum stone. Add M5 mortar until surface is evenly filled without excess mortar. Continue stoning until surface is hard.
 - d. Moist cure surface for 72 hours.
 - e. After curing, make surface smooth in texture and uniform in color by rubbing with a No. 50 or No. 60 grit carborundum stone.
 - f. Continue curing until 7-day curing period is complete.

3.02 CONCRETE FINISHING - UNFORMED SURFACES

- A. Scope:
 - 1. Finish unformed surfaces with one of the finishes specified in the following paragraphs and as indicated in the Schedule of Concrete Finishes in this Section.
 - 2. Unformed surfaces are those surfaces that are not cast against a temporary containment and the specified finish is achieved by tooling.
- B. General:
 - 1. Concrete placement:
 - a. Place concrete at a rate that allows spreading, straight-edging, and initial floating before bleed water appears.
 - 1) Consider characteristics of concrete mixes used, including potential for accelerating or retarding effects of admixtures, fly ash, and temperatures, on plans for and scheduling of placement and finishing.
 - b. Place, consolidate, strike-off, and screed concrete level to bring surfaces to required planes and lines. Eliminate high and low spots.
 - c. Strike tops of walls and similar surfaces smooth and finish as specified to a texture consistent with that of adjacent formed surfaces.
 - d. After screeding, apply evaporation retardant to concrete surface if weather conditions will result in rapid evaporation of moisture from the surface of the concrete. Do not work evaporation retardant into the surface of the concrete.
 - 2. Floating and re-straightening:
 - a. Float concrete to compact and consolidate the surface.

- b. Initial floating:
 - 1) Provide initial floating immediately after screeding.
 - 2) Perform by hand using a wide bull float, darby, or highway straightedge.
 - 3) Complete before excess moisture or bleed water is present on the surface.
- c. Wait for concrete to stiffen and for the bleed water to stop rising and dissipate before proceeding with edging, hand-tooled jointing, and second floating.
- d. After initial floating, apply evaporation retardant to concrete surface if weather conditions will result in rapid evaporation of moisture from the surface of the concrete. Do not work evaporation retardant into the surface of the concrete.
- e. Second floating:
 - 1) Do not commence until bleed water has dissipated and concrete has stiffened enough to support weight of finishers and finishing equipment.
 - 2) May be by hand, or, if accepted by the Engineer, may be done using a bladed power float equipped with float shoes, or a power disk float.
 - 3) Float surfaces to a true, even plane, with no coarse aggregate visible.
 - 4) Evaporation retardant may not be applied after second floating.
- f. Flatness:
 - 1) Specified tolerances for flatness may require re-straightening of the surface between first and second floating operations and before steel troweling. Re-straighten concrete as required.
 - 2) Modify power equipment with alternate float shoes or other equipment if required to achieve specified flatness.
- 3. Troweling: Where finishes require troweling, conform to the following requirements:
 - a. After surface moisture from floating has disappeared, steel trowel to a smooth, hard, dense concrete surface.
 - b. Provide at least 2 trowelings.
 - 1) Avoid excessive troweling.
 - 2) Use smaller trowels for successive troweling.
 - 3) Make each successive troweling perpendicular to the previous pass.
 - c. Do not add dry cement or additional water to the surface during troweling.
 - d. In lieu of hand steel troweling, a power machine for finishing concrete may be used if accepted by the Engineer.
 - 1) Do not use power machine if concrete has not attained the set necessary to permit finishing without introduction of high and low spots into the concrete surface.
 - 2) Use equipment in full compliance with the manufacturer's recommendations.
 - 3) Use smaller blades or higher pressure for each successive troweling.
 - 4) Hand trowel areas of the concrete not accessible to power equipment.
 - 5) Tolerances for flatness specified may require re-straightening of the surface during finishing. Modify power equipment with alternate shoes or other equipment if required to achieve these requirements.
 - e. Finishing with a fresno trowel or finishing to a "fresno finish" is not allowed.

4. Finishing tolerances:
 - a. Slabs sloped to drain: Finish surfaces to adequately drain toward designated points or lines, regardless of tolerances specified.
- C. S1 finish: "Scratch Finish":
 1. Place, consolidate, and screed concrete level.
 2. Provide initial floating of concrete.
 3. Provide surface in accordance with the "Conventional" floor flatness tolerance requirements of ACI 117 using the manual straightedge method (maximum 1/2-inch gap in 10 feet at 90 percent of locations; maximum 3/4-inch gap at any location), unless otherwise specified.
 4. Before final set, roughen the surface with rakes.
 - a. For sloped surfaces, rake grooves in the direction of drainage.
 - b. Provide roughness equivalent to CSP 6 surface as designated by ICRI Guideline 310.2.
 5. Pressure wash surface to remove laitance before placing grout or toppings.
- D. S2 finish: "Floated Finish":
 1. Place, consolidate, and screed concrete to required elevations and slopes.
 2. Provide initial and second floatings of concrete. Float to a uniform texture.
 3. Provide surface in accordance with the "Flat" floor flatness tolerance requirements of ACI 117 using the manual straightedge method (maximum 1/4-inch gap in 10 feet at 90 percent of locations; maximum 3/8-inch gap at any location), unless otherwise specified.
 4. Remove laitance and leave surface clean.
- E. S3 finish: "Steel Trowel Finish":
 1. Place, consolidate, and screed concrete to required elevations and slopes.
 2. Provide S2 Floated Finish.
 3. Provide 2 trowelings.
 4. Provide finish in accordance with the "Flat" floor flatness tolerance requirements of ACI 117 (maximum 1/4-inch gap in 10 feet), unless otherwise specified.
- F. S4 finish: "Steel Trowel Finish - Free of Trowel Marks":
 1. Finish as specified for S3 Steel Trowel Finish, except that final troweling shall remove all trowel marks from the slab surface.
- G. S5 finish: "Broomed Finish":
 1. Finish as specified for S2 Floated Finish, except modify as follows:
 2. Finish surface by drawing a fine-hair broom lightly across the freshly floated surface.
 - a. Provide resulting roughness for a non-skid surface. Finishing and roughness is subject to review and acceptance by the Engineer.
 - b. Direction of brooming:
 - 1) General:
 - a) In same direction of and parallel to expansion joints.
 - b) Perpendicular to primary direction of traffic.
 - 2) For sloped slabs, parallel to the direction of drainage.
 - 3) For round roof slabs, in the radial direction.

- H. S6 finish: "Non-Slip Abrasive Finish":
 - 1. Place, consolidate, and screed concrete to required elevations and slopes.
 - 2. Provide initial floating of surface.
 - 3. Prepare and apply abrasive as recommended by the manufacturer.
 - a. Apply using a shake screen or other accepted method to ensure even coverage without segregation of the abrasive.
 - b. Install abrasive at a rate of 25 pounds for each 100 square feet of surface area.
 - 4. After concrete has hardened enough to support the weight of a person and unless otherwise specified by the abrasive manufacturer, apply approximately 2/3 of the abrasive material required for coverage.
 - 5. Finish as specified for S2 Floated Finish, except that re-floating is not required.
 - 6. Apply remaining abrasive material at right angles to the first application and in locations necessary to provide the minimum specified thickness.
 - 7. Immediately after the second application, re-float the surface to embed abrasive.
 - 8. Finish as specified for S2 Steel Trowel Finish. Trowel abrasive into the surface, properly exposing material to produce a non-slip finish.
- I. Concrete sealer:
 - 1. See Room Finish Schedule Drawings for locations of floors and slabs receiving concrete sealer finish.
 - 2. Apply sealer in accordance with the manufacturer's instructions.

3.03 FIELD QUALITY CONTROL

- A. Provide field quality control for the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Field quality control by the Contractor:
 - 1. Field inspections and testing:
 - a. Submit records of inspections and testing to the Engineer within 24 hours after completion.
 - 2. Manufacturer's services.
 - a. Non-slip abrasive finish. Before beginning installation, conduct pre-installation meeting with the manufacturer's technical representative to review product use and installation requirements.
- C. Field quality control by the Owner:
 - 1. Special inspections, special tests, and structural observation:
 - a. Not required.
 - 2. Field inspections:
 - a. Observe construction for conformance to the Contract Documents and the accepted Submittals.
 - b. Provide record of each inspection. Submit copies to the Engineer upon request.

3.04 NON-CONFORMING WORK

- A. Unsatisfactory finishes that have hardened will require removal, grinding, topping, or other correction acceptable to the Engineer.

B. Requirements as specified in Section 03_30_00 - Cast-In-Place Concrete.

3.05 SCHEDULE OF CONCRETE FINISHES

A. Formed surfaces: As specified in Table A below.

B. Unformed surfaces: As specified in Table B below.

Table A: Concrete Finishes - Formed Surfaces				
Elements	Location	Surface Exposure	Finish	Notes
Exterior Surfaces:				
Walls, columns, slab edges	Wet structure	Above grade or water line		
		Exposed to view	F4	
		Covered	F2	1a
		Below grade or water line		
		No coating	F1	
		Bituminous coating	F2	
		Waterproofing	F3	
	Dry structure	Above grade line		
		Exposed to view	F4	
		Covered	F2	1a
		Below grade line		
		No coating	F1	
		Bituminous coating	F2	
		Waterproofing	F3	
Interior Surfaces:				
Walls, columns, slab edges	Wet structure	Open basin		
		Above water line	F4	
		Below water line	F3	
		Covered basin		
		Above water line	F3	
		Below water line	F3	
	Dry structure	Exposed to view	F4	
		Covered	F2	1b
Overhead slabs and beams	Wet structure	Open basin	F3	1c, 1d
		Covered basin	F2	1d
	Dry structure	Exposed	F3	1c, 1d
		Covered by ceiling	F1	1d
Notes:				
(1a) Coverings include additional surfaces applied over the concrete, such as veneer, stucco, plaster, etc.				
(1b) Coverings include additional surfaces applied over the concrete, such as veneer, stucco, plaster, furring strips with drywall, etc.				
(1c) Applies to overhead surfaces visible from normal pedestrian travel routes.				
(1d) At overhead slabs and beams, patch tie holes on sides of members.				

Table B: Concrete Finishes - Unformed Surfaces				
Element	Location	Exposure	Finish	Notes
Exterior Surfaces:				
Footings	Extensions	Exposed	S3	
		Covered by soil	S2	
Slabs and beams - exposed	Walking or possible walking paths	Tops of treatment structures	S5	2a, 2b, 2g, 2h
		Stairs and landings	S5	
	Roofs	Exposed	S5	
		Covered by roofing	S2	
Slabs and beams - submerged	Unless otherwise noted	All	S5 if concrete is air entrained	2g
Walls, corbels	Top of wall or corbel	All	S3	One troweling
Sidewalks	All		S5	
Equipment slabs	All		S5	
Interior Surfaces:				
Floor slabs, includes flat and sloping surfaces	Wet structure	Exposed		
		Basins and channels	S3	
		Covered		
		To receive basin bottom grout	S1	2e
		To receive concrete fill	S1	2f
	Dry structure	Exposed		
		Pipe galleries	S4	2c
		Stairs and landings	S4	2d
		Shops and garages	S4	
		Equipment rooms	S4	
		Covered		
		Tile on mortar bed	S2	
		Resilient flooring	S3	
		Carpet	S3	

Notes:

(2a) Includes slabs covering tanks, basins, channels and similar structures.

(2b) Includes tops of walls or beams that serve as walkways.

(2c) In galleries with slabs subject to wetting, provide broom finish (S5) where indicated on the Drawings.

(2d) Provide broom finish (S5) where indicated on the Drawings.

(2e) Finish for basin bottom grout: As specified in Section 03_60_01 - Basin Bottom Grout.

(2f) Finish for concrete fill: See floor slab, wet structure, exposed basins and channels.

(2g) Slabs include flat and sloping surfaces.

(2h) Includes top of vault slabs exposed to traffic.

END OF SECTION

SECTION 03_48_53

PRECAST CONCRETE UTILITY STRUCTURES AND PRODUCTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Precast concrete products manufactured to ASTM industry standards.
- B. Alternates:
 - 1. Contractor may propose to construct cast-in-place structures in lieu of the precast structures specified.
 - a. Obtain the Engineer's acceptance of this alternative before submitting, providing, or installing.
 - b. Submit full information on design and detailing of proposed alternatives, including design details and drawings of the same types required by this Section for precast structures.

1.02 REFERENCES

- A. American Association of State Highway Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- B. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 2. 350 - Code Requirements for Environmental Engineering Concrete Structures.
- C. ASTM International (ASTM):
 - 1. A48 - Standard Specification for Gray Iron Castings.
 - 2. C443 - Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
 - 3. C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
 - 4. C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 5. C858 - Standard Specification for Underground Precast Concrete Utility Structures.
 - 6. C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
 - 7. C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
 - 8. C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
 - 9. C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint.
 - 10. C1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

11. C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
 12. C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates.
 13. C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
 14. C1433 - Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.
 15. C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
 16. C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
- D. Code of Federal Regulations (CFR):
1. Title 29, Chapter XVII, Part 1910 - Occupational Safety and Health Standards (OSHA).
- E. National Fire Protection Association (NFPA):
1. 70 - National Electrical Code (NEC).
- F. National Precast Concrete Association (NPCA).
- G. Society of Cable Telecommunications Engineers (SCTE):
1. 77 - Specification for Underground Enclosure Integrity.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
1. Culvert: A single cell precast box element open on opposing faces intended to be used to form a linear structure to convey stormwater or sewage.
 2. Drainage inlet: A drainage structure that collects and diverts stormwater into a below grade conveyance system.
 3. Handhole: An enclosure for use in underground electrical systems that has been sized and detailed to allow personnel to reach into, but not enter, the enclosure to install, operate, or maintain equipment or wiring or both.
 4. Manhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to enter the enclosure to access, install, operate, or maintain equipment, wiring, or clean or service piping. As specified in this Section, manhole may refer to a sewer manhole, stormwater manhole, or electrical manhole.
 5. Precast concrete: A concrete fabrication designed by a qualified engineer and subsequently fabricated at a qualified fabrication site, which is usually located some distance from the site where the fabrication will be installed.
 6. Vault: A below grade enclosure designed to house equipment or instrumentation.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Shop Drawings and calculations for precast concrete utility products.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures and Section 01_60_00 - Product Requirements.
- B. Product data:
 - 1. Manufacturer's catalog data, details, and warranties for the following items.
 - a. Materials of construction.
 - b. Joint details and joint-sealing materials.
 - c. Data for hatches or covers and frames.
 - d. Threaded lifting inserts.
 - e. Preformed channels and accessories for cable racking.
 - f. Drain and sump details, including removable covers.
 - g. Pulling iron details.
- C. Delegated Design Submittals:
 - 1. Shop Drawings:
 - a. Dimensioned plans, sections, and details drawn to scale for each structure, including:
 - 1) Layout plan for that structure.
 - 2) Sizes, locations, and vertical positions of pipe penetrations, duct bank windows, and knockout panels.
 - 3) Locations and details for access openings and sumps.
 - 4) Details of structural reinforcement showing bar size and spacing; true position of reinforcement in structural members with clear concrete cover at both inside and outside faces; location, bar size, and spacing of added reinforcement around openings; and other details relevant to design and fabrication of the structure.
 - 5) Details of joints between adjacent precast sections, including provisions for overlap and for placement of sealants.
 - 6) Locations and details of pulling irons, embedded cable supports, and racks.
 - 2. Calculations:
 - a. Submit calculations that demonstrate the adequacy of the precast to support the required loads:
 - 1) Temporary loads during manufacture, including casting, handling, transportation, and installation.
 - 2) Specified final soil, fluid, and live loads.
 - 3. Concrete mix design.
 - a. Submit full mix design that includes the following:
 - 1) Concrete mix design: For each concrete mix design to be used for the structures, include data describing:
 - a) Concrete mix proportions and design strength.
 - b) Source and type of cement and supplemental cementitious materials.

- c) Sources, grading, and specific gravities of aggregates.
 - d) Aggregate reactivity data.
 - (1) ASTM C1260 and ASTM C1293 test results for:
 - (a) Coarse aggregate.
 - (b) Fine aggregate.
 - (2) If reactivity test results of either coarse or fine aggregates indicates a potential for reactivity, indicate the method by which the risk reduction measures of ASTM C1778 are satisfied. See Design and Performance Criteria in this Section for durability requirements.
 - e) Type, name, and dosage of admixtures included in the concrete mix.
- D. Installation instructions:
 - 1. Detail the complete installation of the equipment, including rigging, moving, and setting into place.
 - 2. Provide manufacturer's installation instructions.
 - 3. Instructions for operation and maintenance of hatches.
- E. Quality Control Submittals:
 - 1. Test reports:
 - a. Manufacturer's tests for compressive strength of concrete used in products, made in accordance with the specified ASTM requirements.
 - b. Reinforcing steel: Mill certificates.
 - c. Manufacturer's inspection reports in accordance with ASTM C1037.
 - 2. Certificates:
 - a. Manufacturer's current plant certification under NPCA for the products to be supplied.
 - 1) Certification shall be current and in effect at the time products are manufactured.
 - b. Manufacturer's certification that the precast products are in accordance with the requirements of the standard specified in Part 2.
- F. Project record documents:
 - 1. Final, revised plans and details of as-constructed precast concrete products if requested for record by the Engineer.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Holding current NPCA plant certification for the products produced.
 - b. Demonstrating at least 5 years of experience in the design, production, and installation of products of the type required for this Work.
 - c. Capable of providing structural designs in the state where the products will be installed.
 - d. Providing inspection during fabrication and handling in accordance with the requirements of ASTM C1037.
 - e. Provide permanent quality control department and laboratory facility capable of performing inspections and testing as specified in this Section.

2. Installer:
 - a. Capable of providing equipment of adequate capacity and mobility to handle and set units with proper bearing on the subgrade and without damage to the unit.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements, and the manufacturer's instructions.
- B. Packing, shipping, handling, and unloading:
 1. Package and brace structures to avoid damage during shipping and handling.
 2. Furnish crane or forklift for unloading and setting of the precast concrete products. Equipment shall be rated to lift the intended load.
 3. Transport and handle precast products in accordance with the manufacturer's instructions.
 - a. Where lifting devices are provided in precast sections, such lifting devices shall be used as intended.
 - b. Where no lifting devices are provided, follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.
 - c. Dragging or dropping of precast concrete products are not permitted.
- C. Acceptance at Site:
 1. Structures delivered to the Site with cracks, damage, and damaged or missing accessories shall be removed from the Site and replaced at no additional cost to the Owner.
 2. Furnish labor necessary to assist the Engineer in inspecting manholes upon delivery.
- D. Storage and protection:
 1. Store precast concrete utility structures, products, and their appurtenances in areas protected from damage due to weather and Site operations.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING

- A. Coordinate installation of precast electrical handholes and manholes with duct banks specified in Section 26_05_44 - Duct Banks.

1.10 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.
- B. Provide manufacturer's standard warranty for precast products and accessories.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Design, manufacture, and install precast concrete members as indicated on the Drawings and specified.
- B. Design and detail precast concrete members and connections to withstand design loads indicated, to maintain clearances at openings; to allow for fabrication and installation tolerances.
 - 1. Analyze and design structures, including the effects of 2-way action ("plate action") and of load transfer around current and future openings.
 - 2. Where structures include panels designed for future removal ("knockout panels"), design structures for loads and stresses with any combination of any or all such panels in place or removed.
 - 3. Design structures in accordance with the requirements of ACI 318 or AASHTO Standard Specifications for Highway Bridges and this Section.
 - 4. Provide reinforcement at areas subject to tensile stress when loaded with the specified loads and combinations thereof.
- C. Unless otherwise indicated on the Drawings, design precast products as follows:
 - 1. Use "roadway" load designation for all utility structures located in or within 15 feet of roadways.
 - 2. Use "sidewalk" load designation for all utility structures that do not require "roadway" designation.
- D. Structural analysis, including loads on structures, and design:
 - 1. For structures designated to be in accordance with ASTM C857, follow the requirements of that standard, except as modified in this Section as follows:
 - a. Vehicle and pedestrian loadings in the following paragraphs need not be additive, however, structures designated for "roadway" loading shall also support "sidewalk" loads.
 - 1) Sidewalk: Load from regular pedestrian traffic with considerations for occasional non-deliberate vehicular traffic: Designation A-0.3 in ASTM C857, Table 1 (300-psf uniform load).
 - 2) Roadway: Load from heavy, frequently repeated vehicle traffic: Designation A-16 in ASTM C857, Table 1 (AASHTO HS20-44).
 - b. Lateral earth pressure loads: Determine in accordance with the following requirements. Include effects of groundwater and seismic accelerations on lateral earth pressures.
 - 1) Equivalent lateral pressure (at-rest): 55 pounds per square foot per foot of depth (triangular distribution).
 - 2) Surface surcharge load:
 - a) Backfill-induced live load surcharge of 120 pounds per square foot (rectangular distribution).

- b) In accordance with ASTM C857 Vehicle Load Designation A-16 for Roadway, or A-0.3 for Sidewalk, where such surcharge exceeds backfill loads described in the preceding paragraph.
 - 3) Groundwater effects:
 - a) Include effects from groundwater and soils saturated by flooding using design elevations specified in Section 01_81_50 - Design Criteria.
 - 4) Seismic design:
 - a) As specified in Section 01_81_50 - Design Criteria.
 - b) Equivalent lateral pressure (active): 55 pounds per square foot per foot of depth (triangular distribution).
 - c) On opposite sides of the structure that are perpendicular to the direction of acceleration, include equivalent lateral pressure (inverted fluid pressure distribution), beginning with a pressure of 0 at the base of the structure, and increasing at a rate of 32 pounds per square foot per foot of rise toward the ground surface.
 - d) Apply seismic effects as additive force on side where the soil mass is being accelerated toward the structure, and as subtractive force on the opposite side where the soil mass is being accelerated away from the structure.
- c. Groundwater and flood loads - buoyancy effects:
 - 1) As specified in Section 01_81_50 - Design Criteria, for design groundwater and design flood elevations.
 - 2) Buoyancy: For groundwater and flood conditions, provide factor of safety against flotation of at least 1.20.
 - a) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 30 pounds per cubic foot.
- d. Soil-bearing pressure at base:
 - 1) Maximum 1,000 pounds per square foot total pressure on prepared subgrade soils or pressure not greater than the weight of the vertical column of soil removed (assuming a soil unit weight of 125 pounds per cubic foot).
- e. Lifting and handling loads:
 - 1) Make provision in the design for the effects of loads or stresses that may be imposed on structures during fabrication, transportation, or installation.
- f. Load combinations:
 - 1) Design structures to sustain the specified loads individually or in combination.
- 2. For structures designated to be in accordance with ASTM C890, follow the specified design requirements for loads, except as modified for hydrostatic load as follows:
 - a. Hydrostatic load:
 - 1) Design for dead, live, lateral earth pressures, seismic loads, groundwater and flood loads, soil-bearing pressure, lifting and handling loads as specified for structures to be designed for ASTM C857.
 - a) As indicated on the Drawings, for design fluid elevations.

- E. Materials:
1. Proportion cement, supplemental cementitious materials, aggregates, admixtures, and water in accordance with the specified ASTM standard.
 2. Proportion cement, supplemental cementitious materials, aggregates, admixtures, and water that provides at least the minimum level of durability performance required in accordance with ACI CODE-350 for the following exposure category:
 - a. Freeze-thaw resistance: Exposure Category: EF2
 - b. Corrosion resistance: EC2.
 3. Aggregate reactivity.
 - a. If reactivity test results of either coarse or fine aggregates indicates a potential for reactivity, the concrete mix design shall be proportioned with an appropriate supplemental cementitious material to mitigate the potential risk of aggregate silica reaction in accordance with either the performance-based approach or the prescriptive-based approach of ASTM C1778.
 - 1) If the performance-based approach is used, ASTM C1567 and ASTM C1293 test results must be available.
 - 2) If the prescriptive-based approach is used, the following parameters shall be assumed:
 - a) Concrete is exposed to humid air, buried, or immersed.
 - b) Structure classification based on the severity of consequences: SC3 (Precast elements in which economic costs of replacement are severe).

2.03 GENERAL

- A. Identification markings: Provide identification marks on the exterior of bases, risers, grade rings, and include the following information:
1. Date of manufacture of the item.
 2. Name or trademark of the manufacturer.
 3. Internal dimensions in inches.
 4. Number of the precast structure as indicated on the Drawings.
- B. Precast products shall be solid walled construction.
1. Where penetrations of the precast concrete walls are required for piping, conduit, or ductbanks, such penetrations shall be accommodated through precast openings or core-drilled sections.
 2. Wall openings shall be smooth and free of surface irregularities and without exposed steel reinforcing.
 3. Precast need not be designed to resist thrust from piping passing through the vault unless indicated on the Drawings.
 4. Coordinate opening locations with piping or ductbank arrangement as indicated on the Drawings.
- C. Joints in precast products:
1. Construct floors as a monolith. Where sump or low-point drain is included, slope floor to that point.
 2. Where joints are designed in precast concrete products, such joints shall be interlocking to secure proper alignment between members and prevent

- migration of soil or water through the joint. Provide structures with non-skid, shiplap or tongue and groove joints between sections.
3. Joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
 4. Seal joints watertight with precast concrete joint sealant as specified in this Section.
 5. Provide structures with watertight joints between sections and detailed to minimize water infiltration at duct bank and conduit penetrations.

2.04 PRECAST CONCRETE VAULTS

- A. Includes reinforced precast concrete section comprised of one or more components that, when properly assembled in the field, forms a vault that houses piping or instrumentation.
- B. Manufacturers:
 1. One of the following or equal.
 - a. Jensen Precast.
 - b. Oldcastle Precast.
- C. Design basis:
 1. Furnish precast concrete vaults in accordance with the requirements of ASTM C858.
 2. Furnish products of nominal sizes as indicated on the Drawings.
 3. Structural design in accordance with ASTM C858 and the requirements of ASTM C857, and Design and Performance Criteria in this Section.
- D. Materials:
 1. Concrete in accordance with ASTM C858 and as specified in this Section.

2.05 PRECAST CONCRETE MANHOLES

- A. Precast concrete manholes include grade rings, flat slab tops, conical tops, risers, and base sections.
- B. Manufacturers:
 1. One of the following or equal:
 - a. Jensen Precast.
 - b. Oldcastle Precast.
- C. Design basis:
 1. Furnish precast concrete manholes that are in accordance with the requirements of ASTM C478.
 2. Furnish products of nominal sizes as indicated on the Drawings.
 3. Structural design in accordance with the prescriptive requirements of ASTM C478 and Design and Performance Criteria in this Section.
 4. Maximum elevation from top of conical top section to final grade: 18 inches.
 5. Furnish grade rings in 1 or 2 sections.

- D. Materials:
 - 1. Concrete in accordance with ASTM C478 and as specified in this Section.

2.06 PRECAST CONCRETE ELECTRICAL MANHOLES AND HANDHOLES

- A. Precast concrete manholes and handholes include reinforced precast box sections comprised of one or more components that, when properly assembled in the field, form a vault that may be used to route electrical conduits and conductors or house electrical or instrumentation equipment.
- B. Design basis:
 - 1. As specified in Section 26_05_00 - Common Work Results for Electrical for general requirements for electrical work.
 - 2. Furnish products of nominal sizes as indicated on the Drawings.
 - 3. Precast concrete manholes and handholes in accordance with the requirements of ASTM C858.
 - 4. In accordance with the requirements of the NEC.
 - 5. Structural design in accordance with the requirements of ASTM C857 and specified in this Section.
 - 6. Install embedded items with provisions for drainage to remove dripping or standing water, and to minimize corrosion.
 - a. Pulling irons may not be placed on the floor or in pockets that will collect water.
 - b. Detail bottom of cable rack channels to provide a downward sloping "sill" at the bottom of each vertical channel, so that the channel slot drains toward the floor.
- C. Manufacturers:
 - 1. One of the following or equal:
 - a. Jensen Precast.
 - b. Oldcastle Precast.
- D. Materials:
 - 1. Concrete in accordance with ASTM C858 and as specified in this Section.
- E. Tests and inspections:
 - 1. In accordance with ASTM C858 and ASTM C1037.

2.07 APPURTENANCES

- A. Ladders and manhole rungs:
 - 1. Ladders:
 - a. In accordance with OSHA Subpart D, Requirements for walking and working surfaces.
 - b. FRP as specified in Section 06_80_17 - Fiberglass Reinforced Plastic Fabrications.
 - 2. Manhole rungs:
 - a. Copolymer or fiberglass manhole rungs in accordance with OSHA Subpart D, Requirements for walking and working surfaces.

- B. Floor access doors:
1. Aluminum plate hinged floor access door (hatch) as specified in Section 08_31_14 - Floor Access Doors with load rating as follows:
 - a. "Heavy Duty" for covers at locations designated for "roadway" loads.
 - b. "Medium Duty" or stronger for covers at locations designated for "sidewalk" loads.
 2. Minimum access door size not less than 36 inches square, unless otherwise indicated on the Drawings.
 3. Provide bearing surface with pre-installed continuous elastomeric gasket to minimize water infiltration at lid.
 4. Provide skid-resistant lid with cast-in or machined-in grid pattern and the word "ELECTRICAL" in block letters at least 1.5 inches high.
- C. Manholes: Frame and cover:
1. Manhole rings and covers: As specified in Section 05_50_00 - Metal Fabrications.
 2. Manhole rings and covers:
 - a. Gray cast iron in accordance with ASTM A48, Class 30B with ring and cover machined to fit with flat bearing surfaces.
 - b. Cover with the word "ELECTRICAL" cast into the top exposed face for electrical manholes.
 - c. Manhole riser access:
 - 1) Heavy-duty bottom flange frame with solid cover for placement on grade adjustment rings above top slab.
 - 2) 36-inch diameter nominal opening.
 - 3) Manufacturers: The following or equal.
 - a) Neenah Foundry Co., R1640-D.
 - d. Embedded in top slab of structure:
 - 1) Heavy-duty top flange frame with solid cover for embedment in top slab of a structure.
 - 2) 36-inch diameter nominal opening.
 - 3) Manufacturers: The following or equal.
 - a) Neenah Foundry Co., R6095.
- D. Threaded lifting inserts:
1. Furnish devices that are fully threaded inserts cast into the precast concrete.
 2. Do not use reinforcing steel bars.
 3. Do not fully penetrate through entire precast product.
 4. Provide lifting device compatible with spreader bar and chains, hooks and slings.
 5. Design with minimum safety factor of 4.0.
- E. Cable racks and racking hardware:
1. Materials: Stainless steel as specified in Section 26_05_29 - Hangers and Supports.
 2. Embedded slots: Maximum depth of 1.5 inches.
- F. FRP grating:
1. As specified in Section 06_80_17 - Fiberglass Reinforced Plastic Fabrications.

2.08 OTHER MATERIALS

- A. Coatings:
 - 1. Dampproofing: As specified in Section 07_11_00 - Dampproofing.
- B. Joint sealant:
 - 1. Preformed, cold applied flexible joint sealant in accordance with ASTM C990 and ASTM C443.
 - 2. Manufacturers:
 - a. One of the following or equal.
 - 1) Henry Corp., Ram-Nek.
 - 2) Kent Seal - Hamilton Kent Corp.
 - 3. Physical properties:
 - a. Hydrocarbon content: 50 to 70 percent.
 - b. Inert mineral filler: 30 to 50 percent by weight.
 - c. Volatile matter: 2.0 to 3.0 percent by weight lost when heated for 5 hours at 325 degrees Fahrenheit.
 - d. Specific gravity: 1.20 to 1.35 at 77 degrees Fahrenheit.
 - e. Ductility: 5.0 at 77 degrees Fahrenheit.
 - f. Softening point: 320 degrees Fahrenheit.
 - g. Sag or flow: None.
 - h. Chemical resistance: No reaction when exposed for 30 days by 5 percent sulfuric acid, potassium hydroxide, caustic potash, and hydrochloric acid; and saturated hydrogen sulfide solution.
 - 4. Precast concrete joint sealer primer: As recommended by the precast concrete joint sealer manufacturer.

2.09 SOURCE QUALITY CONTROL

- A. Source Testing (Factory Acceptance Tests):
 - 1. As specified in Section 01_75_17 - Commissioning.
 - 2. Precast concrete manholes:
 - a. Perform pre-production and post-production tests by the manufacturer.
 - b. Examine each completed manhole section for dimensional requirements, strength, and workmanship.
 - c. Complete required testing in accordance with ASTM C478.
 - 3. All tools and equipment shall have current calibrations.
 - 4. Furnish test reports and the Manufacturer's Certificate of Source Testing.

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish and install precast concrete products as indicated on the Drawings and specified.
- B. Manufacturer shall make available services of representative throughout the project duration when deemed necessary by the Engineer.

3.02 PREPARATION

- A. Site preparation:
 - 1. Excavate and prepare exposed subgrade as indicated on the Drawings and as specified.
 - 2. Install and compact foundation layer as indicated on the Drawings and specified.
 - 3. Level foundation materials so that structures will be set plumb and duct banks will be at proper grade and alignment.
 - a. Install with uniform bearing on foundation materials.
 - b. Wedging or blocking of base sections for leveling over the foundation materials will not be permitted.

3.03 INSTALLATION

- A. General:
 - 1. Protect precast concrete utility structures from displacement, flooding, or flotation.
 - 2. Install structures in accordance with ASTM C891 and as specified in this Section.
 - a. In the event of conflicts, the more restrictive provisions shall apply.
 - 3. Clean and prime joints between adjacent precast sections.
 - a. Install joint sealant between sections in accordance with the manufacturer's instructions and provide watertight joints.
 - 4. Set manhole covers and floor access doors at elevations indicated on the Drawings.
 - a. Lay grade rings in joint sealant with sides plumb and tops level. Securely attach frames to top of precast structures or grade rings.
 - 5. Penetrations:
 - a. Holes for duct banks, piping, and other penetrations may not be cut into precast products unless they are located at designated locations shown on the Shop Drawings or at knockout panels cast into the structure during manufacturing.
 - b. Carefully remove concrete from knockout panel areas with saws.
 - 1) Ensure that break-back does not extend beyond the designated limits of the knockout panel.
 - c. Coat any reinforcement cut or exposed during removal of knockout panel sections with minimum 2 coats of high solids epoxy as specified in Section 09_96_01 - High-Performance Coatings.
 - 1) Apply epoxy coating applied over and at least 1 inch past the perimeter of the reinforcement.

6. Install duct banks, conduit, and pipe penetrations in accordance with the penetration details indicated on the Drawings.
 - a. Place joint fillers, caulks, and sealants before coating exterior concrete surface with bituminous dampproofing.
 7. Fill blockouts that were provided for threaded lifting inserts or other temporary purposes with non-shrink cement grout using procedures as specified in Section 03_60_00 - Grouting, unless otherwise detailed by the manufacturer.
 8. After structures are set and before backfilling, coat exterior below-grade surfaces (around the sidewalls, over the top slab, around any vertical risers to grade, and to face of grade rings) with 2 heavy coats of bituminous dampproofing as specified in Section 07_11_00 - Dampproofing.
 - a. Mask over at least 1 inch back from joint caulks or sealants and prevent dampproofing from coming in contact with those materials.
 - b. Apply dampproofing in accordance with the coating manufacturer's instructions and at a rate of 40 to 60 square feet per gallon per coat.
 - c. Allow dampproofing to dry sufficiently before backfilling.
 9. Backfill precast concrete products as indicated on the Drawings and as specified in Section 31_00_00 - Earthwork.
- B. Site tolerances:
1. Set precast concrete products plumb and true at locations indicated on the Drawings.
 2. Tolerances on placing:
 - a. Horizontal location: Within 1 inch.
 - b. Vertical elevation: Within 1/2 inch.
 - c. Plumb: Within 1/8 inch over 10 feet.

3.04 REPAIR/RESTORATION

- A. Repair cracks or blemishes in concrete as specified in Section 03_30_00 - Cast-in-Place Concrete. Submit proposed repairs for acceptance before commencing work.

3.05 FIELD QUALITY CONTROL BY CONTRACTOR

- A. As specified in Section 01_45_00 - Quality Control.

3.06 FIELD QUALITY CONTROL BY OWNER

- A. Special tests and inspections: As specified in Section 01_45_24 - Regulatory Quality Assurance.
- B. Field tests:
1. Engineer may request, at any time, additional testing to confirm materials being delivered and placed conform to the requirements of the Contract Documents.
 - a. If such additional testing shows that the material do not conform to the specified requirements, the Contractor shall pay the cost of these tests.
 - b. If such additional testing shows that the materials do conform to the specified requirements, the Owner will pay the cost of these tests.

3.07 ADJUSTING

- A. After final grading is complete, adjust access covers to grade.

3.08 CLEANING

- A. Remove concrete spoil, other construction material, forms, debris, silt, dust, and other foreign material.

3.09 SCHEDULES

- A. See Drawings for Electrical Handhole and Electrical Manhole Schedule.

END OF SECTION

SECTION 03_48_55

POLYMER CONCRETE ELECTRICAL HANDHOLES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Polymer concrete handholes and accessories.

1.02 REFERENCES

- A. American Association of State Highway Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- B. ASTM International (ASTM):
 - 1. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
- C. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code (NEC).
- D. Society of Cable Telecommunications Engineers (SCTE):
 - 1. 77 - Specification for Underground Enclosure Integrity.
- E. Underwriters Laboratories (UL).

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Handhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to reach into, but not enter, the enclosure to install, operate, or maintain equipment or wiring or both (Reference: NEC, Article 100).
 - a. As used in this Section, handhole will refer to a precast electrical handhole.
 - 2. Polymer concrete: A composite material consisting of an organic polymer binder mixed with embedded aggregate particles. Also known as "resin concrete."
 - a. Abbreviated PC as in PC HANDHOLE.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Shop Drawings for polymer concrete electrical handhole.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures and Section 01_60_00 - Product Requirements.
- B. Product data:
 - 1. Manufacturer's catalog data, details, and warranties for the following items.
 - a. Materials of construction, and resistance of those materials to water absorption, flammability, sunlight/ultraviolet exposure, and chemicals likely to be found in the area of use.
 - b. Available colors.
 - c. Details for covers, cover support, and cover attachment to the underlying box.
- C. Delegated Design Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's catalog cuts showing dimensions and details of construction.
 - b. Dimensioned and to-scale plans, sections, and details for each structure, including:
 - 1) Layout plan for that structure.
 - 2) Sizes, locations, and vertical positions of duct bank windows and knockout panels.
 - 3) Locations and details for access openings, pulling irons, embedded cable supports and racks, and sumps.
 - 4) Details of joints between adjacent sections, including provisions for overlap and for placement of sealants.
- D. Samples:
 - 1. Polymer concrete handholes.
- E. Installation instructions:
 - 1. Detail the complete installation of the equipment, including rigging, moving, and setting into place.
 - 2. Provide manufacturer's installation instructions.
- F. Quality Control Submittals:
 - 1. Test reports:
 - a. Independent laboratory test reports bearing the seal of a licensed professional engineer and demonstrating compliance with the requirements of SCTE 77 for the loading conditions specified.
 - 2. Certificates:
 - a. Manufacturer's certification that polymer concrete handholes are in accordance with the requirements of SCTE 77 and the load rating specified in this Section.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Demonstrating at least 5 years of experience in the design and production of products of the type required for this Work.
 - b. Holding product testing records demonstrating load resistance of products to be installed.
 - 2. Installer:
 - a. Capable of providing equipment of adequate capacity and mobility to handle and set units with proper bearing on the subgrade and without damage to the unit.
- B. Polymer electrical handholes shall be UL listed.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements and the manufacturer's instructions.
- B. Packing, shipping, handling, and unloading:
 - 1. Package and brace structures to avoid damage during shipping and handling.
- C. Acceptance at Site:
 - 1. Structures delivered to the Site with cracks, damage, and damaged or missing accessories shall be removed from the Site and replaced at no additional cost to the Owner.
- D. Storage and protection:
 - 1. Store handholes and their appurtenances in areas protected from damage due to weather and Site operations.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING

- A. Coordinate installation of polymer concrete electrical handholes with duct banks specified in Section 26_05_44 - Duct Banks.

1.10 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.
- B. Provide manufacturer's standard warranty for polymer concrete handhole structures and accessories.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Enclosures, boxes, and cover shall be in accordance with test provisions of SCTE 77.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Design, fabricate, and install polymer handholes of the size and type indicated on the Drawings and specified.
- B. Provide structures of the sizes and shapes indicated on the Drawings, with layouts, dimensions, and details as indicated on the Drawings and as specified.
 - 1. In accordance with the requirements of:
 - a. NEC.
 - b. Project regulatory requirements as specified in Section 01_41_00 - Regulatory Requirements.
- C. Load resistance of boxes and covers:
 - 1. In accordance with provisions of SCTE 77 for Tier 5, 8, 15, or 22 applications as specified in this Section.
 - a. Where multiple tiers are specified, handholes shall adequately support compatible covers while providing the highest tier rating specified.
 - b. Load rating of cover for an assembly shall not exceed the load capability of the box below.
 - c. Coefficient of friction of top of cover: Not less than 0.50 when measured in accordance with ASTM C1028.
- D. Load rating:
 - 1. Provide "TIER" rating based on the Electrical Handhole and Manhole Schedule indicated on the Drawings and the following loading requirements:

Surface Loading Rating	Requirements
Sidewalk	TIER 22 - Medium Duty: For driveway, parking, and ramp areas where vehicle wheel loads will not exceed 2,000 pounds on a single wheel.
Roadway	Not allowed: Do not use polymer concrete handhole.

- 2. Provide covers with the tier rating embossed or cast into the top surface.
- 3. Design load rating of cover for an assembly may not exceed the design load rating of the box below.

2.03 MANUFACTURERS

- A. The following or equal:
 - 1. Quazite Division of Hubbell, Incorp.

2.04 MANUFACTURED UNITS

- A. Materials:
 - 1. Polymer concrete with optional fiberglass reinforcement.
 - a. Handholes constructed of plastic or fiberglass will not be permitted.
- B. Components:
 - 1. Cover:
 - a. Provide gasketed cover with lifting slot and stainless steel hex head bolts for attachment to box.
 - b. Fasten cover to box using stainless steel hex head bolts.
 - c. Skid-resistant surface: Coefficient of friction for walking surface on top of cover shall be at least 0.50 when measured in accordance with ASTM C1028.
 - d. Custom logo not required.
 - 2. Box:
 - a. Open-bottom base unless otherwise indicated on the Drawings.
 - 1) Stackable sections with interlocking joints to maintain horizontal and vertical alignment.
 - b. Provide knockouts, terminators, pulling eyes, and inserts as required for a complete installation.
 - 3. Fabrication:
 - a. Components in assembly (boxes and cover) shall be manufactured using matched surface tooling for consistency of production.
- C. Accessories:
 - 1. Provide 2 non-corroding steel lifting hooks for removing covers.

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish and install polymer concrete electrical handholes as indicated on the Drawings and specified.

3.02 PREPARATION

- A. Site preparation:
 - 1. Excavate and prepare exposed subgrade as indicated on the Drawings and as specified.
 - 2. Install and compact foundation layer as indicated on the Drawings and specified.
 - 3. Level foundation materials so that structures will be set plumb, and duct banks will be at proper grade and alignment.
 - a. Install with uniform bearing on foundation materials.
 - b. Wedging or blocking of base sections for leveling over the foundation materials will not be permitted.

3.03 INSTALLATION

- A. General:
 - 1. Protect handholes from displacement, flooding, or flotation.
- B. Polymer concrete handholes:
 - 1. Install structures in accordance with the manufacturer's recommendations.
 - 2. Clean joints between adjacent sections for tight fit.
 - 3. Set covers at elevations indicated on the Drawings.
 - a. Securely attach cover to below-grade box.
 - 4. Backfill polymer concrete handholes as indicated on the Drawings and as specified.
- C. Site tolerances:
 - 1. Set electrical handholes plumb and true at locations indicated on the Drawings.
 - 2. Tolerances on placing:
 - a. Horizontal location: Within 1 inch.
 - b. Vertical elevation: Within 1/2 inch.
 - c. Plumb: Within 1/8 inch over 10 feet.

3.04 FIELD QUALITY CONTROL

- A. Site test and inspection.
- B. Manufacturer's field service.

3.05 ADJUSTING

- A. After final grading is complete, adjust access covers to grade.

3.06 CLEANING

- A. Before installation of cables in any duct banks and handholes, remove concrete spoil, forms, debris, silt, dust, and other foreign material.
- B. Pressure wash interior of structures if required to provide clean interior surfaces.
 - 1. Block drains and provide pumps to remove washwater from structures.
 - 2. Do not permit washwater to drain into subgrade soils.

3.07 PROTECTION

- A. Where handhole structures are installed adjacent to existing site structures or utilities, provide excavation support or other protection as required to maintain those facilities in service and to prevent damage to both existing and new facilities.

3.08 SCHEDULES

- A. See Drawings for the Electrical Handhole and Manhole Schedule.

END OF SECTION

SECTION 03_60_00

GROUTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Preblended grout:
 - a. Non-shrink cement grout.
 - 1) General use.
 - 2) Potable water contact.
 - b. Non-shrink epoxy grout.
 - 1) General use.
 - 2) Potable water contact.
 - 2. Site-proportioned grout:
 - a. Neat cement grout.
 - b. Epoxy grout.

1.02 REFERENCES

- A. American Concrete Institute (ACI).
- B. ASTM International (ASTM):
 - 1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens).
 - 2. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 3. C150 - Standard Specification for Portland Cement.
 - 4. C404 - Standard Specification for Aggregates for Masonry Grout.
 - 5. C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 6. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
 - 7. C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
 - 8. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - 9. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
 - 10. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
 - 11. C1437 - Standard Test Method for Flow of Hydraulic Cement Mortar.
- C. International Concrete Repair Institute (ICRI):
 - 1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

- D. Society for Protective Coatings (SSPC):
 - 1. SP 1 - Solvent Cleaning.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Grout consistency. From most flowable to least flowable:
 - a. Fluid:
 - 1) Forms a nearly level surface without vibration or rodding.
 - 2) Efflux time is between 10 and 30 seconds when tested by the flow cone method in accordance with ASTM C939.
 - b. Flowable:
 - 1) Forms a nearly level surface when lightly rodded.
 - 2) Efflux time is greater than 30 seconds when tested by the flow cone method in accordance with ASTM C939.
 - 3) Flow is 125 to 145 percent when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 (5 drops of flow table in 3 seconds).
 - c. Plastic:
 - 1) Flow is 100 to 125 percent when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 (5 drops of flow table in 3 seconds).
 - d. Stiff plastic:
 - 1) Flow is 50 to 99 percent when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 for plastic mixes.
 - e. Dry pack:
 - 1) Grout that can be molded in closed fist without showing water when squeezed, and without crumbling when pressure is released.
 - 2) Flow is 0, or near 0 percent, when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 for plastic mixes.
 - 2. Preblended grout: Grout with constituent materials proportioned, thoroughly blended, and packaged by a manufacturer for the addition of water (cement-based grout) or catalysts (epoxy-based grout) at the construction site.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. As specified in Section 01_60_00 - Product Requirements.
 - a. Where products conforming to NSF-61 are required, submit evidence of current listing for use in contact with potable water.
 - 2. Preblended grouts:
 - a. Manufacturer's instructions for preparation of surface receiving grout.
 - b. Manufacturer's instruction for mixing, placement, and curing of grout.

3. Site-mixed grouts:
 - a. Product data for materials used in mixes.
 - 1) As specified in Section 03_30_00 - Cast-in-Place Concrete, for Submittal requirements for cementitious materials, aggregates, and water.
 - b. Mix designs with proportions of materials to be used.
 - c. Test results demonstrating compliance with grout properties specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements, and the manufacturer's instructions.

1.06 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.07 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Locations of use:
 1. See Schedules at the end of Part 3 of this Section.

2.02 PREBLENDED GROUT

- A. Non-shrink cement grout:
 1. General requirements:
 - a. Hydraulic-cement based, pre-proportioned, pre-blended, and pre-packaged mix, requiring only the addition of water.
 - b. In accordance with ASTM C1107.
 - c. Non-metallic: Containing no metallic particles, such as aluminum powder, and no metallic aggregate, such as iron filings.
 - d. Allowing for the addition of non-reactive mineral aggregate when recommended by the manufacturer for placements with increased thermal mass due to depth or volume.
 - e. Consistency:
 - 1) Manufacturer's mixing instructions allow for mixing to consistencies required for placement.
 - a) "Fluid," "flowable," or "plastic," as defined in ASTM C1107.
 - b) "Stiff plastic" or "dry pack" as specified in this Section.

- f. Temperatures:
 - 1) Installation and curing: Manufacturer's recommendations allow mixing, placing, and curing at temperatures ranging from 45 to 90 degrees Fahrenheit.
 - 2) Service: After 28 days curing, suitable for exposure to temperatures of at least 400 degrees Fahrenheit.
- g. Working time:
 - 1) Provides designated consistency for at least 20 minutes after mixing at the temperature where grout will be installed.
- h. Dimensional stability:
 - 1) Height change: Positive expansion in accordance with the requirements of ASTM C1107 for early height change, and for height change during moist curing.
- 2. Non-shrink cement grout - General use (NSCG):
 - a. Additional requirements:
 - 1) Compressive strength: In accordance with the following when tested in accordance with ASTM C109, as modified in ASTM C1107:

NSCG: Minimum Compressive Strength (psi)	
	Fluid
1 day	3,500
3 days	4,400
7 days	6,500
28 days	7,500

- b. Manufacturers: One of the following or equal:
 - 1) Dayton Superior, 1107 Advantage Grout.
 - 2) Euclid Chemical Co., NC Grout.
 - 3) Five Star Products, Inc., Five Star Grout.
 - 4) L&M Construction Chemicals, Inc., Duragrout.
 - 5) Master Builder Solutions (MBCC Group), MasterFlow 713.
 - 6) Sika Corporation, SikaGrout 212.
 - 7) US Spec, GP Grout.
- 3. Non-shrink cement grout - Potable water contact (NSCG-PW):
 - a. Additional requirements:
 - 1) Current listing under NSF-61.
 - 2) Compressive strength: In accordance with the following when tested in accordance with ASTM C109, as modified in ASTM C1107:

NSCG-PW: Minimum Compressive Strength (psi)			
	Fluid	Flowable	Plastic
1 day	3,500	4,000	4,500
3 days	4,400	5,000	6,000
7 days	6,500	6,700	7,000
28 days	7,500	8,000	9,000

- b. Manufacturers: One of the following or equal:
 - 1) Dayton Superior, Sure-Grip High Performance Grout.

2) Master Builder Solutions (MBCC Group), MasterFlow 928.

B. Non-shrink epoxy grout:

1. General requirements:

- a. System consisting of epoxy resin and hardener plus aggregate.
 - 1) Epoxy: 100 percent solids, 2-component thermosetting resin and hardener.
 - 2) Aggregate: Non-reactive mineral material provided by the manufacturer.
 - b. Pre-proportioned and pre-packaged for mixing.
 - c. Non-metallic: Containing no metallic aggregate such as aluminum or iron filings.
 - d. Allowing for the addition of mineral aggregate when recommended by the manufacturer for placements with increased thermal mass due to depth or volume.
 - e. Consistency: Flowable as required for the conditions of placement.
 - f. Working time: Retains consistency for placement for at least 15 minutes after mixing at the temperature where the grout will be installed.
 - g. Temperature:
 - 1) Installation and curing: Manufacturer's recommendations allow mixing, placing, and curing at temperatures ranging from 45 to 90 degrees Fahrenheit.
 - 2) Service temperature: Cured material suitable for exposure to temperatures up to 140 degrees Fahrenheit.
 - h. Consistency and working time:
 - 1) Flowable for at least 10 minutes after mixing with catalyst when tested at 60 degrees Fahrenheit.
 - i. Dimensional stability:
 - 1) Shrinkage or expansion: In accordance with at least one of the following:
 - a) Shrinkage: Less than 0.0006 inches per inch when tested in accordance with ASTM C531.
 - b) Expansion: Positive expansion when tested in accordance with ASTM C827.
 - 2) Compressive creep: In accordance with at least one of the following:
 - a) Not exceeding 0.004 inches per inch when tested in accordance with ASTM C1181 under constant load of 600 pounds per square inch at 140 degrees Fahrenheit.
 - b) Not exceeding 0.002 inches per inch when tested in accordance with ASTM C1181 under constant load of 400 pounds per square inch at 140 degrees Fahrenheit.
 - 3) Coefficient of thermal expansion:
 - a) Not exceeding 0.000019 inches per inch per degree Fahrenheit when tested in accordance with ASTM C531, Method B.
2. Non-shrink epoxy grout - General use (NSEG):
- a. Additional requirements:
 - 1) Compressive strength: Minimum when tested in accordance with ASTM C579, Method B.

NSEG: Minimum Compressive Strength (psi)	
	Fluid
1 day	9,000
7 days	11,500

- b. Manufacturers: One of the following or equal:
 - 1) Dayton Superior, J55/Pro-Poxy 2000.
 - 2) Euclid Chemical Co., E3-Flowable Grout.
 - 3) Five Star Products, Inc., Five Star DP Epoxy Grout.
 - 4) Laticrete/L&M Construction Chemicals, Inc., EpogROUT 758.
 - 5) Master Builder Solutions (MBCC Group), MasterFlow 648.
 - 6) Sika Corporation, Sikadur-42 Grout-Pak.
 - 7) US Spec, EPG 2000.

2.03 SITE-PROPORTIONED GROUT

- A. Neat cement grout (NCG):
 - 1. Description: Mixture of portland cement and water.
 - 2. Materials:
 - a. Cement: In accordance with ASTM C150.
 - 1) Match type used in concrete placed against the joint.
 - b. Water: Potable water.
 - 3. Proportioning ratios:
 - a. Use water-to-cementitious materials ratio that is no more than that specified for the plastic concrete that will be placed against the grout.
- B. Epoxy grout:
 - 1. Description: Mixture of epoxy or epoxy gel and sand.
 - 2. Materials:
 - a. Epoxy and epoxy gel: As specified in Section 03_63_01 - Epoxies.
 - b. Sand: Clean, bagged, and kiln-dried silica sand.
 - 1) Gradation in accordance with ASTM C404, Size No. 2.
 - 3. Proportioning:
 - a. Horizontal work: 1 part epoxy with not more than 2 parts sand.
 - b. Vertical and overhead work: 1 part epoxy gel with not more than 2 parts sand.

2.04 MATERIALS SPECIFIED ELSEWHERE

- A. Grout for leveling floors of water/wastewater treatment structures below solids collection equipment:
 - 1. As specified in Section 03_60_01 - Basin Bottom Grout.
- B. Grout and mortar for masonry unit construction:
 - 1. As specified in Section 04_05_17 - Mortar and Masonry Grout.

PART 3 EXECUTION

3.01 PREPARATION

- A. General:
 - 1. Protect surfaces adjacent to grouting operations. Prevent grout staining.
 - 2. Preblended grout:
 - a. Refer to the manufacturers' product literature for limits on physical or environmental conditions associated with storage and use of products.
 - b. Review any special conditions with manufacturers, prior to installation of products. Document discussions and submit records to the Engineer.
- B. Surface preparation:
 - 1. General:
 - a. Remove grease, oil, dirt, dust, ice and frost, curing compounds, laitance, paint, and other deleterious materials that reduce grout bond to substrate.
 - 2. Concrete surfaces receiving grout:
 - a. Roughen surface in accordance with the grout manufacturer's recommendations.
 - 1) Take care during surface preparation to avoid microcracking of the base materials.
 - 2) Roughen concrete surfaces in contact with grout to surface profile CSP-6 in accordance with ICRI 310.2R.
 - 3) Remove loose or broken concrete.
 - 3. Concrete surfaces receiving cement-based grouts:
 - a. Saturate concrete surface receiving the grout, and adjacent concrete surfaces 6 inches beyond limits of grout, with clean water or not less than 24 hours before grout placement.
 - b. Immediately prior to grout placement, remove standing water from concrete and anchor holes. Use clean rags or oil-free compressed air to leave saturated surface-dry (SSD) condition.
 - 4. Concrete surfaces receiving epoxy-based grouts:
 - a. Do not wet surfaces with water. Provide dry surface with moisture content not exceeding the grout manufacturer's recommended limits.
 - b. Prepare surfaces as recommended by the grout manufacturer.
 - c. Before placing epoxy-based grouts, wet surfaces with epoxy:
 - 1) Horizontal work: Wet with epoxy used for epoxy grout.
 - 2) Vertical and overhead work: Wet with epoxy gel compatible with epoxy used in epoxy grout.
- C. Base plates:
 - 1. For large or complex base plates, including base plates with shear lugs:
 - a. Provide plates with air relief holes at least 1/8 inch in diameter and spaced to prevent entrapment of air for complete filling under the plate.
 - 2. Remove grease, oil, dirt, dust, ice and frost, debris, and other materials that would contaminate grout or result in uneven bearing below plates.
 - a. Clean anchor holes and block-outs.
 - b. Clean surfaces in accordance with SSPC-SP 1.

3. Base plates over non-shrink epoxy grout:
 - a. At locations where equipment will be removed for maintenance or replacement, coat base plate with 2 coats of heavy duty paste wax to prevent bonding to grout.
- D. Forms for grout:
 1. Construct forms:
 - a. With adequate strength and stiffness to withstand grout placement and consolidation procedures without deformation.
 - b. That provide a smooth and uniform finish for grout surfaces.
 - c. That are liquid tight. Caulk cracks and joints with elastomeric sealant compatible with the grout to be placed.
 - d. That allow venting of displaced air.
 - e. That allow grout to flow horizontally beyond the perimeter of the base plate a distance not less than the thickness of the grout or 1 inch.
 - f. Line forms with polyethylene, or coat with 2 coats of heavy paste wax, to allow for easy form release.
 2. Construct forms with "head box."
 - a. Make head box continuous over entire length of one side of form.
 - 1) For larger placements, space head boxes to maintain continuous flow of grout from one side of the base plate to the other.
 - b. Make head box height sufficient to force grout to flow under full dimensions of base and to the surrounding form faces.
 - c. Position bottom of head box not less than 4 to 6 inches higher than bottom of the base plate.

3.02 INSTALLATION

- A. General:
 1. Maintain temperature of grouts, their constituent materials, and surfaces receiving the grouts within the manufacturer's specified limits during grout mixing, placement, and curing.
- B. Mixing:
 1. General:
 - a. Mix grouts to uniform consistency and to provide uniform distribution of constituent materials throughout the mix before beginning placement.
 - b. Where grout includes aggregate, mix until aggregate is uniformly wetted and dispersed in the mix.
 - c. Avoid overworking and entrapment of air in the mix.
 2. Preblended grout:
 - a. Mix products in accordance with the manufacturer's instructions.
 - 1) Comply with the manufacturer's recommendations for conditioning of materials prior to mixing.
 - 2) Mix in complete units. Do not mix partial batches.
 - 3) Do not vary ratio of components from the manufacturer's instructions.
 - b. Non-shrink cement grout:
 - 1) Pre-measure water for mixing. Do not exceed the manufacturer's recommended water content for the mix consistency to be used.
 - 2) Do not re-temper by adding water as the mix stiffens.

- c. Non-shrink epoxy grout:
 - 1) Manufacturer's reported working time may vary significantly from working time for actual onsite conditions.
 - 2) Make preparations to mix, place, and consolidate grout rapidly and within actual onsite working time.
 - 3) Do not add solvents to adjust consistency.
 - 3. Site-proportioned grout:
 - a. Cement grouts:
 - 1) Use mortar mixer with moving paddles.
 - 2) Pre-wet mixer and empty excess water before beginning mixing.
 - 3) Do not retemper by adding more water after grout stiffens.
 - b. Epoxy grout.
 - 1) Blend epoxy and aggregates in accordance with the epoxy manufacturer's recommendations for extending grout.
- C. Placement:
 - 1. General:
 - a. Place grout:
 - 1) Only after location, leveling, and alignment of structural elements and equipment is within required tolerances.
 - 2) Only after verifying compliance of grout substrates and environmental conditions.
 - 3) Immediately after mixing, and in a continuous placement.
 - b. Flowable grout:
 - 1) Fill head boxes and work grout down so it flows under base plate.
 - 2) At all times, keep the level of grout in the head box above the bearing surface of the base plate, sole plate, or skid.
 - 3) Maintain hydraulic pressure and continuous flow of grout from head box to opposite side of forms without trapping air or forming voids.
 - 4) Completely fill grout space, placing grout only to the bottom edge of bearing or base plates.
 - 5) Vibrate, rod, or chain flowable and plastic grout to facilitate grout flow, consolidate grout, and remove trapped air.
 - c. Dry pack grout:
 - 1) Pack into confined space, without voids, using tamping or ramming procedures recommended by the grout manufacturer.
 - 2. Preblended grout:
 - a. General:
 - 1) Place grout within the manufacturer's recommended working time for the temperature conditions during installation.
 - b. Non-shrink cement grout:
 - 1) After grout reaches initial set, remove forms and trim vertical edges of grout at a 45-degree angle sloping out and down from bottom edge of base plate to top of support.
 - 2) Finish cut surface to uniform texture.
 - c. Non-shrink epoxy grout:
 - 1) Do not trim edges of grout after it sets. Construct forms using chamfered edges built into the formwork to create sloped edge at perimeter.

3. Site-proportioned grout:
 - a. General:
 - 1) Do not place grout more than 30 minutes after mixing.
 - b. Neat cement grout:
 - 1) As specified in Section 03_30_30 - Cast-in-Place Concrete.
 - c. Epoxy grout:
 - 1) Place as indicated on the Drawings.
- D. Curing:
 1. Cement based grouts:
 - a. Keep continuously wet for minimum of 7 days after initial set.
 - 1) Use wet burlap, soaker hose, sun shading, ponding, or a combination of these methods.
 - b. Temperature: Maintain temperature of grout, substrate, and elements:
 - 1) Cold weather:
 - a) Above 70 degrees Fahrenheit for a minimum of 24 hours after placement to avoid damage from freezing.
 - b) Above 40 degrees Fahrenheit until grout has attained compressive strength of 3,000 pounds per square inch, but not less than 7 days.
 - 2) Hot weather:
 - a) Below 90 degrees Fahrenheit for a minimum of 72 hours after placement.
 2. Epoxy-based grouts:
 - a. Cure grouts in accordance with the manufacturers' recommendations.
 - b. Temperature: Maintain temperature of grout, substrate, and elements:
 - 1) Cold weather:
 - a) Above 70 degrees Fahrenheit for a minimum of 48 hours after placement.
 - 2) Hot weather:
 - a) Below 80 degrees Fahrenheit for a minimum of 24 hours after placement.

3.03 FIELD QUALITY CONTROL

- A. Provide field quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Field quality control by the Contractor:
 1. Inspections: Observe grout mixing and placement to confirm:
 - a. Product or mix installed at each location.
 - b. Preblended grouts:
 - 1) Mixing of full volume of prepackaged materials.
 - 2) Mixed and placed within the manufacturer's recommended temperature and working time limits.
 - 3) Cement-based: Addition of water complies with the manufacturer's instructions for specified strength and required consistency.
 - c. Complete and uniform filling of spaces designed for grouting.
 - d. Curing and protection as specified.
 2. Field testing - Site-mixed grouts:
 - a. Neat cement grout: Not required.

- b. Epoxy grout: Not required.
- C. Field quality control by the Owner:
 1. Special inspections:
 - a. Observe structure bearing plates and equipment base plates for presence of grout and for complete filling of grout spaces.

3.04 CLEANING

- A. Remove grout from adjacent surfaces.

3.05 SCHEDULES

- A. Install grout at locations indicated on the Drawings.
- B. General applications for products specified in this Section are specified in the General Applications for Grout Materials table below.
 1. Where specified grout or repair materials are not indicated on the Drawings or in the other Sections of the Specifications, confirm requirements with the Engineer before installation.

General Applications for Grout Materials	
Product	Application
Preblended Grouts	
Non-shrink cement grout	General use (NSCG): - Below base plates and bearing plates for structural framing. - Below equipment bases, sole plates and skids unless otherwise indicated on the Drawings. - Locations indicated on the Drawings.
	<u>Potable water contact (NSCG-PW):</u> Locations submerged in water that is or that will become potable water, including, but not limited to: - Below base plates and bearing plates for structural framing. - Below equipment bases, sole plates and skids. - Filter bottom grouting. - Locations indicated on the Drawings.
Non-shrink epoxy grout	General use (NSEG): Locations indicated on the Drawings.
Site-proportioned Grouts	
Neat cement grout	For spreading over construction joints and cold joints in concrete placements (not for other uses).
Epoxy grout	For filling divots where reinforcement or embedded metallic materials are burned back behind the face of concrete or masonry. Other locations indicated on the Drawings.

END OF SECTION

SECTION 03_60_01
BASIN BOTTOM GROUT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Grouting basin bottom slabs.

1.02 REFERENCES

- A. International Concrete Repair Institute (ICRI):
 - 1. 310.2 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

1.03 DEFINITIONS

- A. Grout that has not bonded: Grout that, after placing and setting, has hollow sound when tapped with 4-foot long, nominal, 2-inch by 4-inch piece of lumber.
- B. Jitterbug: An expanded metal or grate tamper designed for finishing concrete surfaces with a rough surface profile.

1.04 SUBMITTALS

- A. Manufacturer's instructions:
 - 1. For equipment to be used in grouting basin bottom slabs:
 - a. Submit grout placement instructions from manufacturer of equipment designated to operate in basin.
 - b. Include in such instructions statements on limitations and precautions to be observed when using equipment for grout placement.

1.05 QUALITY ASSURANCE

- A. Pre-installation conference for grouting basin bottom slabs: Schedule meeting with Engineer not less than 24 hours before planned grouting operations to discuss method of placement of grout.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials for grout:
 - 1. Cement, sand, and water: As specified in Section 03_30_00 - Cast-in-Place Concrete.

2.02 MIXES

- A. Grout mixture:
 - 1. 1 part portland cement and 4-1/2 parts sand, by weight.
 - 2. Water content:
 - a. Sufficient to allow workability for spreading grout with screeds attached to arms of equipment mechanism.
 - b. Not excessive, to prevent formation of surface water, laitance, segregation, and to allow grout to stay in place after screeding.
 - 3. Do not use admixtures.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface preparation:
 - 1. Basin bottom slab surface preparation:
 - a. Concrete slab surfaces shall have rough texture, suitable for bonding grout.
 - b. During concrete placement: finish concrete surface with jitterbug. Do not provide a smooth troweled surface.
 - c. Roughen top of slab surface to a ICRI 310.2 surface profile of CSP-5 or rougher using one of the following methods:
 - 1) Abrasive blasting.
 - 2) Steel shotblasting.
 - 3) Ultra-high-pressure water jetting.
 - d. Clean entire slab surface as required to remove dirt, oil, curing compound, laitance, dust, and other matter that may prevent proper grout bonding.
 - e. Saturate concrete slabs with water for minimum of 3 days just before placing grout. At time grout is placed, concrete shall be saturated and surface damp.
- B. Equipment preparation:
 - 1. Preparation of equipment for grouting basin bottom slabs:
 - a. Setting the screeds:
 - 1) Bolt nominal 2-inch by 4-inch section of lumber blades on arms of equipment mechanism.
 - 2) Locate leading edge of lumber approximately 2 inches in front of blade and cut it parallel to centerline of arm.
 - 3) Securely nail nominal 2-inch by 6-inch screed board to ends of 2 by 4 lumber, in manner such that screed runs parallel to centerline of arm.
 - 4) Nail bent sheet metal to lower edge of screed board.
 - 5) Ensure that bottom of screed board is 1-1/2 inches below steel blades on arms of equipment mechanism.

3.02 APPLICATION

- A. Grouting basin bottom slabs:
 - 1. Placement, general:
 - a. Place grout in accordance with equipment manufacturer's instructions and in accordance with limitations and precautions given in such instructions.
 - b. Bring promptly to attention of the Engineer, conflicts between manufacturer's instructions and this Section.
 - 2. Placing grout:
 - a. Use grouting equipment to apply grout for basin bottom slabs.
 - b. Perform grouting continuously without interruptions until basin slab is covered.
 - c. Place ring of grout approximately 3 feet wide on outer edge of slab and gradually widened towards center following spiral pattern until basin bottom slab is covered.
 - d. Unacceptable placing procedure: Following procedures will not be accepted:
 - 1) Grouting by circular sectors or "pie" sections.
 - 2) Grouting from center outward.
 - e. Use finishing workers to control area immediately in front of screed boards in manner so that:
 - 1) Grout is installed to specified thickness.
 - 2) No low areas occur.
 - 3) No excessive amount of grout accumulates.
 - 4) Grout surface has uniform wood trowel finish without ridges, gouges, or other defect.
 - f. Coordinate grout placement rate and number of finishing workers with travel speed of arms of equipment mechanism.
 - g. Last grout area to be grouted in center may be finished by worker operating from 1 of the arms.
 - h. Use misters or means acceptable to Engineer to keep grout from drying out before start of curing.
 - 3. Following grout placement:
 - a. After completion of slab grouting, allow mechanism to run continuously until there is no more danger that grout sloughing may occur.
 - b. Prevent dry clumps of grout or rocks from being caught under screed board and gouging finish surface of grout.
 - 4. Corrections:
 - a. Before grout has set:
 - 1) Where sloughing has occurred, remove grout from sloughed areas and place grout in low areas.
 - 2) Repair gouges in grouted surface.
 - 5. Curing:
 - a. After grout has set, water cure grout for 7 days.
 - b. Keep grout surface continuously wet for duration of curing period.

B. Tolerances:

1. For grouting basin bottom slabs:
 - a. Tolerance in elevation of finished grout surface: Plus or minus 1/8 inch.
 - 1) Specified tolerance is more exacting than customary industry standards for slab finish.
 - 2) Tolerance is required for proper operation of equipment.
 - b. Thickness of grout layer:
 - 1) Not less than 1 inch at any point.
 - 2) Provide average thickness of grout as indicated on the Drawings.

3.03 FIELD QUALITY CONTROL

A. Inspection:

1. Verify grout elevation tolerance on basin bottom slabs as follows:
 - a. After grout has set, operate grouting equipment with blades set to clear grout surface.
 - b. Under these conditions, blades shall not clear grout surface by more than 1/4 inch at any point:
 - 1) Excess clearance: Correct as specified in article titled "Adjusting" in this Section.

3.04 ADJUSTING

A. Grouting basin bottom slabs:

1. After grout has set:
 - a. Where clearance between blades and grouted surface exceeds tolerance specified in this Section, grind high points in grout surface using terrazzo machine until specified tolerance is met.
 - b. Grout that has not bonded to concrete slab is not acceptable. Remove and replace such grout.

END OF SECTION

SECTION 03_63_01

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Epoxy.
 - 2. Epoxy gel.
 - 3. Epoxy bonding agent.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C881 - Standard Specification for Epoxy-Resin-Base Systems for Concrete.
 - 2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. D638 - Standard Test Method for Tensile Properties of Plastics.
 - 4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
- B. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Manufacturer's data completely describing epoxy materials:
 - 2. Evidence of conformance to ASTM C881. Include manufacturer's designations of type, grade, class, and color.
 - 3. Documentation that materials meet or exceed the specified strength and performance characteristics. Indicate test methods and test results.
 - 4. Documentation confirming listing under NSF 61.
- C. Installation instructions:
 - 1. Provide manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Performance requirements:
 - 1. Provide epoxy materials that are new.
 - 2. Store and use products within limitations in accordance with the manufacturer.
 - 3. Perform and conduct Work of this Section in a neat, orderly manner.

2.02 MATERIALS

A. General:

1. Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the performance properties specified when tested in accordance with the standards specified.
2. Listed under NSF 61 for use in direct contact with potable water.

B. Epoxy: Low viscosity product in accordance with ASTM C881; Types I, II, and IV; Grade 1; Class C, except as modified in this Section.

1. Manufacturers: One of the following, or equal:
 - a. Dayton Superior, Unitex Pro-Poxy 100.
 - b. Master Builders Solutions/Sika, MasterInject 1380.
 - c. Sika Corporation, Sikadur 35 Hi-Mod LV.
2. Required properties:

Table 1. Material Properties - Epoxy		
Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	7,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	10,000 pounds per square inch, minimum.
Bond Strength (hardened concrete to hardened concrete after 2-day cure)	ASTM C882	1,000 pounds per square inch, minimum. Concrete failure before failure of epoxy.
Viscosity (mixed)		250 to 550 centipoise
<u>Notes:</u> (1) Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.		

C. Epoxy gel: Non-sagging product in accordance with ASTM C881, Types I and IV, Grade 3, Class C.

1. Manufacturers: One of the following, or equal:
 - a. Dayton Superior, Sure Anchor J50.
 - b. Master Builders Solutions/Sika, MasterEmaco ADH 327.
 - c. Sika Corp., Sikadur 31, Hi-Mod Gel.
2. Required properties:

Table 2. Material Properties - Epoxy Gel		
Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C882	1,500 pounds per square inch, minimum.
<u>Notes:</u> (1) Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.		

- D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C881, Type II, Grade 2, Class C.
1. Manufacturers: One of the following, or equal:
 - a. Dayton Superior, Sure Bond J58.
 - b. Master Builders Solutions/Sika, MasterEmaco ADH 326.
 - c. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
 2. Required properties:

Table 3. Material Properties - Epoxy Bonding Agent		
Property	Test Method	Required Results
Tensile Strength (7-day)	ASTM D638	3,300 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C882	1,800 pounds per square inch, minimum. Concrete failure before failure of epoxy bonding agent.
Pot Life	-	Minimum 30 minutes at 65 degrees Fahrenheit.
Notes: (1) Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.		

3. If increased contact time is required for concrete placement, epoxy resin/portland cement bonding agent, as specified in Section 03_63_02 - Epoxy Resin/Portland Cement Bonding Agent, may be used instead of epoxy bonding agent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and cure epoxy materials in accordance with the manufacturer's installation instructions.
- B. Epoxy:
 1. Apply in accordance with the manufacturer's installation instructions.
- C. Epoxy gel:
 1. Apply in accordance with the manufacturer's installation instructions.
 2. Use for vertical or overhead work, or where high viscosity epoxy is required.
 3. Epoxy gel used for vertical or overhead work may be used for horizontal work.
- D. Epoxy bonding agent:
 1. Apply in accordance with the manufacturer's installation instructions.
 2. Will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 03_63_02

EPOXY RESIN/PORTLAND CEMENT BONDING AGENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Epoxy resin/portland cement bonding agent.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
 - 2. C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
 - 3. C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - 4. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
- B. Federal Highway Administration (FHWA):
 - 1. FHWA-RD-86-193 - Highway Concrete Pavement Technology Development and Testing Volume V: Field Evaluation of SHRP C9206 Test Sites (Bridge Deck Overlays).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sika Corp., Sika Armatec 110.
- B. Substitutions: The use of other than the specified product will be considered, providing the Contractor requests its use in writing to the Engineer. This request shall be accompanied by:
 - 1. A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds specified performance criteria, tested in accordance with the specified test standards.
 - 2. Documented proof that the proposed substitute product has a 1-year proven record of performance of bonding portland cement mortar/concrete to hardened portland cement mortar/concrete, confirmed by actual field tests and 5 successful installations that the Engineer can investigate.

2.02 MATERIALS

- A. Epoxy resin/portland cement adhesive:
 - 1. Component "A" shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.

2. Component "B" shall be primarily a water solution of a polyamine.
3. Component "C" shall be a blend of selected portland cements and sands.
4. The material shall not contain asbestos.

2.03 DESIGN AND PERFORMANCE CRITERIA

- A. Properties of the mixed epoxy resin/portland cement adhesive:
 1. Pot life: 75 to 105 minutes.
 2. Contact time: 24 hours.
 3. Color: Dark gray.
- B. Properties of the cured epoxy resin/portland cement adhesive:
 1. Compressive strength in accordance with ASTM C109:
 - a. 3 day: 4,500 pounds per square-inch minimum.
 - b. 7 days: 6,500 pounds per square-inch minimum.
 - c. 28 days: 8,500 pounds per square-inch minimum.
 2. Splitting tensile strength in accordance with ASTM C496:
 - a. 28 days: 600 pounds per square-inch minimum.
 3. Flexural strength:
 - a. 1,100 pounds per square-inch minimum in accordance with ASTM C348.
 4. Bond strength in accordance with ASTM C882 modified at 14 days:
 - a. 0 hours open time: 2,800 pounds per square-inch minimum.
 - b. 24 hours open time: 2,600 pounds per square-inch minimum.
 5. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.
 6. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the FHWA Program Report Number FHWA-RD-86-193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mixing the epoxy resin: Shake contents of Component "A" and Component "B." Empty all of both components into a clean, dry mixing pail. Mix thoroughly for 30 seconds with a jiffy paddle on a low-speed with 400 to 600 revolutions per minute drill. Slowly add the entire contents of Component "C" while continuing to mix for a minimum of 3 minutes and until uniform with no lumps. Mix only the quantity that can be applied within its pot life.
- B. Placement procedure:
 1. Apply to prepared surface with stiff-bristle brush, broom, or "hopper-type" spray equipment:
 - a. For hand applications: Place fresh plastic concrete/mortar while the bonding bridge adhesive is wet or dry, up to 24 hours.
 - b. For machine applications: Allow the bonding bridge adhesive to dry for 12 hours minimum.

- C. Adhere to all limitations and cautions for the epoxy resin/portland cement adhesive in the manufacturer's current printed literature.

3.02 CLEANING

- A. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 04_05_17

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Mortar and grout for masonry construction.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - 2. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 3. C150 - Standard Specification for Portland Cement.
 - 4. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 5. C270 - Standard Specification for Mortar for Unit Masonry.
 - 6. C404 - Standard Specification for Aggregates for Masonry Grout.
 - 7. C476 - Standard Specification for Grout for Masonry.
 - 8. C595 - Standard Specification for Blended Hydraulic Cements.
 - 9. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 10. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
 - 11. C1019 - Standard Test Method for Sampling and Testing Grout.
 - 12. C1384 - Standard Specification for Admixtures for Masonry Mortars.
 - 13. C1586 - Standard Guide for Quality Assurance of Mortars.
 - 14. C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 - 15. C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete.
 - 16. C1714 - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Submit data completely describing products and demonstrating compliance with the requirements specified in this Section.
 - 2. Data for products in the mix for mortar and masonry grout shall be submitted concurrently with that mix design.

- 3. Admixtures:
 - a. For each admixture included in mixes, submit the manufacturer's product data demonstrating compliance with standards specified.
- C. Design mixes:
 - 1. Preblended dry packaged mortar.
 - 2. Site-batched mortar.
 - 3. Ready-mix plant-batched grout.
- D. Certificates:
 - 1. Cementitious materials:
 - a. Certification that portland cement complies with ASTM C150 or blended cement complies with ASTM C595.
 - 2. Aggregates:
 - a. Certification that aggregate for mortar complies with ASTM C144.
 - b. Certification that coarse and fine aggregates for grout complies with ASTM C404.
 - 3. Admixtures:
 - a. Certification of compliance with specified ASTM standard.
 - b. Certification of chloride limits.
- E. Source Quality Control Submittals:
 - 1. Mortar trial batch test results.
 - a. Mortar test results.
 - 2. Grout trial batch test results.
 - a. Grout test results.
- F. Field Quality Control Submittals:
 - 1. Truck batch tickets for each load of grout delivered to the Site, whether accepted or rejected.
 - 2. Mortar test results.
 - 3. Grout test results.

1.05 QUALITY ASSURANCE

- A. Pre-installation meetings: As specified in Section 04_22_00 - Concrete Unit Masonry.
- B. Materials for mortar and grout: Do not change source of materials which will affect the appearance of finished work after the work has started unless acceptable to the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements and the manufacturer's instructions.
- B. Packing and shipping:
 - 1. Deliver, store, and handle materials in a manner that prevents damage and inclusion of foreign substances.
 - 2. Deliver and store packaged materials in original containers until ready for use.

3. Deliver aggregate to the mixing site and handle in such manner that variations in moisture content will not interfere with steady production of mortar and grout of specified degree of uniformity and slump.
- C. Acceptance at Site:
1. Reject material containers or materials showing evidence of water or other damage.
 2. Do not accept or incorporate into the work mortar and grout that does not comply with the specified requirements for water content or slump.

1.07 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.
- B. Environmental requirements:
1. Cold weather:
 - a. Cold weather construction: In accordance with the building code as specified in Section 01_41_00 - Regulatory Requirements.
 - b. Provide adequate equipment for heating mortar and grout materials when air temperature is below 40 degrees Fahrenheit.
 - 1) Temperatures of separate materials, including water, shall not exceed 140 degrees Fahrenheit when placed in mixer.
 - 2) Maintain mortar temperature on boards above freezing.
 2. Hot weather:
 - a. Wet mortar board before loading and cover mortar to retard drying when not being used.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Provide mortar and grout with a homogeneous mixture that, when cured and hardened, will have required strength, watertightness, and durability.

2.02 MATERIALS

- A. Water:
1. For mortar and grout mixes and for washing aggregate: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances from a municipal potable water source.
- B. Cementitious material:
1. Portland cement: Type II, in accordance with ASTM C150.
 2. Blended cement: Type IL in accordance with ASTM C595.
- C. Hydrated lime:
1. Type S in accordance with ASTM C207.

- D. Aggregate for mortar:
1. Fine aggregate: Sand in accordance with ASTM C144.
- E. Aggregate for grout:
1. Fine aggregate: Size No. 2 in accordance with ASTM C404.
 2. Coarse aggregate: Size No. 8 in accordance with ASTM C404.
- F. Admixtures:
1. Do not include admixtures, other than those specified, unless written acceptance has been obtained from the Engineer during Submittal of mix designs.
 2. Compatible with mortar or grout constituents and with other admixtures.
 3. All admixtures in a given mix, except mortar color admixture, shall be products of the same manufacturer to ensure compatibility.
 - a. Manufacturers: One of the following or equal.
 - 1) Euclid Chemical.
 - 2) GCP Applied Technologies (formerly W.R. Grace).
 - 3) Master Builders Solutions/Sika.
 4. Mortar color admixture:
 - a. Provide colored pigments for integrally colored mortar in accordance with ASTM C979.
 - b. Test for compatibility with mortar repellent admixture in accordance with ASTM C979, section 4.7 and 8.7.
 - c. Containing maximum 10 percent lime proof, inorganic mineral oxide pigment.
 - d. Maximum 2 percent carbon black by weight of cement.
 - e. Maximum 0.2 percent chloride ions.
 - f. Preblended dry packaged mortar:
 - 1) Factory blend and incorporate into packaged product for full color saturation of mortar joint.
 - g. Mortar color:
 - 1) To match existing buildings.
 5. Mortar water repellent admixture:
 - a. In accordance with ASTM C1384.
 - b. Containing workability agents that improve water repellency and bond to concrete products manufactured with integral water repellent.
 - c. Compatible with the masonry product to which it will bond.
 - d. Shall not contribute more than 65 parts per million (ppm) water soluble chloride or 90 ppm acid soluble chloride to the grout.
 6. Grout high-range water-reducing admixture (HRWRA):
 - a. In accordance with ASTM C494, Type F (high-range, water-reducing).
 - 1) ASTM C494, Type G (high-range, water-reducing and retarding) may be used during periods of hot weather with prior acceptance by the Engineer.
 - b. Producing non-segregating, plasticized self-consolidating grout with little bleeding or segregation.
 - c. Shall maintain treated concrete in a plasticized state for not less than 1 hour.
 7. Other admixtures:
 - a. Prohibited, unless accepted by the Engineer.

- G. Other materials:
1. Prohibited, unless acceptable to the Engineer.

2.03 MIXES

- A. Masonry mortar mix: Cement-lime mortar shall be furnished as a preblended dry packaged product or site-batched mortar as follows:
1. Preblended dry packaged mortar:
 - a. Provide a mix of dry aggregate, cement, and hydrated lime proportioned to achieve the following property requirements of Type S cement-lime mortar in accordance with ASTM C270.
 - 1) Minimum water retention: 75 percent.
 - 2) Maximum air content: 12 percent.
 - b. Preblended mortar shall be thoroughly blended at a factory in accordance with ASTM C1714 and delivered in individual packages not exceeding 100 pounds.
 - c. Packages delivered to the Site with damage that allow loss of the dry contents shall not be incorporated into the work and shall be removed from the Site.
 2. Site-batched mortar:
 - a. Mortar mix proportions by volume: As specified in the following table:

Mortar Type	Parts by Volume of Cement	Parts by Volume of Hydrated Lime	Aggregate Measured in a Damp Loose Condition
S	1	Greater than 1/4 to 1/2	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials
N	1	Greater than 1/2 to 1-1/4	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials

Notes:

(1) When the masonry units include an integral waterproofing admixture, a compatible water repellant admixture shall be incorporated into the mortar at the manufacturer's recommended dosage rate.

- B. Grout mix: Grout shall be furnished batched at a ready-mixed plant and delivered to the Site as follows.
1. Ready-mix plant-batched grout:
 - a. Furnish fine or coarse conventional masonry grout as specified in this Section containing aggregates, cement, and water produced in accordance with ASTM C476.
 - b. Grout shall achieve a compressive strength of 2,000 psi at 28 days when tested in accordance with ASTM C1019.
 - c. Slump: 8 to 11 inches when tested in accordance with ASTM C143, unless otherwise accepted by the Engineer.

2.04 SOURCE QUALITY CONTROL

A. Tests:

1. Trial batches:
 - a. Have trial batches of preblended dry packaged mortar and grout prepared by a testing laboratory acceptable to the Engineer.
 - b. Prepare trial batches with sufficient quantity to determine strength, slump, workability, and consistency and to provide sufficient material for tests.
2. Mortar trial batch testing:
 - a. Source testing of preblended dry packaged mortar to confirm property specifications shall disclose the materials and volumetric proportions in accordance with ASTM C1586, section 5.2.
 - b. Aggregate ratio test of mortar: In accordance with ASTM C780, Annex A4, by a testing laboratory acceptable to the Engineer.
 - c. Cost of tests and trial batches shall be paid by the Contractor.
3. Grout trial batch testing:
 - a. Compressive strength testing: In accordance with ASTM C1019 by a testing laboratory acceptable to the Engineer.
 - b. Cost of tests and trial batches shall be paid by the Contractor.

PART 3 EXECUTION

3.01 MIXING AND TRANSPORTING

A. Mortar mixing:

1. General:
 - a. Mix on jobsite in accordance with ASTM C270.
 - b. Mix in mechanical mixer and only in quantities needed for immediate use. Do not exceed the rated capacity of the mechanical mixer.
 - c. Mix for minimum 3 minutes, and maximum of 5 minutes after materials have been added to mixer.
 - d. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the surfaces of masonry units.
 - e. Whenever 90 minutes has elapsed since last batch was mixed, completely empty mixer drum of materials and wash down before placing next batch of materials.
 - f. Use no mortar which has been standing for more than 1 hour after being mixed.
2. Site-batched mortar:
 - a. Measurement by volume: Measurement of constituents shall be accomplished by the use of a container of known capacity.
 - 1) Counting shovels of constituents into the mixer is not considered use of a container of a known capacity.
3. Preblended dry packaged mortar:
 - a. Mix only full packages of preblended mortar. Do not mix partial packages.
 - b. Add no other materials, including admixtures, to preblended mortar, except water.

- B. Grout mixing:
1. Ready-mix plant-batched grout:
 - a. Mix masonry grout in a ready mix batch plant in accordance with ASTM C476.
 - b. Upon delivery to the Site, furnish to the Engineer a delivery ticket for each batch of grout within 24 hours after delivery. Include the following information on each ticket:
 - 1) Time of day grout was batched, and time of day that discharge from the truck is complete.
 - 2) Printed record of the individual weight of each of the following constituents in the batch: Fine aggregate, coarse aggregate, cement, admixture, and water.
 - 3) Type of grout specified in Part 2 of this Section.
 - 4) Type, brand, and quantity of each admixture in the batch.
 - 5) Volume of grout delivered in the batch.
 - 6) Numerical sequence of the batch delivered for that placement.
 - c. Addition of admixtures in the field is not permitted.
 - d. Maximum time to placement of grout remains 90 minutes after water is initially added to the mix, not 90 minutes after any field additions or adjustments.
- C. Conveying mortar and masonry grout:
1. Convey from mixer to location of final use by methods that prevent separation or loss of materials.
 2. Use equipment for chutes, pumps, and conveying of mortar and grout of such size and design as to ensure practically continuous flow, from mixer to the point of placement, without separation of materials.
 3. Keep equipment for conveying mortar and grout thoroughly clean by washing and scraping upon completion of any day's placement.

3.02 INSTALLATION

- A. Use coarse grout for hollow cell masonry units with minimum 4-inch cell dimensions in both horizontal directions.
1. Calculate cell dimension for this criterion by subtracting diameter(s) of any horizontal reinforcement crossing the cell from clear cell dimensions of the masonry unit.

3.03 FIELD QUALITY CONTROL

- A. Provide field quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Field quality control by Contractor:
1. During progress of construction, provide testing to determine whether the mortar and masonry grout, as being produced, complies with requirements specified.
 - a. Cooperate in testing by allowing free access to the Work for testing laboratory to sample and test materials.
 - b. Provide full access for the Engineer to observe sampling and testing at any time.

2. Sampling and testing shall be performed by the Contractor's testing laboratory. Requirements as specified in Section 01_45_24 - Regulatory Quality Assurance - Special Tests and Inspections.
 3. Provide full access for the Engineer to observe sampling and testing at any time.
 4. Include the following, as specified in this Section and Section 01_45_24 - Regulatory Quality Assurance.
 - a. Sampling of mortar in accordance with ASTM C780.
 - b. Sampling of grout in accordance with ASTM C1019.
 - c. Test mortar and grout at the following intervals:
 - 1) At the beginning of each placement.
 - 2) At least 2 test specimens of grout and mortar will be made per week.
 - 3) When there is reason to suspect there is a change in materials or performance of the mix.
 - 4) When requested to do so by the Engineer.
 - d. Field testing:
 - 1) Mortar testing:
 - a) Aggregate ratio testing: In accordance with ASTM C780, Annex A4.
 - 2) Grout testing:
 - a) Compressive strength testing: In accordance with ASTM C1019.
 - b) Slump test: In accordance with ASTM C143.
 5. Do not use grout and mortar that does not meet specification.
 - a. Remove such mortar and grout from the Project Site.
 6. Assume responsibility for care of and providing proper curing conditions for test specimens.
- C. Field quality control by Owner:
1. The following, as specified in Section 01_45_24 - Regulatory Quality Assurance, and as indicated on the Drawings.

3.04 ADJUSTING

- A. Repair of defective masonry:
1. Remove and replace or repair defective work.
 2. Do not patch, repair, or cover defective work without inspection by the Engineer.
 3. Provide repairs having strength equal to or greater than specified strength for areas involved.

END OF SECTION

SECTION 04_05_18

ADHESIVE BONDING REINFORCING BARS AND ALL THREAD RODS IN MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Bonding reinforcing bars and all thread rods in masonry using injectable, 2 component adhesive.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. B212.15 - Cutting Tools - Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills.
- B. ICC Evaluation Service, Inc. (ICC-ES):
 - 1. AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements.
- C. Society for Protective Coatings (SSPC):
 - 1. Surface Preparation Standards (SP).
 - a. SP-1 - Solvent Cleaning.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Evaluation Report: Prepared by ICC-ES, or by other testing agency acceptable to the Engineer and to the Authority Having Jurisdiction, that documents testing and review of the adhesive product to confirm that it conforms to the requirements of ICC-ES AC58.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures and Section 01_60_00 - Product Requirements.
- B. Product data: Furnish technical data for adhesives, including:
 - 1. Independent testing laboratory results indicating allowable loads in tension and shear for masonry walls of the types included in the Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
 - 2. Handling and storage instructions.
 - 3. Installation instructions.
- C. Quality Control Submittals:
 - 1. Special inspection: Detailed instructions for special inspection to comply with the building code specified in Section 01_41_00 - Regulatory Requirements and as required by the Evaluation Report for each product.

2. Evaluation Report confirming that the product complies with the requirements of ICC-ES AC58.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements and the manufacturer's instructions.
- B. Store and protect as follows, unless the manufacturer has more stringent requirements:
 1. Store adhesive components on pallets or shelving in a covered-storage area protected from weather.
 2. Control temperature to maintain storage within the manufacturer's recommended temperature range.
 - a. If products are stored at temperatures outside the manufacturer's recommended range, test components prior to use by methods acceptable to the Engineer to determine if the products still meet specified requirements.
 3. Dispose of products that have passed their expiration date.

1.06 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.
- B. Seismic design category (SDC) for structures: As specified in Section 01_81_50 - Design Criteria and as indicated on the Drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Like items of materials: Use end products of one manufacturer to achieve structural compatibility and single-source responsibility.

2.02 ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

- A. Adhesive shall have a current Evaluation Report demonstrating compliance with the requirements of ICC-ES AC58.
- B. Materials:
 1. 2-component structural adhesive, insensitive to moisture, and gray in color.
 2. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.
- C. Packaging:
 1. Furnished in disposable, side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
 - a. Nozzle designed to thoroughly blend the components, in the proper mixing ratio, for injection from the nozzle directly into prepared hole.

- b. Provide nozzle extensions as required to allow full-depth insertion and filling from the bottom of the hole.
- 2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
- D. For installation in solid masonry and solid-grouted masonry (concrete or brick):
 - 1. Manufacturers: One of the following or equal:
 - a. Hilti, Inc., HY-270 Adhesive Anchor System.
 - b. Simpson Strong-Tie Co., Inc., ET-3G Anchoring Adhesive.

2.03 ALL THREAD RODS

- A. As specified in Section 05_12_00 - Structural Steel Framing.

2.04 REINFORCING BARS

- A. As specified in Section 04_05_23 - Masonry Accessories.

2.05 REPAIR MATERIALS

- A. Dry-pack mortar: As specified in Section 03_35_29 - Concrete Finishes.
- B. Epoxy grout: As specified in Section 03_60_00 - Grouting.

PART 3 EXECUTION

3.01 GENERAL

- A. Unless otherwise required for "Conditions of Use" in the Evaluation Report submitted, prepare and install holes, adhesive, and inserts (all thread rods or reinforcing bars) in accordance with the manufacturer's recommendations and this Section.
 - 1. In the event of conflicts, the more restrictive provisions shall govern.
- B. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined and overhead applications.

3.02 PREPARATION

- A. Prior to completing the manufacturer's on-site training specified in this Section, do not:
 - 1. Drill holes for reinforcing bars or all thread rods.
 - 2. Mix or install adhesive in holes.
- B. Review the manufacturer's installation instructions and "Conditions of Use" stipulated in the Evaluation Report before beginning Work.
- C. Confirm that adhesive and substrate receiving adhesive are within the manufacturer's recommended temperature range and will remain so during the cure time for the product.

3.03 HOLE LAYOUT AND INSTALLATION

- A. Drilling holes:
 - 1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device. Mark locations with on the surface of the masonry using removable construction crayon, or other method acceptable to the Engineer.
 - 2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the masonry without prior acceptance by the Engineer.
- B. Hole drilling equipment:
 - 1. Electric or pneumatic rotary impact type.
 - a. Set drill to “rotation only” mode, or to “rotation plus hammer” mode in accordance with the manufacturer’s installation instructions and the requirements of the Evaluation Report.
 - 2. Where edge distances are less than 2 inches and “rotation plus hammer” mode is permitted, use lighter impact equipment to prevent micro-cracking and spalling from drilling.
 - 3. Drill bits: Carbide-tipped in accordance with ANSI B212-15.
 - 4. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
- C. Hole diameter: As recommend in the manufacturer’s installation instructions and the Evaluation Report.
- D. Hole depth: As recommended by the manufacturer’s installation instructions to provide minimum effective embedment indicated on the Drawings.
- E. Obstructions in drill path:
 - 1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill to the required depth.
 - a. Allow dry-pack mortar to cure to strength equal to that of the surrounding masonry before resuming drilling in that area.
 - b. Epoxy grout may be substituted for dry-pack mortar when acceptable to the Engineer.
 - 2. Avoid drilling an excessive number of adjacent holes that would weaken the structural member and endanger the stability of the structure. Obtain the Engineer’s acceptance of distance between abandoned and relocated holes.
- F. Cleaning holes:
 - 1. Insert air nozzle to bottom of hole and blow out loose dust.
 - a. Use compressed air that is free of oil, water, or other contaminants.
 - b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
 - 2. Using a stiff bristle brush of diameter that provides contact around the full perimeter of the hole, vigorously brush the hole to dislodge compacted drilling dust.
 - a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
 - b. Repeat at least 4 times.

3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and as required by the manufacturer and the Evaluation Report.
4. Leave prepared hole clean and dry.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

- A. Clean and prepare inserts:
 1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
 2. Solvent-clean prepared reinforcing bars and all thread rods over their embedment length in accordance with SSPC SP-1. Provide an oil and grease-free surface for bonding of adhesive to steel.
- B. Fill holes with adhesive:
 1. Solid or solid-grouted masonry:
 - a. Only when dry. Do not fill with adhesive when the hole is filled with water or damp except with written authorization by the Engineer.
 - b. Starting at the bottom of the hole: Before inserting the reinforcing bar or all thread rod.
 - c. Without creating air voids as nozzle is withdrawn.
 - d. Fill with sufficient adhesive so that excess is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
 - e. Where metal or plastic screens are required for use in masonry (units with hollow cells or holes, and multi-wythe brick walls), fill screen with adhesive and insert into hole in accordance with the manufacturer's recommendations.
- C. Install reinforcing bars and all thread rods:
 1. Install to depth, spacing, and locations as indicated on the Drawings.
 2. Insert into hole in accordance with the manufacturer's recommended procedures. Confirm that insert has reached the designated embedment in the hole and that adhesive completely surrounds the embedded portion.
 3. Clean excess adhesive from the mouth of the hole.
- D. Curing and loading:
 1. Provide curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the actual temperature of the masonry.
 2. Do not disturb or load anchors until the manufacturer's recommended cure time has elapsed.

3.05 FIELD QUALITY CONTROL

- A. As specified in Section 01_45_00 - Quality Control.
- B. Manufacturers' services:
 1. Before beginning installation, furnish adhesive manufacturer's representative to conduct on-site training in proper storage and handling of adhesive, drilling

and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.

- a. Provide notice of training to the Engineer and special inspector not less than 10 working days before training occurs. Engineer and special inspector may attend training sessions.
2. Submit record, signed by the Engineer, listing the Contractor's personnel who completed the training. Only qualified personnel who have completed the manufacturer's on-site training shall perform installations.
3. Do not install holes or adhesive until training is complete.

3.06 FIELD QUALITY ASSURANCE

- A. Owner's representative will provide on-site inspection and field quality assurance.
- B. Special inspection:
 1. As specified in Section 01_45_24 - Regulatory Quality Assurance.
 2. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the "Conditions of Use" in the Evaluation Report for the product installed.
 3. Provide a written record of each inspection using form acceptable to the Engineer and the Authority Having Jurisdiction.
 4. Preparation:
 - a. Review Drawings and Specifications for the Work being observed.
 - b. Review the adhesive manufacturer's recommended installation and evaluation report's special inspection procedures.
 5. Provide an initial inspection by for each combination of masonry type and reinforcing bar or all thread rod being installed.
 - a. During initial inspection, observe the following for compliance with installation requirements. Furnish report of inspection that includes the following items:
 - 1) Masonry construction: Type and thickness; whether fully or partially grouted; locations and types of voids and holes in units.
 - 2) Environment: Temperature and moisture conditions of masonry base material and work area.
 - 3) Holes: Locations, spacing, edge distances; verification of drill bit compliance with ANSI B212.15; cleaning equipment and procedures; cleanliness of hole.
 - a) Before placing adhesive, confirm that depth and preparation of holes conforms to requirements of the Contract Documents, installation recommendations of the manufacturer, and "Conditions of Use" specified in the Evaluation Report.
 - 4) Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedures. Note initial set times observed during installation.
 - 5) Embedded reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment.

6. Subsequent installations of the same reinforcing bars or threaded rods in the same masonry may be performed without the presence of the special inspector, provided that:
 - a. There is no change in the personnel performing the installation, the type or details of the masonry receiving the insert, the adhesive or the reinforcing bars and all thread rods being used. Changes in any of these items shall require a new initial inspection.
 - b. For ongoing installations over a period of time, the special inspector visits the Site at least once per day during each day of installation to observe the Work for compliance with material requirements and installation procedures.
- C. Special testing:
1. If required by the Engineer, proof test reinforcing bars and all thread rods before installing production work:
 - a. Owner's independent testing firm will proof test reinforcing bars and all-thread rods in tension after curing:
 - 1) Test locations will be at the laboratory's discretion, unless otherwise directed by the Engineer, subject to the following minimum requirements:
 - a) For each reinforcing bar type and anchor, perform a minimum of 5 proof tests.
 - b) Proof test each reinforcing bar type and anchor to 133 percent of its design value.
 - b. Tests shall be tension tests using test loads indicated in Table A.
 - c. Report results of proof testing to the Engineer within 5 days after testing.
 - 1) Should any reinforcing bar or all thread rod fail to meet these criteria, notify the Engineer immediately. Test additional reinforcing as directed by the Engineer.
 2. Production testing for reinforcing bars and all thread rods:
 - a. Owner's independent testing firm will provide quality control testing program for reinforcing bars and anchors bonded into masonry using adhesive.
 - b. Test locations and frequency will be at the laboratory's discretion, unless otherwise directed by the Engineer, subject to the following minimum requirements:
 - 1) Perform at least the minimum percentage of quality control tests specified in Table A for each reinforcing bar type.
 - 2) Test a minimum of 5 reinforcing bars for each reinforcing bar type and anchor.
 - 3) Perform tests at different locations and conditions to obtain a representative sample for each reinforcing bar type.
 - c. Tests shall be tension tests:
 - 1) Test loads in Table A may be modified by the Engineer based on the results of proof test load tests.
 - 2) Maintain quality control test load for a minimum of 5 minutes.
 - d. There shall be no loosening or movement of the reinforcing bar out of the hole and no cracking or spalling of the masonry in which the reinforcing bar is set.

- e. For reinforcing bar failing to meet these criteria, increase quantity of quality control testing of similar reinforcing bars by 100 percent. If other failures occur during additional testing, test all similar reinforcing bars.
- 3. Contractor shall be responsible for the following:
 - a. Replacement of failed reinforcing bars, as directed by the Engineer at no additional cost.
 - b. Payment for increased quality control testing and reinforcing bar replacement caused by reinforcing bar failure.
 - c. Repair of the surface of the masonry, by means acceptable to the Engineer at no additional cost, if damage results from failed load test.

END OF SECTION

SECTION 04_21_12
ANCHORED BRICK VENEER

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Anchored brick veneer.

1.02 -REFERENCES

- A. American Concrete Institute (ACI):
1. ACI 530.1 - Specification for Masonry Structures.
- B. ASTM International (ASTM):
1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 2. A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 3. A580 - Standard Specification for Stainless Steel Wire.
 4. A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 5. C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
 6. C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- C. Mason Contractors Association of America (MCAA).

1.03 DEFINITIONS

- A. Mortar Smears: Mortar paste smeared across the permanent masonry construction during construction and absorbed into the masonry pores.
- B. Mortar Splash: Mortar splashed onto the permanent masonry construction at the base of the wall or off the scaffolding when dropped from a height.
- C. Mortar Stains: Mortar paste left after mortar tags are removed.
- D. Mortar Tag: Excess mortar between masonry units worked out of the joints during tooling or striking.

1.04 SUBMITTALS

- A. Product data:
1. Submit manufacturer's product data for veneer units.
 2. Submit manufacturers' product data for proposed cleaning agent.
- B. Shop drawings: Include elevations of each wall indicating type and layout of units.

- C. Samples: Include samples of masonry units in sufficient quantity to illustrate color range.
- D. Test reports:
 - 1. Test reports for each type of facing brick.
 - 2. Testing and reports are to be completed by and independent laboratory. Test reports shall include:
 - a. Compressive strength.
 - b. 24-hour cold water absorption.
 - c. 5-hour boil absorption.
 - d. Saturation coefficient.
 - e. Initial rate of absorption - laboratory test.
 - f. Efflorescence.
- E. Letter of Certification.
- F. Manufacturer's instructions:
 - 1. Submit printed or written recommendations from the masonry unit manufacturer describing cleaning procedures and cleaning agents appropriate for each type of masonry unit included in the work.
- G. Quality assurance submittals:
 - 1. If requested by the Engineer, submit a record of the Installer's evidence of qualifications.
 - 2. If requested by the Engineer, submit a record of the Masonry Cleaner's evidence of qualifications.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer qualifications:
 - a. The mason shall have not less than 5 years' experience and shall have completed a minimum of 20 projects, at least 5 of which included the type of masonry units specified for this Work.
 - b. The mason shall hold current certification demonstrating successful completion of the quality certification program administered by the Rocky Mountain Masonry Institute.
 - 2. Masonry cleaner qualifications:
 - a. The masonry cleaner shall have not less than 5 years' experience and shall have completed a minimum of 20 projects
- B. Pre-installation meeting: Conduct as specified in Section 01_31_19 - Project Meetings.
- C. A letter of Certification from the supplier of the materials attesting to compliance with the applicable specifications for grades, types, or classes included in these specifications, shall be provided at the time of, or prior to, delivery of the materials to the jobsite.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport and handle brick masonry units as required to prevent discoloration, chipping, and breakage.
- B. Locate storage piles, stacks, and bins to protect materials from heavy traffic.
- C. Store brick off ground to prevent contamination by mud, dust, or materials likely to cause staining or other defects.
 - 1. If masonry units are delivered in shrink-wrapped packaging and condensation develops under the wrapping, remove the shrink-wrap packaging.
- D. Cover materials when necessary to protect from the elements.
- E. Remove chipped, cracked, and otherwise defective units from jobsite upon discovery.

1.07 PROJECT CONDITIONS

- A. Cold weather requirements:
 - 1. In accordance with building code as specified in Section 01_41_00 - Regulatory Requirements.
 - 2. Provide adequate equipment for heating masonry materials when air temperature is below 40-degrees Fahrenheit.
- B. Hot weather requirements:
 - 1. When ambient air temperature exceeds 100 degrees Fahrenheit, or when ambient air temperature exceeds 90 degrees Fahrenheit and wind velocity is greater than 8 miles per hour, implement hot weather protection procedures.
 - 2. Wet mortarboard before loading and cover mortar to retard drying when not being used.
 - 3. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
 - 4. Place masonry units within 1 minute of spreading mortar.

1.08 SEQUENCING AND SCHEDULING

- A. Order brick masonry units well before start of installation (8 weeks minimum) to assure adequate time for manufacturing.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Brick masonry veneer units:
 - 1. Type:
 - a. ASTM C216, Grade SW, Type FBS with minimum compressive strength of 2,500 pounds per square inch.
 - b. Rated "not effloresced" when tested in accordance with ASTM C67.
 - 2. Surface texture: To match existing buildings.

3. Size: To match existing buildings.
 4. Special sizes and shapes: As required for window and door soldier coursing, accent band soldier coursing and custom sills where indicated on the Drawings, bond beams, piers, lintels, control joints, and other special applications to minimize cutting.
 5. Do not exceed variations in color and texture of samples accepted by the Engineer.
- B. Mortar and grout: As specified in Section 04_05_17 - Mortar and Masonry Grout.
 - C. Through-wall flashing: As specified in Section 04_05_23 - Masonry Accessories.
 - D. Weep holes: As specified in Section 04_05_23 - Masonry Accessories.
 1. Wire reinforcement: 9 gauge, cold-drawn steel wire in accordance with ASTM A1064 and hot-dip galvanized after fabrication in accordance with ASTM A15.
 - a. Manufacturers: One of the following or equal:
 - 1) Hohmann and Barnard, Inc.
 - 2) Heckmann Building Products, Inc.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of brick masonry units.
- B. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other objectionable matter.

3.02 INSTALLATION

- A. General:
 1. Comply with the execution requirements of Part 3 of ACI 530.1 unless more restrictive requirements are contained in this Section.
- B. Brick masonry veneer units:
 1. Use dry masonry units. Wet bricks with fine spray about 4 hours prior to their use.
 2. When brick suction exceeds the recommendations of ASTM C216, sprinkle with heated water:
 - a. When units are above 32 degrees Fahrenheit, heat water above 70 degrees Fahrenheit.
 - b. When units are below 32 degrees Fahrenheit, heat water above 130 degrees Fahrenheit.
 3. Do not use wet or frozen masonry units.
 4. Lay units in uniform and true courses, level, plumb, and without projections or offset from adjacent units.
 5. Lay units to desired height with joints of uniform thickness.

6. For brick veneer over masonry wall surfaces use pin and eye type reinforcing wires as shown in referenced details.
7. Spot bedding with cement mortar at all anchor locations.
8. Bond shall be plumb throughout.
9. Lay units to avoid formation of cracks when units are placed.
10. Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
 - a. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
 - 1) In adjacent masonry units: 1/8 inch.
 - 2) In 10 feet: 1/4 inch.
 - 3) In any story or 20 feet maximum: 3/8 inch.
 - 4) In 40 feet or more: 1/2 inch.
 - b. Maximum variations from the plumb for external corners, expansion joints, and other conspicuous lines:
 - 1) In any story or 20 feet maximum: 1/4 inch.
 - 2) In 40 feet or more: 1/2 inch.
 - c. Maximum variations from the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
 - 1) In any bay or 20 feet maximum: 1/4 inch.
 - 2) In 40 feet or more: 1/2 inch.
 - d. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
 - 1) In any bay or 20 feet maximum: 1/2 inch.
 - 2) In 40 feet or more: 3/4 inch.
 - e. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
 - 1) Minus: 1/4 inch.
 - 2) Plus: 1/2 inch.
 - f. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.
11. Prevent mortar from staining the face of masonry to be left exposed or painted:
 - a. Immediately remove mortar in contact with face of such masonry.
 - b. Protect all sills, ledges, and projections from droppings of mortar. Protect doorjambs and corners from damage during construction.
12. Protect masonry not being worked on from rain by completely covering with a weather resistive membrane.
13. Remove mortar tags and smears daily with a non-metallic tool. Mortar tags and smears shall be removed after they initially set, but shall not be permitted to remain more than 24 hours.
14. Where practical, protect completed work from mortar splash by placing thin plastic sheeting around the base of walls. Place sand, straw, sawdust or other similar material on the floor around the base of walls to protect floors and walls.
15. Turn scaffold planks over at the end of the workday to avoid mortar splashes from wet weather. Cover tops of walls at the end of the workday and other work stoppages to prevent entry of water into the partially completed masonry.

- C. Mortar joints:
1. Make joints straight, clean, smooth, and uniform in thickness.
 2. Pointing: Tool exposed joints, slightly concave. Strike concealed joints flush.
 3. Joint thickness: Make vertical and horizontal joints 3/8-inch thick.
 4. Where fresh masonry joins totally or partially set masonry, clean and roughen set masonry before laying new units.
 5. Remove mortar that protrudes more than 1/2 inches into the air space cavity. The mason shall provide a means remove excess mortar from the air space cavity:
 - a. Provide 2 by 4 lumber laid in bottom of cavity with string or wires for retrieval. As veneer is laid, the lumber is withdrawn from the cavity to remove mortar droppings in the cavity.
 - b. Other means may be acceptable to the Engineer if the mason can demonstrate its effectiveness.
- D. Weep holes:
1. Install weep holes in the veneer at the base of the walls and above all locations of through-wall flashing.
 2. Install weep holes at 24 inch maximum spacing and flush with the exterior face of veneer or maximum of 1/8 inch recessed maximum.
- E. Through-wall flashing:
1. Install flashing straight and true without offsets in installation.
 - a. Lay flashing in a 1/4 inch diameter bead of flashing sealant along the face of the veneer.
 2. Install flashing with a 1/2 inch hemmed drip edge at the exterior face of veneer, and locate a minimum 4 to 6 inches above the exterior finished grade and directly below weep holes.
 - a. Fill the cavity below the flashing solid with mortar.
 3. Flashing shall extend a minimum 8 inches above the bottom of the drip edge and be secured to the backup wall as follows:
 - a. Masonry backup wall: Embed the flashing 3/4 inches into a bed joint of the concrete masonry unit backup wall.
 - b. Concrete backup wall:
 - 1) Provide sawcut reglet in concrete:
 - a) Secure flashing to reglet with wedges and caulk with sealant to prevent moisture in reglet.
 4. Install the flashing sloped from the backup wall to the face of the veneer to promote drainage.
 - a. Do not install the flashing with any sags or low points that will allow ponding of moisture within the wall cavity.
 5. At splices in flashing, lap sections 6 inches and apply a 1/4 inch diameter bead of flashing sealant 1 1/2 inches from the end of each section of flashing.
 6. Where flashing transitions direction, corners shall be fashioned by cutting and folding.
 - a. Seal folds in the flashing with flashing sealant.
 7. Where flashing terminates within the wall, such as at the head and sill of windows and doors, fashion minimum 2 inches high end dams by cutting and folding the flashing.
 - a. Seal folds in the flashing with flashing sealant.

8. Isolate flashing from dissimilar metals (e.g. steel lintels, etc.) by applying epoxy mastic as specified in Section 09_96_01 - High-Performance Coatings, coating system EPX-M-5.
- F. Bond pattern:
1. Lay brick masonry units in running bond pattern, except where special patterns are indicated on the Drawings.
- G. Cutting masonry units:
1. When possible, use full units of the proper size in lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.
 2. Cut and fit units with power-driven carborundum or diamond disc blade saw.
- H. Control joints:
1. Control joint spacing:
 - a. Provide control joints in masonry walls at locations indicated on the Drawings.
 - b. If the location of control joints are not indicated on the Drawings, provide control joints at 20-foot maximum spacing. Submit proposed control joint spacing to the Engineer for acceptance.
 2. Make full height and continuous in appearance.
 3. Insert control joint filler in joints as wall is constructed.
 4. Apply sealant as specified in Section 07_92_00 - Joint Sealants.
- I. Steel door frames:
1. Anchor and fully grout jambs and head of steel doorframes connected to brick unit masonry.
 2. Fill frames with grout as each 2 feet of brick unit masonry is laid.
- J. Enclosures:
1. Where brick masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.
 2. Point openings around flush-mounted electrical outlet boxes with mortar, including flush joints above boxes.
 3. Do not cover enclosures until inspected and when appropriate, tested.
- K. Other embedded items:
1. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.
- L. Patching:
1. Patch exposed brick masonry units in such manner that patching will be indistinguishable from similar surroundings and adjoining construction.
- M. Water curing:
1. Protect brick masonry units from drying too rapidly by frequently fogging or sprinkling for minimum of 3 days.

- N. Miscellaneous:
 - 1. Build in required items, such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications, as required for complete installation.
- O. Forms and shores:
 - 1. Where required, construct forms to the shapes indicated on the Drawings:
 - a. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
 - b. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected:
 - 1) Wait at least 16 hours after grouting masonry columns or walls before applying uniform loads.
 - 2) Wait at least 72 hours before applying concentrated loads.

3.03 PROTECTION

- A. Provide temporary protection for exposed masonry corners subject to damage.
- B. Bracing:
 - 1. Adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse.
 - 2. Keep bracing in place until permanent supporting elements of structure are in place.
- C. Limited access zone:
 - 1. Establish limited access zone prior to start of masonry wall construction.
 - 2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on unscaffolded side of wall.
 - 3. Limit access to zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
 - 4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

3.04 FINAL CLEANING

- A. General.
 - 1. Final cleaning shall be performed within 7 to 14 days after construction of masonry work.
 - 2. Protect adjacent materials and equipment that may be damaged by cleaning.
 - 3. Pre-wet masonry before applying cleaning agent, but do not saturate masonry.
 - 4. Remove mortar stains, smears, and splash, efflorescence, and grout stains on exposed surfaces with the submitted cleaning agent as directed by the masonry unit manufacturer's recommendations.
 - 5. Do not use muriatic acid as cleaning agent.

6. Cleaning agents shall be applied when the masonry surface and air temperatures are at least 50 degrees Fahrenheit:
 - a. Dilute cleaning agents in accordance with manufacturer's recommendations.
 - b. Do not allow cleaning agents to dry on the masonry.
7. Clean wall from the top to the bottom, without overlapping areas being cleaned for consistency.
8. If pressure cleaning equipment is used, the following limitations shall be observed:
 - a. Apply cleaning agent to pre-wetted wall with low pressure (less than 50 psi).
 - b. Use a 25 degree to 50 degree flared-tip nozzle (not a pointed tip).
 - c. Maintain a consistent distance from the spray nozzle to the masonry surface no closer than 12 inches.
 - 1) Masonry cleaner shall use a combination of pressure, nozzle, and distance from tip to masonry that does not damage the masonry surface.
9. Rinse cleaning agents off the wall with potable water.
10. Dispose of debris, refuse, and surplus material offsite legally.

3.05 FIELD QUALITY CONTROL

- A. Site tests:
 1. Efflorescence tests:
 - a. Perform efflorescence tests on mortar that will be exposed to weathering. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary.

END OF SECTION

SECTION 04_22_00
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Concrete masonry units and accessories.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
 - 2. C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 3. C426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
- B. The Masonry Society (TMS):
 - 1. 602 - Specification for Masonry Structures.

1.03 TERMINOLOGY

- A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
 - 1. Grout lift height: The height of grout placed in a single continuous operation within the grout pour height.
 - 2. Grout pour height: Entire height of the masonry to be grouted prior to the construction of additional masonry.
 - 3. Mortar smears: Mortar paste smeared across the permanent masonry construction during construction and absorbed into the masonry pores.
 - 4. Mortar splash: Mortar dropped splashed onto the permanent masonry construction at the base of the wall or off the scaffolding.
 - 5. Mortar stains: Mortar paste left after mortar tags are removed.
 - 6. Mortar tag: Excess mortar between masonry units worked out of the joints during tooling or striking.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Submit manufacturer's product data for proposed cleaning agent.

- C. Shop Drawings:
 - 1. Include elevations of each wall indicating type and layout of units, including type of mortar joints, bond pattern, reinforcing steel, connecting dowels, joint reinforcement, grouted cells, and control joints.
- D. Samples: Include samples of stretcher units in sufficient quantity to illustrate color range.
- E. Test reports:
 - 1. Compressive strength.
 - 2. Linear shrinkage.
 - 3. Moisture content as a percentage of total absorption.
 - 4. Total absorption.
 - 5. Unit weight.
- F. Manufacturer's instructions:
 - 1. Submit printed or written recommendations from the masonry unit manufacturer of the cleaning procedures and cleaning agents appropriate for each type of masonry unit included in the Work.
- G. Quality assurance Submittals:
 - 1. If requested by the Engineer, submit a record of the installer's evidence of qualifications.
 - 2. If requested by the Engineer, submit a record of the masonry cleaner's evidence of qualifications.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer:
 - a. Mason shall hold an appropriate contractor's license in the state where the Work will be constructed.
 - b. Mason shall have not less than 5 years' experience and completed a minimum of 20 projects, at least 5 of which included the type of masonry units specified for this Work.
 - c. Mason shall hold current certification demonstrating successful completion of the quality certification program administered by the Rocky Mountain Masonry Institute or the Mason Contractors Association of America.
 - 2. Masonry cleaner qualifications:
 - a. Shall have not less than 5 years' experience and completed a minimum of 20 projects, at least 5 of which included the type of masonry units specified for this Work.
- B. Mockup:
 - 1. A minimum 2 weeks to starting construction of masonry, construct minimum 4 foot inches by 4 foot inches square mockup.
 - a. Mockup shall be constructed by the mason who will be performing the Work.
 - 2. Intended for use as the project standard of workmanship, construction, quality, appearance, and material selection.

3. Use accepted materials containing each different kind and color of concrete masonry units to illustrate wall design.
 4. Constructed by the mason who will be performing the Work.
 5. Cleaned with the exact equipment, products, and methods submitted and cleaned by the individual who will perform the Work.
 6. When accepted, mockup will be standard of comparison for remainder of masonry work.
 - a. May be accepted by the Engineer with exceptions that will not be accepted in the final construction.
 - 1) In such cases, those areas of the mockup not accepted will be clearly identified by the Engineer.
 7. When not accepted by the Engineer, construct another mockup.
 8. Upon completion of the Project, dispose of mockups in legal manner at offsite location.
- C. Pre-installation conference: Conduct as specified in Section 01_31_19 - Project Meetings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport and handle concrete masonry units as required to prevent discoloration, chipping, and breakage.
- B. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.
 1. Locate storage piles, stacks, and bins to protect materials from heavy traffic.
 2. If masonry units are delivered in shrink-wrapped packaging and condensation develops, remove shrink-wrap packaging.
- C. Remove masonry units that are chipped, cracked, and otherwise defective from jobsite upon discovery.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Cold weather requirements:
 1. Provide adequate equipment for constructing and protecting masonry when air temperature is:
 - a. Below 40 degrees Fahrenheit as follows:
 - 1) Remove frozen snow and ice from surfaces to receive masonry.
 - 2) Do not use masonry units having visible snow or ice on the surface or containing frozen moisture.
 - 3) Do not lay masonry units that have a temperature of 20 degrees Fahrenheit or below.
 - b. 32 degrees Fahrenheit to 40 degrees Fahrenheit:
 - 1) As required above and as follows:
 - a) Heat aggregates and/or mix water to provide mortar between 40 degrees Fahrenheit and 120 degrees Fahrenheit.
 - b) Heat aggregates and/or mix water to provide grout between 32 degrees Fahrenheit and 120 degrees Fahrenheit.
 - c) Do not heat any constituents above 140 degrees Fahrenheit.

- d) Protect newly constructed masonry work by covering surfaces with a weatherproof covering for 48 hours after completion.
 - c. 25 degrees Fahrenheit to 32 degrees Fahrenheit:
 - 1) As required above and as follows:
 - a) Furnish mortar at point of use above 32 degrees Fahrenheit until immediately prior to incorporation into the Work.
 - b) Heat aggregates and/or mix water to provide grout between 70 degrees Fahrenheit and 120 degrees Fahrenheit until immediately prior to incorporation into the Work.
 - c) Protect newly constructed masonry work by covering surfaces with a weatherproof covering for 48 hours after completion.
 - d. 20 degrees Fahrenheit to 25 degrees Fahrenheit:
 - 1) As required above and as follows:
 - a) Heat masonry units and adjoining completed Work to a minimum temperature of 40 degrees Fahrenheit.
 - b) Use enclosures or wind breaks when wind speeds exceed 15 mph.
 - c) Heat masonry to a minimum of 40 degrees Fahrenheit and maintain prior to grouting.
 - d) Protect newly constructed masonry work by covering surfaces with weatherproof, insulating concrete blankets for 48 hours after completion.
 - e. Below 20 degrees Fahrenheit:
 - 1) As required above and as follows:
 - a) Provide an auxiliary heated enclosure that maintains the ambient air temperature above 32 degrees Fahrenheit.
 - (1) Heat shall not vent combustion products into the enclosure.
 - (2) Maintain specified temperature for a minimum 48 hours after completion of masonry work.
- B. Hot weather requirements:
 - 1. Provide adequate equipment for constructing and protecting masonry as follows:
 - a. When the air temperature exceeds 90 degrees Fahrenheit with a wind speed greater than 8 mph, or when the air temperature exceeds 100 degrees Fahrenheit:
 - 1) Maintain sand for mortar and grout in damp, loose piles. Shade material stockpiles and mixing equipment from direct sunlight.
 - 2) Provide mortar and grout below 120 degrees Fahrenheit.
 - 3) Flush mixer and mortar containers with cool water before use.
 - 4) Wet mortarboard before loading and cover mortar to retard drying when not being used.
 - 5) Do not spread mortar beds more than 48 inches ahead of placing masonry units.
 - 6) Place masonry units within 1 minute of spreading mortar.
 - 7) Use mortar within 1 hour of initial mixing.
 - 8) Protect masonry from drying by frequently fogging or sprinkling so walls will always be visibly damp for minimum 3 days.

- b. When the air temperature exceeds 105 degrees Fahrenheit with a wind speed greater than 8 mph, or when the air temperature exceeds 115 degrees Fahrenheit:
 - 1) As required above and as follows:
 - a) Use water less than 70 degrees Fahrenheit to batch mortar and grout. Ice is permitted to precool the mix water but must be fully melted before adding to other constituents.

1.08 SEQUENCING AND SCHEDULING

- A. Order concrete masonry units well before start of installation to ensure adequate time for manufacturing and minimum 28-days for curing and drying before start of installation. Protect from weather after curing period to avoid moisture increase.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Hollow load bearing concrete masonry units:
 - 1. Density classification: Light weight (LW) in accordance with ASTM C90, with minimum net area compressive strength as follows:
 - a. Average of 3 units: 2,000 pounds per square inch.
 - b. Any individual unit: 1,800 pounds per square inch.
 - 2. Surface texture: Precision (smooth face) with dense faces suitable for painting, where scheduled to be painted.
 - 3. Color: Integral, natural gray of concrete.
 - 4. Typical size: 8 inches wide by 8 inches high by 16 inches long, unless otherwise indicated on the Drawings, or other sizes as needed to minimize cutting.
 - 5. Special sizes and shapes: As required for window and door openings, bond beams, piers, lintels, control joints, and other special applications to minimize cutting.
- B. Mortar and grout: As specified in Section 04_05_17 - Mortar and Masonry Grout.
- C. Anchor bolts: As specified in Section 05_12_00 - Structural Steel Framing and Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
- D. Steel reinforcement: As specified in Section 04_05_23 - Masonry Accessories.
- E. Wall ties: As specified in Section 04_05_23 - Masonry Accessories.
- F. Wire joint reinforcement: As specified in Section 04_05_23 - Masonry Accessories.
- G. Loose fill insulation: As specified in Section 04_05_23 - Masonry Accessories.
- H. Surface-applied water repellent: As specified in Section 07_19_00.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protection:
 - 1. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of concrete masonry units.
- B. Surface preparation:
 - 1. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other matter that will reduce bond.
 - 2. Examine foundation to confirm it is constructed within tolerance for masonry Work. Confirm dowels are installed in correct locations and with proper projection for the required lap splice before beginning laying masonry units.
 - 3. Place sand, straw, sawdust or other similar material on the floor around the base of walls to protect floors and walls.

3.02 INSTALLATION

- A. General:
 - 1. Standard level of quality: Furnish conventional quality work having no more than 5 percent of the units in the completed Work exhibiting one or more of the following defects:
 - a. Chips larger than 1 inch in any direction.
 - b. Cracks wider than 0.02 inch and longer than 25 percent of the nominal height of the unit.
 - c. Completed Work shall not show chips, cracks, or other imperfections when viewed from a distance of 20 feet under diffused lighting.
- B. Temporary forms and shores:
 - 1. Where required, construct forms to the shapes indicated on the Drawings:
 - a. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
 - b. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected.
 - 1) Wait at least 24 hours after grouting masonry columns or walls before applying uniform loads.
 - 2. Wait at least 72 hours before applying concentrated loads.
- C. Laying of masonry units - General:
 - 1. Lay concrete masonry units dry. Units having wet surfaces over 50 percent or more of its surface area may not be placed. Wet surfaces are distinguished from damp surfaces as those which do not darken when additional water is applied.
 - 2. Lay units in uniform and true courses, level, plumb, and without projections or offset of adjacent units.
 - 3. Lay units to preserve unobstructed vertical continuity of cells to be filled with grout or insulation.

4. When possible, use full units of the proper size in lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.
 - a. Cut and fit units with power-driven carborundum or diamond disc blade saw.
 5. Align vertical cells to be filled with grout to maintain clear, unobstructed continuous vertical cell measuring not less than 2.5 inches by 3 inches.
 6. Lay concrete masonry units in running bond pattern, unless otherwise indicated on the Drawings.
 7. Where practical, protect completed Work from mortar splash by placing thin plastic sheeting around the base of walls.
- D. Mortar joints:
1. Make joints straight, clean, smooth, and uniform in thickness. Bond shall be plumb throughout.
 2. Make vertical and horizontal joints 3/8 inch thick.
 3. Place mortar with full coverage of joints at webs of all cells and face shells.
 - a. Ensure full mortar coverage of joints on webs of cells that will be grouted solid, and face shells.
 4. Butter vertical head joints for thickness equal to face shell thickness of units, and shove joints tightly together so that mortar bonds to both masonry units.
 5. Solidly fill joints from face of units to inside face of cells.
 6. Where fresh masonry joins totally or partially set masonry, clean and roughen set masonry before laying new units.
 7. Lay units to avoid formation of cracks when units are placed.
 8. Keep cells of units as free of mortar as possible as masonry wall height increases.
 9. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.
 10. Tool exposed joints, slightly concave. Strike concealed joints flush.
- E. Wire joint reinforcement:
1. Lap splice longitudinal wire joint reinforcement minimum 40 wire diameters, but not less than 6 inches.
 2. Place longitudinal wires in approximate centers of mortar beds with minimum 5/8-inch mortar cover on exposed faces.
 3. Provide intersecting masonry walls with prefabricated wire joint reinforcement tees.
 4. Rake intersecting joints 1/2 inch and caulk joints.
 5. Remove mortar, mortar droppings, debris, and other obstructions and materials from inside of cell walls.
- F. Bond beams:
1. Starting courses at bottom of walls shall be bond beams.
 2. Place horizontal reinforcement and solidly grout bond beam units in place.
 3. Provide wire mesh at openings in bottom of bond beams to support grout where walls are not grouted solid.
- G. Masonry control joints:
1. Provide in masonry walls at locations indicated on the Drawings.
 2. Make full height and continuous in appearance.

3. Run bond beams and bond beam reinforcing bars continuously through control joints.
 4. Insert control joint filler in joints as wall is constructed.
 5. Apply sealant as specified in Section 07_92_00 - Joint Sealants.
- H. Openings and lintels:
1. Place horizontal reinforcement in fully grouted bond beam units.
 2. Use lintel block units where underside of lintel will be exposed.
 3. Provide a minimum of 8-inch bearing at each end of lintel or as indicated on Drawings.
 4. Embed reinforcing bars minimum 24 inches or 48-bar diameters, whichever is longer, into wall past edges of openings or as indicated on the Drawings:
 - a. At corners, provide 90-degree bend with equivalent total embed development.
- I. Embedments:
1. Steel door frames:
 - a. Anchor and fully grout jambs and head of steel doorframes connected to concrete unit masonry.
 - b. Fill frames with grout as each 2 feet of concrete unit masonry is laid.
 2. Bearing plates:
 - a. Provide minimum of 12 inches of grouted concrete unit masonry below steel bearing plates and beams bearing on masonry walls.
 3. Anchor bolts:
 - a. Hold in place with template during grouting to ensure precise alignment.
 - b. Do not cut or ream members being anchored or use other means to accommodate misaligned anchor bolts in roof deck support angles.
 - c. Provide minimum 6-inch wide grouted concrete unit masonry entirely around anchor bolts and other attachment devices.
 4. Enclosures:
 - a. Where concrete masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.
 - b. Point openings around flush mounted electrical outlet boxes with mortar, including flush joints above boxes.
 - c. Do not cover enclosures until inspected and when appropriate, tested.
 5. Conduits and electrical boxes:
 - a. See Drawings for details of conduit installation in masonry.
 6. Other embedded items:
 - a. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.
 7. Miscellaneous:
 8. Build in required items, such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications, as required for complete installation.
- J. Daily cleaning:
1. Remove mortar tags and smears daily with a non-metallic tool.
 - a. Removed after they initially set but shall not be permitted to remain more than 24 hours.

2. Turn scaffold planks over at the end of the workday to avoid mortar splashes from wet weather.
 - a. Cover tops of walls at the end of the workday and other work stoppages to prevent entry of water into the partially completed masonry.
 3. Seal cleanouts after inspection and before grouting or placing insulation.
- K. Grouting and reinforcement:
1. Where horizontal and vertical bars are spliced, the lap splice length shall be in accordance with TMS 602 and as indicated on the Drawings.
 2. Hold vertical reinforcing bars in position at top and bottom and at intervals not exceeding 200-bar diameters.
 - a. Use steel wire bar positioners to position bars.
 - b. Tie reinforcing bars to dowels with wire ties.
 3. Obtain acceptance of reinforcement placement before grouting.
 - a. Grouting:
 - 1) Grout pour height shall be limited to a maximum of 5.33 feet, unless the Contractor submits sufficient evidence to the Engineer for review and acceptance that the requirements of TMS 602 as it relates to grout pour height can be met.
 - 2) Grout lift height shall be limited to a maximum of 5.33 feet, unless the Contractor submits sufficient evidence to the Engineer for review and acceptance that the requirements of TMS 602 as it relates to grout lift height can be met.
 - 3) Slushing with mortar will not be permitted.
 - 4) Allow hollow unit masonry to cure at least 24 hours prior to grouting.
 - 5) Each lift shall be allowed to set for 10 minutes after initial consolidation of grout before successive lift is placed.
 - 6) Full height of each section of wall shall be grouted in 1 day.
 4. Placement:
 - a. Use a hand bucket, concrete hopper, or grout pump.
 - b. Do not pump grout through aluminum tubes.
 - c. Operate pumps to produce a continuous stream of grout without air pockets.
 - d. Upon completion of each day's pumping, eject grout from pipeline without contamination or segregation of the grout. Remove from Site and dispose. Do not incorporate into masonry work.
 - e. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
 - f. Remove grout spills immediately by hand washing with a bucket and brush.
 - g. Fill spaces and cells solidly with grout.
 - h. Grout in cells shall have full contact with surface of concrete footings.
 - i. Time constraints:
 - 1) When grouting stops for 1 hour or longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost unit containing grout.
 - 2) Place grout in final position within 1-1/2 hours after mixing. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
 - j. Consolidation:
 - 1) Do not vibrate self-consolidating grout.

- 2) Standard masonry grout:
 - a) Do not insert vibrators into lower grout placements that are in a semi-solidified state.
 - b) After placement, consolidate grout using mechanical immersion vibrators designed for consolidating grout.
 - c) Maintain at least 1 spare vibrator at the Site at all times.
 - d) Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine.
 - e) Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.
 - f) Reconsolidate grout after initial water loss and settlement has occurred.

3.03 TOLERANCES

- A. Masonry tolerances: Lay masonry plumb, true to line, and with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
 1. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
 - a. In adjacent masonry units: 1/8 inch.
 - b. In 10 feet: 1/4 inch.
 - c. In any story or 20 feet maximum: 3/8 inch.
 - d. In 40 feet or more: 1/2 inch.
 2. Maximum variations from the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
 - a. In any bay or 10 feet maximum: 1/4 inch.
 - b. In 40 feet or more: 1/2 inch.
 3. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
 - a. In any bay or 20 feet maximum: 1/2 inch.
 - b. In 40 feet or more: 3/4 inch.
 4. Maximum variation of top surface of bearing walls from level:
 - a. In any bay or 20 feet maximum: 1/4 inch.
 - b. In 40 feet or more: 1/2 inch.
 5. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
 - a. Minus: 1/4 inch.
 - b. Plus: 1/2 inch.
 6. Mortar bed joint thickness between masonry courses:
 - a. Plus or minus: 1/8 inch.

3.04 FINAL CLEANING

- A. General:
 1. Patch exposed concrete masonry units at completion of the Work and in such manner that patching will be indistinguishable from similar surroundings and adjoining construction.
 2. Final cleaning shall be performed within 7 to 14 days after construction of masonry work.
 3. Protect adjacent materials and equipment that may be damaged by cleaning.
 4. Pre-wet masonry before applying cleaning agent but do not saturate masonry.

5. Remove mortar stains, smears, and splash, efflorescence, and grout stains on exposed surfaces with the submitted cleaning agent as directed by the masonry unit manufacturer's recommendations.
6. Do not use muriatic acid as cleaning agent.
7. Cleaning agents shall be applied when the masonry surface and air temperatures are at least 50 degrees Fahrenheit.
 - a. Dilute cleaning agents in accordance with the manufacturer's recommendations.
 - b. Do not allow cleaning agents to dry on the masonry.
8. Clean wall from the top to the bottom, without overlapping areas being cleaned for consistency.
9. If pressure cleaning equipment is used, the following limitations shall be observed:
 - a. Apply cleaning agent to pre-wetted wall with low pressure (less than 50 pounds per square inch).
 - b. Use a 25-degree to 50-degree flared-tip nozzle (not a pointed tip).
 - c. Maintain a consistent distance from the spray nozzle to the masonry surface no closer than 12 inches.
 - 1) Masonry cleaner shall use a combination of pressure, nozzle, and distance from tip to masonry that does not damage the masonry surface.
10. Rinse cleaning agents off the wall with potable water.
11. Dispose of debris, refuse, and surplus material offsite legally.

3.05 PROTECTIVE SURFACE TREATMENTS

- A. Water repellent:
 1. Apply as specified in Section 07_19_00 - Water Repellents.

3.06 FIELD QUALITY CONTROL

- A. Site tests:
 1. Owner will have tests performed by an independent laboratory.
 2. Have minimum 3 concrete masonry units of each type proposed for the Project tested in accordance with ASTM C90, ASTM C140, and ASTM C426 to verify conformance to Specifications.
 3. Tests shall include compressive strength, linear shrinkage, moisture content as percent of total absorption, total absorption, and unit weight.
- B. Special inspection:
 1. As specified in Section 01_45_24 - Regulatory Quality Assurance.
 2. Owner will employ a qualified masonry special inspector for continuous special inspection of the masonry work.
 - a. Acceptance by a state or municipality having a program of examining and certifying masonry inspectors will be considered adequate qualifications.
 - b. Masonry inspector shall be at the Site during masonry construction and perform the following duties:
 - 1) Review Drawings and Specifications and meet with the Contractor to discuss requirements before Work commences.
 - 2) Before masonry work commences, the Contractor and the Contractor's Quality Control Representative shall attend meeting with

the Engineer to review the requirements for surveillance and quality control of the masonry work.

- 3) Check brand and type of cement, lime (if used), and source of sand.
 - 4) Verify that foundation is clean, rough, and ready to receive units.
 - 5) Check reinforcing steel dowels for correct location, straightness, proper alignment, spacing, size, and length.
 - 6) Observe field proportioning of mortar. Visually check aggregate to determine uniformity of grading, cleanliness, and moisture.
 - 7) Verify that joints are full of mortar and kept tight during Work.
 - a) Inspect grout cells to verify that fins will not interfere with grouting.
 - b) Verify that masons keep grout cells clean of mortar droppings and inspect to determine compliance.
 - 8) Continuously observe placing of grout.
 - 9) Perform or supervise performance of required sampling and testing.
3. Keep complete record of inspections. Report daily to the Building Official, Contractor's Quality Control Representative, Engineer, and Owner the progress of the masonry inspection.

3.07 PROTECTION

- A. Provide temporary protection for exposed masonry corners subject to damage.
- B. Bracing:
 1. Unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse, adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse.
 2. Keep bracing in place until permanent supporting elements of structure are in place.
- C. Limited access zone:
 1. Establish prior to start of masonry wall construction.
 2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on unscaffolded side of wall.
 3. Limit access zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
 4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

END OF SECTION

SECTION 05_05_24

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes requirements for:
 - 1. Cast-in anchors and fasteners.
 - 2. Post-installed steel anchors and fasteners.
 - 3. Appurtenances for anchoring and fastening.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.
- B. American National Standards Institute (ANSI):
 - 1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.
- C. ASTM International (ASTM):
 - 1. A29 - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.
 - 2. A36 - Standard Specification for Carbon Structural Steel.
 - 3. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
 - 4. B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 5. B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 6. E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
 - 7. F436 - Standard Specification for Hardened Steel Washers.
 - 8. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
 - 9. F594 - Standard Specification for Stainless Steel Nuts.
 - 10. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
 - 11. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- D. International Code Council Evaluation Service, Inc. (ICC-ES):
 - 1. AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.
 - 2. AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry.
 - 3. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
1. Built-in anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.
 2. Cast-in anchor: Headed bolt or assembly installed in position before placing plastic concrete around.
 3. Overhead installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 45 degrees above a horizontal line so the fastener resists sustained tension loads.
 4. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.
 5. Post-installed anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.
 6. Terms relating to structures or building environments as used with reference to anchors and fasteners:
 - a. Corrosive locations: Describes interior and exterior locations as follows:
 - 1) Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.
 - 2) Exterior and interior locations at the following treatment structures:
 - a) Water treatment facilities:
 - (1) Sludge Day Tank.
 - (2) Sludge Pump Station.
 - b. Wet and moist locations: Describes locations, other than "corrosive locations," that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
 - 1) Exterior portions of buildings and structures.
 - 2) Liquid-containing structures:
 - a) Locations at and below the maximum operating liquid surface elevation.
 - b) Locations above the maximum operating liquid surface elevation and:
 - (1) Below the top of the walls containing the liquid.
 - (2) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams, or walkways enclosing the open top of the structure).
 - 3) Liquid handling equipment:
 - a) Bases of pumps and other equipment that handles liquids.
 - 4) Indoor locations exposed to moisture, splashing, or routine wash down during normal operations, including floors with slopes toward drains or gutters.
 - 5) Other locations indicated on the Drawings.
 - c. Other locations:
 - 1) Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Calculations.

1.05 SUBMITTALS

- A. General:
 - 1. Submit as specified in Section 01_33_00 - Submittal Procedures and Section 01_60_00 - Product Requirements.
- B. Product data:
 - 1. Cast-in anchors:
 - a. Manufacturer's data, including catalog cuts showing anchor sizes and configuration, materials, and finishes.
 - 2. Post-installed anchors:
 - a. For each anchor type, manufacturer's data, including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.
- C. Delegated Design Submittals:
 - 1. When requesting product substitutions for post installed anchors, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.
- D. Samples:
 - 1. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.
- E. Certificates:
 - 1. Cast-in anchors:
 - a. Mill certificates for steel anchors that will be supplied to the Site.
 - 2. Post-installed anchors:
 - a. Manufacturer's statement or certified test reports demonstrating that anchors that will be supplied to the Site comply with the materials properties specified.
- F. Test reports:
 - 1. Post-installed anchors: For each anchor type used for the Work:
 - a. Current ICC-ES report (ESR), or equivalent acceptable to the Engineer and the authority having jurisdiction, demonstrating:
 - 1) Acceptance of that anchor for use under the building code specified in Section 01_41_00 - Regulatory Requirements.
- G. Manufacturer's instructions:
 - 1. Requirements for storage and handling.
 - 2. Recommended installation procedures, including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.

3. Requirements for inspection or observation during installation.
- H. Qualification statements:
1. Post-installed anchors: Installer qualifications:
 - a. Submit list of personnel performing installations. Include letter of training from manufacturer indicating date of manufacturer's training for each installer.

1.06 QUALITY ASSURANCE

- A. Qualifications:
1. Post installed anchors shall be in accordance with building code specified in Section 01_41_00 - Regulatory Requirements.
 2. Installers: Post-installed mechanical anchors:
 - a. Conduct a training session with the manufacturer's authorized technical representative for the Project on site:
 - 1) Training shall cover the complete installation process for each type of anchor to be used and shall include, but not be limited to, hole drilling procedures and techniques, hole preparation and cleaning, bolt installation, and bolt proof loading and torquing.
 - 2) Use only trained and qualified personnel for anchor installation.
 - b. Installations shall be performed by trained installers having at least 1 year of experience, performing similar installations with similar types of anchors.
- B. Special inspection:
1. Provide special inspection of post-installed anchors as specified in Section 01_45_24 - Regulatory Quality Assurance and this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.
- C. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.
- D. Protect anchors from weather and moisture until installation.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.
- B. Seismic Design Category (SDC) for structures is indicated on the Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. General:

1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
 - a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
 - b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.
2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact the Engineer for clarification.
3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:

1. Provide and install anchors of materials as specified in this Section.

2.02 CAST-IN ANCHORS AND FASTENERS

A. Anchor bolts:

1. Straight steel rod having one end with an integrally forged head, and one threaded end. Embedded into concrete with the headed end cast into concrete at the effective embedment depth indicated on the Drawings or specified, and with the threaded end left to project clear of concrete face as required for the connection to be made.
2. Furnish anchor bolts with heavy hex forged head or equivalent acceptable to the Engineer.
 - a. Rods or bars with angle bend for embedment in concrete (i.e., "L" or "J" shaped anchor bolts) are not permitted in the Work.
3. Materials:
 - a. Ship anchor bolts with properly fitting nuts attached.
 - b. Type 316 stainless steel:
 - 1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
 - 2) Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
 - 3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
 - 4) Washers: Type 316 stainless steel.
 - c. Galvanized steel:
 - 1) Hot-dip galvanized coating in accordance with ASTM F2329.
 - 2) Bolts: ASTM F1554, Grade 36, heavy hex, coarse thread.
 - 3) Nuts: ASTM A563, Grade A, heavy hex, threads to match bolt.
 - 4) Washers: ASTM F436, Type 1.

- B. Welded studs:
 - 1. Anchor with forged head for embedment into concrete on one end, and welding ferrule for attachment to steel on the other. Welded to steel members or plates to provide anchorage for steel connections to concrete.
 - 2. Shall be in accordance with AWS D1.1, Type B.
 - 3. Manufacturers: One of the following or equal:
 - a. Nelson Stud Welding (Stanley Engineered Fastening), H4L Concrete Anchors or S3L Shear Connectors as indicated on the Drawings.
 - b. Stud Welding Products, Headed Concrete Anchors (HCA) or Headed Shear Connectors (HSC) as indicated on the Drawings.
 - 4. Materials:
 - 1) Hot-dip galvanized after fabrication with coating in accordance with ASTM A123.
 - 2) Steel: Low carbon steel in accordance with ASTM A29/A108 with 51,000 pounds per square inch minimum yield strength, and 65,000 pounds per square inch minimum tensile strength.
- C. Steel plates or shapes for fabrications, including assemblies with welded studs or deformed bar anchors:
 - 1. Stainless steel: Type 316L or Type 304L:
 - a. Plates (embedded): ASTM A240.
 - 2. Galvanized steel:
 - a. Hot dip galvanized in accordance with ASTM A123.
 - b. Steel: ASTM A36.

2.03 POST-INSTALLED ANCHORS AND FASTENERS - ADHESIVE

- A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete:
As specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.
- B. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in masonry:
As specified in Section 04_05_18 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

2.04 POST-INSTALLED ANCHORS AND FASTENERS - MECHANICAL

- A. General:
 - 1. Post-installed anchors shall hold a current ICC Evaluation Service report demonstrating acceptance for use under the building code specified in Section 01_41_00 - Regulatory Requirements.
 - a. Acceptance report shall indicate acceptance of the product for use under the following conditions:
 - 1) In regions of concrete where cracking has occurred or may occur.
 - 2) To resist short-term loads due to wind forces.
 - 3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.
- B. Concrete anchors:
 - 1. Post-installed anchor assembly consisting of a threaded stud and a surrounding wedge expansion sleeve that is forced outward by torquing the center stud to

transfer loads from the stud to the concrete through bearing, friction, or both. Sometimes referred to as “expansion anchors” or “wedge anchors.”

- a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials to develop holding power.
 2. Concrete expansion bolts for anchorage to concrete:
 - a. Shall have a current ICC-ES report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
 - b. Performance in the current ICC-ES report shall be “Category 1” as defined in ACI 355.2.
 - c. Manufacturers: One of the following:
 - 1) Hilti, Kwik Bolt TZ2 Wedge Anchor.
 - 2) Simpson Strong-Tie, Strong-Bolt 2 Wedge Anchor.
 - d. Materials. Integrally threaded stud, wedge, washer, and nut:
 - 1) Stainless steel: Type 316.
 - 2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5).
 3. Concrete anchors for anchorage to concrete masonry (fully grouted cells):
 - a. Shall have a current ICC-ES report demonstrating that the anchors have been tested and qualified in accordance with ICC-ES AC01, including all mandatory tests and optional seismic tests.
 - b. Manufacturers: One of the following or equal:
 - 1) Hilti, Kwik TZ2 Wedge Anchor.
 - 2) Simpson Strong-Tie, Strong-Bolt 2 Wedge Anchor.
 - c. Materials. Integrally threaded stud, wedge, washer, and nut:
 - 1) Stainless steel: Type 316.
 - 2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5) or mechanically galvanized in accordance with ASTM B695, Class 55, Type 1.
- C. Flush shells:
1. Post-installed anchor assembly consisting of an internally threaded mandrel that is forced into a pre-drilled concrete hole with a setting tool until the top of the anchor is flush with the face of the concrete. Once installed, a removable threaded bolt is installed in the mandrel.
 2. Flush shell anchors are not permitted in the Work.
- D. Sleeve anchors:
1. Post-installed, torque-controlled anchor assembly consisting of an externally threaded stud with a spacer sleeve near the surface of the base material, and an expansion sleeve on the lower part of the stud. Expansion sleeve is forced outward by torquing of the center stud to transfer load.
 - a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials in order to develop holding power.
 2. Sleeve anchors for anchorage to concrete:
 - a. Shall have a current ICC-ES report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for

- Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
- b. Performance in the current ICC-ES report shall be "Category 1" as defined in ACI 355.2.
 - c. Manufacturers: One of the following or equal:
 - 1) DEWALT/Powers, Power Bolt+ Heavy Duty Sleeve Anchor.
 - 2) Hilti, HSL-3 Heavy Duty Expansion (sleeve) Anchor.
 - d. Materials:
 - 1) Stainless steel: Type 316.
 - 2) Galvanized steel: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5).
- E. Undercut concrete anchors:
- 1. Post-installed concrete anchor that develops tensile strength from mechanical interlock provided by creation of an undercut "key" at the embedded end of the anchor. Undercut may be achieved with a special drill before anchor installation, or by the anchor itself during installation.
 - a. Shall have a current ICC-ES report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
 - b. Performance in the current ICC-ES report shall be "Category 1" as defined in ACI 355.2.
 - c. Use pre-setting units. Through-setting units are not allowed unless prior written acceptance for specific locations is obtained from the Engineer.
 - 2. Manufacturers: One of the following or equal:
 - a. Hilti, HDA (carbon steel) or HDA-R (stainless steel) Undercut Anchor.
 - b. Simpson Strong-Tie, TCA Anchor.
 - 3. Materials:
 - a. Stainless steel: Corrosive, wet, and moist and locations: Type 316.
 - b. Galvanized: Carbon steel.
 - 1) Zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5).
 - 2) Sherardized coating which exceeds ASTM B695, Class 55, Type I.

2.05 APPURTENANCES FOR ANCHORING AND FASTENING

- A. Anchor bolt sleeves:
- 1. Fabricated steel sleeves:
 - a. Fabricate to the following dimensions unless otherwise indicated on the Drawings:
 - 1) Inside diameter: At least 2 inches greater than bolt diameter.
 - 2) Inside length: Not less than 10-bolt diameters.
 - 3) Bottom plate:
 - a) Square plate with dimensions equal to the outside diameter of the sleeve plus 1/2 inch each side.
 - b) Thickness equal to or greater than one-half of the anchor bolt diameter.

- b. Carbon steel:
 - 1) Fabricated from ASTM A36 plate and ASTM A53, Grade B pipe.
 - 2) Welded connections: Conform to requirements of AWS D1.1.
 - 3) Hot dip galvanized in accordance with ASTM A153.
- c. Stainless steel:
 - 1) Fabricated from ASTM A240 plate and pipe. Type 304L or Type 316L to match type of the anchor bolt.
 - 2) Welded connections: In accordance with AWS D1.6.
- B. Forged steel hardware:
 - 1. As specified in Section 05_12_00 - Structural Steel Framing for forged steel hardware connectors, including clevises, turnbuckles, eye bolts, eye nuts, and sleeve nuts.
- C. Isolating sleeves and washers:
 - 1. Manufacturers: One of the following or equal:
 - a. Allied Corrosion Industries.
 - b. Central Plastics Co.
 - 2. Sleeves: Mylar, 1/32-inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending halfway into both steel washers.
 - 3. One sleeve required for each bolt.
 - 4. Washers: Inside diameter of washers shall fit over the isolating sleeve, and both the steel and isolating washers shall have the same inside diameter and outside diameter.
 - a. Proper size to fit bolts.
 - b. Two 1/8-inch thick steel washers for each bolt.
 - c. G3 Phenolic: 2 insulating washers are required for each bolt:
 - 1) Thickness: 1/8 inch.
 - 2) Base material: Glass.
 - 3) Resin: Phenolic.
 - 4) Water absorption: 2 percent.
 - 5) Hardness (Rockwell): 100.
 - 6) Dielectric strength: 450 volts per mil.
 - 7) Compression strength: 50,000 pounds per square inch.
 - 8) Tensile strength: 20,000 pounds per square inch.
 - 9) Maximum operating temperature: 350 degrees Fahrenheit.
- D. Coating for repair of galvanized surfaces:
 - 1. Manufacturers: The following or equal:
 - a. Jelt, Galvinox.
- E. Thread coating: For use with threaded stainless steel fasteners:
 - 1. Manufacturers: One of the following or equal:
 - a. Bostik, Never-Seez.
 - b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION - GENERAL

- A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.
- B. Substitution of anchor types:
 - 1. Post-installed anchors may not be used as an alternative to cast-in/built-in anchors at locations where the latter are indicated on the Drawings.
 - 2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.
- C. Protect products from damage during installation. Protect threads and threaded ends.
- D. Accurately locate and position anchors and fasteners:
 - 1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
 - 2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.
- E. Interface with other products:
 - 1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), use stainless steel anchors and separate or isolate dissimilar metals using isolating sleeves and washers.
 - 2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION - CAST-IN ANCHORS

- A. General:
 - 1. Accurately locate cast-in and built-in anchors.
 - a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
 - b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.
 - c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not "stab" anchors into plastic concrete, mortar, or grout.
 - d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.

2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
 3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.
- B. Anchor bolts:
1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
 2. Where indicated on the Drawings, set anchor bolts in galvanized steel or stainless steel sleeves to allow for adjustment.
- C. Welded studs:
1. Butt weld to steel fabrications with automatic stud welding gun as recommended by the manufacturer.
 2. Ensure that butt weld develops full strength of the stud.

3.04 INSTALLATION - POST-INSTALLED ADHESIVE ANCHORS

- A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete: As specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.
- B. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in masonry: As specified in Section 04_05_18 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

3.05 INSTALLATION - POST-INSTALLED MECHANICAL ANCHORS

- A. General:
1. Install anchors in accordance with the manufacturer's instructions, ACI 355.2, the anchor's ICC-ES report. Where conflict exists between the ICC-ES report and the requirements specified in this Section, the requirements of the ICC-ES report shall control.
 2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
 3. After anchors have been positioned and inserted into concrete or masonry, do not:
 - a. Remove and reuse/reinstall anchors.
 - b. Loosen or remove bolts or studs.
- B. Holes drilled into concrete and masonry:
1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f'_c or f'_m).
 2. Accurately locate holes:
 - a. Before drilling holes, use a reinforcing bar locator to identify the position of reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.

- b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.
 3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry.
 - a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await the Engineer's instructions before proceeding.
 4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
 5. Drill using anchor manufacturer's recommended equipment and procedures:
 - a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
 - 1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
 - 2) Drill bits: Carbide-tipped in accordance with ANSI B212.15. Hollow drills with flushing air systems are preferred.
 6. Drill holes at manufacturer's recommended diameter and to depth required to provide the effective embedment indicated.
 7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES report for that anchor.
 - a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
 - b. Repeat cleaning process as required by the manufacturer's installation instructions.
 - c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.
- C. Insert and tighten (or torque) anchors in accordance with the manufacturer's installation instructions.
 1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.
- D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In Concrete	In Grouted Masonry	
3/8 inch	2-1/2 inch	2-5/8 inch	8 inch
1/2 inch	3-1/2 inch	3-1/2 inch	8 inch
5/8 inch	4-1/2 inch	4-1/2 inch	10 inch
3/4 inch	5 inch	5-1/4 inch	12 inch

- E. Flush shell anchors:
 1. Not permitted in the Work.
 2. If equipment manufacturer's installation instructions recommend the use of flush shell anchors, contact the Engineer for instructions before proceeding.

F. Sleeve anchors:

1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Sleeve Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In Concrete	In Grouted Masonry	
M8 (1/2 inch)	70 mm (2-3/4 inch)	Not accepted	100 mm (8 inch)
M10 (5/8 inch)	76 mm (3 inch)	Not accepted	250 mm (10 inch)
M12 (3/4 inch)	80 mm (3-1/4 inch)	Not accepted	300 mm (12 inch)

2. Install with the sleeve fully engaged in the base material.

G. Undercut concrete anchors:

1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Undercut Anchors			
Nominal Diameter (bolt)	Minimum Effective Embedment Length		Minimum Member Thickness ⁽¹⁾
	In Concrete	In Grouted Masonry	
M10 (3/8 inch)	100 mm (4 inch)	Not accepted	200 mm (8 inch)
M12 (1/2 inch)	125 mm (5 inch)	Not accepted	350 mm (14 inch)
M16 (5/8 inch)	190 mm (7-1/2 inch)	Not accepted	460 mm (18 inch)
M20 (7/8 inch)	250 mm (10 inch)	Not accepted	510 mm (20 inch)
Notes: (1) Thickness indicated is for pre-set units. If through-set units are accepted, obtain minimum member thickness requirements from the Engineer.			

2. Installations of undercut anchors shall not be allowed where edge distances are less than 12 times the nominal diameter of the anchor stud.
3. Undercut bottom of hole using cutting tools manufactured for this purpose by the manufacturer of the undercut anchors being placed.

3.06 FIELD QUALITY CONTROL

A. Provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.

1. Expenses associated with Work described by the following paragraphs shall be paid by the Contractor.

B. Post-installed anchors:

1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service report (hereafter referred to as "installation documents") for each anchor type and material.
2. Observe hole-drilling and cleaning operations for conformance with the installation documents.

3. Certify in writing that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.07 FIELD QUALITY ASSURANCE

- A. Owner's representative will provide on-site observation and field quality assurance for the Work of this Section.
 1. Expenses associated with work described by the following paragraphs shall be paid by the Owner.
- B. Field inspections and special inspections:
 1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted Submittals, and the manufacturer's installation instructions for the products used.
 2. Record of inspections:
 - a. Maintain record of each inspection.
 - b. Submit copies to the Engineer upon request.
 3. Statement of special inspections: At the end of the Project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.
- C. Special inspections: Anchors cast into concrete and built into masonry.
 1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
 - a. Anchor bolts.
 - b. Deformed bar anchors.
 - c. Welded studs.
 2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents.
 - a. Anchor:
 - 1) Type and dimensions.
 - 2) Material: Galvanized steel, Type 304 stainless steel or Type 316 stainless steel, as specified in this Section or indicated on the Drawings.
 - 3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
 - 4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.
 3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
 - a. Base material (concrete or grouted masonry):
 - 1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
 - 2) Material encapsulating embedment is dense and well-consolidated.

- D. Special inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry.
1. Provide special inspection during installation of the following anchors:
 - a. Concrete anchors.
 - b. Sleeve anchors.
 - c. Screw anchors.
 - d. Undercut concrete anchors.
 2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torquing of anchors.
 - a. Provide continuous special inspection for post-installed anchors in "overhead installations" as defined in this Section.
 3. Requirements for periodic special inspection:
 - a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Service report for the anchor being used. Observe the initial installation of each type and size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours.
 - 1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor shall require a new "initial inspection."
 - b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor's rated strength.
 - c. Anchor:
 - 1) Manufacturer, type, and dimensions (diameter and length).
 - 2) Material (galvanized, Type 304 stainless steel, or Type 316 stainless steel).
 - d. Hole:
 - 1) Positioning: Spacing and edge distances.
 - 2) Drill bit type and diameter.
 - 3) Diameter, and depth.
 - 4) Hole cleaned in accordance with the manufacturer's required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
 - 5) Anchor's minimum effective embedment.
 - 6) Anchor tightening/installation torque.
 4. Requirements for continuous special inspection:
 - a. Special inspector shall observe all aspects of anchor installation, except that holes may be drilled in their absence provided that they confirm the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.
- E. Field tests:
1. Owner's Representative may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
 - a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
 - b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests.

2. Post-installed anchors:
 - a. Proof load testing:
 - 1) In addition to performing special inspections, the Owner's Representative may select up to 10 percent of each type and size of post-installed mechanical anchor for proof-load testing for pullout or shear. Tests shall be non-destructive whenever possible.
 - 2) Perform tension testing in accordance with ASTM E488. Apply proof loads using a calibrated hydraulic ram.
 - b. Torque load testing:
 - 1) Using a calibrated torque wrench, apply manufacturer's recommended installation torque. Do not exceed the maximum torque listed by the manufacturer.
 - c. Acceptance criteria:
 - 1) Minimum anchor embedment, proof load for pullout and shear, and torque shall be as specified in this Section.
 - 2) Anchors that fail to resist their designated proof load or installation torque requirements shall be regarded as non-performing.
 - 3) If more than 10 percent of the tested anchors fail to achieve their specified torque or proof load, all anchors of the same diameter and type as the failed anchors shall be tested.
 - 4) Remediate non-performing anchors as specified in "non-conforming work."

3.08 NON-CONFORMING WORK

- A. Remove misaligned or non-performing anchors.
- B. Fill empty anchor holes and repair failed anchor locations using non-shrink cement grout as specified in Section 03_60_00 - Grouting, unless otherwise directed by the Engineer.
- C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.09 SCHEDULES

- A. Provide and install anchor materials as scheduled in the following table.

Required Anchoring Materials by Location			
Location/Exposure		Materials	Notes
1.	Anchors into concrete and grouted masonry for attachment of carbon steel, including structural steel and other steel fabrications:		
a.	Interior dry areas	Carbon steel - galvanized	
b.	Locations with galvanized steel structures or fabrications	Stainless steel - Type 304 or 316	1
c.	Exterior and interior wet and moist locations	Stainless steel - Type 316	1

Required Anchoring Materials by Location			
Location/Exposure		Materials	Notes
d.	Corrosive locations	Stainless steel - Type 316	1
2.	Anchors into concrete and grouted masonry for attachment of aluminum, stainless steel, or fiber-reinforced plastic (FRP) shapes and fabrications:		
a.	Interior dry areas	Stainless steel - Type 304 or 316	1
b.	Exterior and interior wet and moist locations	Stainless steel - Type 316	1
c.	Corrosive locations	Stainless steel - Type 316	1
3.	Anchors for attaching equipment and its appurtenances:		
a.	All locations	Stainless steel - Type 316 (unless Type 304 is specifically indicated in the specifications for the equipment.)	1
Notes: (1) Where anchors are in contact with a metal that differs from that of the anchor, provide isolation sleeves and washers.			

END OF SECTION

SECTION 05_12_00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Structural steel shapes and plate.
 - 2. Fasteners and structural hardware:
 - a. All thread rods.
 - b. All thread rods, high-strength.
 - c. High-strength bolts.
 - 3. Welding.
 - 4. Bolting.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC):
 - 1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
 - 2. 360 - Specification for Structural Steel Buildings.
- B. American Iron and Steel Institute (AISI):
 - 1. Steel and stainless steel alloys (types) as indicated.
- C. American Welding Society (AWS):
 - 1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - 2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
 - 3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
 - 4. D1.1 - Structural Welding Code - Steel.
 - 5. D1.6 - Structural Welding Code - Stainless Steel.
- D. ASTM International (ASTM):
 - 1. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - 2. A36 - Standard Specification for Carbon Structural Steel.
 - 3. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 6. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 7. A276 - Standard Specification for Stainless Steel Bars and Shapes.

8. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 9. A489 - Standard Specification for Carbon Steel Lifting Eyes.
 10. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 11. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 12. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 13. A992 - Standard Specification for Structural Steel Shapes.
 14. F436 - Standard Specification for Hardened Steel Washers.
 15. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 16. F594 - Standard Specification for Stainless Steel Nuts.
 17. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 18. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
 19. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
 20. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
- E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
1. Snug-tight: At bolted joints, a condition that exists when all plies in a connection have been pulled into firm contact by the bolts in the joint and all the bolts in the joint have been sufficiently tightened to prevent the removal of the nuts without the use of a wrench. The tightness may be attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench.
 2. Stainless steel related terms:
 - a. Descaling: Removal of heavy, tightly adherent oxide films resulting from hot-forming, heat-treatment, welding, and other high-temperature operations.
 - b. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.
 - c. Pickling: Chemical descaling of stainless steel using aqueous solutions of nitric and hydrofluoric acid, or various proprietary formulations as specified.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures and Section 01_60_00 - Product Requirements.
- B. Product data:
 - 1. Welding electrodes for field welds: Electrode manufacturer's data.
 - 2. Compressible-washer-type direct tension indicators: Manufacturer's detailed installation instructions, including:
 - a. Requirements for type and frequency of pre-installation verification.
 - b. Requirements for coordination with regular washers.
 - c. Instructions for assembling and tightening the joint so that work progresses from the most rigid part until the connected plies are in firm contact.
- C. Shop Drawings:
 - 1. Fabrication and erection drawings.
- D. Quality Control Submittals:
 - 1. Welding procedure specifications (WPS) in accordance with AWS D1.1 and D1.6.
 - a. Submit WPS for each type of welded joint used, whether prequalified or qualified by testing.
 - 1) State electrode manufacturer and specific electrodes used.
 - 2) Indicate required AWS qualification for joint.
 - b. Submit WPS with Shop Drawings that indicate those welds.
 - c. Submit Procedure Qualification Record (PQR) in accordance with AWS D1.1 and D1.6 for welding procedures qualified by testing.
 - 2. Welder qualifications: For each welding process and position:
 - a. Welder's qualification certificates.
 - b. Contractor's statement that certificate will be "in effect" at the time(s) welding will be performed based on the "Period of Effectiveness" provisions of AWS D1.1 and D1.6.
 - 3. Steel fabricator's AISC certification.
- E. Test reports:
 - 1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

- A. Certification:
 - 1. Steel fabricators shall be certified by the AISC or other certification acceptable to the Engineer and the building official having jurisdiction.
- B. Welding:
 - 1. Perform welding of structural metals in accordance with AWS D1.1 and D1.6 using welders who have current AWS qualification certificate for the process, position, and joint configuration to be welded.

2. Make welding procedure specifications available at the locations where welding is performed.
3. Notify the Engineer at least 24 hours before starting shop or field welding.
4. Engineer may check materials, equipment, and qualifications of welders.
5. Remove welders performing unsatisfactory Work, or require requalification.
6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
7. Contractor shall bear costs of retests on defective welds.
8. Contractor shall also bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.
- C. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified or indicated on the Drawings, materials shall be in accordance with the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Carbon Steel		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A36	--
Rolled W and WT shapes	A992	Grade 50
Hollow structural sections/HSS: Round, square, or rectangular (including "pipe" where indicated for structural members and supports)	A500	Grade C
Stainless Steel		
Plate, sheet, and strip	A240	Type 304 ⁽¹⁾ or 316 ⁽²⁾
Bars and shapes	A276	Type 304 ⁽¹⁾ or 316 ⁽²⁾
(1) Use Type 304L (low-carbon stainless steel) if material will be welded.		
(2) Use Type 316L (low carbon stainless steel) if material will be welded.		

2.02 FASTENERS AND STRUCTURAL HARDWARE

- A. General:
 1. Materials: Of domestic manufacture.
 2. Where fasteners and hardware are specified to be galvanized, hot-dip galvanize in accordance with ASTM A153 or ASTM F2329, unless otherwise specified.

- B. All thread rods:
1. Carbon steel:
 - a. In accordance with ASTM A36 unless otherwise indicated on the Drawings.
 - b. High strength all thread rods: In accordance with ASTM F1554, Grade 55.
 - c. Nuts: ASTM A194.
 - d. Washers: ASTM F436.
 2. Galvanized carbon steel:
 - a. In accordance with ASTM A36 unless otherwise indicated on the Drawings and hot dip galvanized in accordance with ASTM A153.
 - b. High strength galvanized all thread rods: In accordance with ASTM F1554, Grade 55, and galvanized in accordance with ASTM F2329.
 - c. Nuts: ASTM A194; hot-dip galvanized in accordance with ASTM A153.
 - d. Washers: ASTM F436; hot-dip galvanized in accordance with ASTM A153.
 3. Stainless steel:
 - a. Units descaled, pickled, and passivated as specified in the Fabrication article in this Section.
 - b. Threaded rods and nuts shall be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship all thread rods with properly fitting nuts attached.
 - c. Alloy Type 304 or Type 316 as indicated on the Drawings.
 - d. Type 304:
 - 1) Rod: ASTM F593, Group 1, Condition CW, coarse threads.
 - 2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
 - 3) Washers: Type 304 stainless steel.
 - e. Type 316:
 - 1) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
 - 2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
 - 3) Washers: Type 316 stainless steel.
- C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
- D. High-strength bolts:
1. Provide high-strength bolt assembly with nuts, hardened flat washers, and where required, compressible-washer-type direct tension indicators.
 2. Carbon steel: Uncoated:
 - a. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1.
 - b. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade C.
 - c. Washers:
 - 1) Adjacent to normal, oversized, and short-slotted holes: Circular, square or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1. Flat circular washers unless otherwise indicated on the Drawings.
 - 2) Adjacent to long slotted holes: Fabricated from 5/16-inch thick plate in accordance with ASTM A36.

- d. Load indicator devices: At slip critical connections, provide one of the following devices at each bolt:
 - 1) Compressible-washer-type direct tension indicators (DTI): In accordance with ASTM F959, Type 325-1.
 - 2) Twist-off type tension-control bolt assemblies: ASTM F3125, Grade F1852.
- 3. Carbon steel: Galvanized:
 - a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM F3125, Grade A325 and the RCSC Specification.
 - b. Bolts, nuts, and washers: Hot-dip galvanized in accordance with ASTM F2329.
 - c. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1 and galvanized as specified.
 - d. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A563, Supplementary Requirement S1 to minimize galling.
 - e. Washers:
 - 1) Adjacent to normal, oversized, and short-slotted holes: Circular, square or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1 and galvanized as specified. Flat circular washers unless otherwise indicated on the Drawings.
 - 2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A36 and galvanized in accordance with ASTM A123.
 - f. Load indicator devices: At slip critical connections, provide one of the following devices at each bolt:
 - 1) Compressible-washer-type direct tension indicators (DTI): In accordance with ASTM F959, Type 325-1, with mechanically deposited zinc coating in accordance with ASTM B695, Class 55.
 - 2) Twist-off type tension-control bolt assemblies: ASTM F3125, Grade F1852 with mechanically deposited zinc coating in accordance with ASTM B695, Class 55.

2.03 ISOLATING SLEEVES AND WASHERS

- A. As indicated on the Drawings and as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.04 GALVANIZED SURFACE REPAIR

- A. Manufacturers: The following or equal:
 - 1. Jelt, Galvinox.

2.05 SUPPLEMENTARY PARTS

- A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.06 FABRICATION

- A. Shop assembly:
 - 1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
 - 2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
 - 3. Round off sharp and hazardous projections and grind smooth.
 - 4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
 - 5. Take responsibility for correct fitting of metalwork.
 - 6. Welded connections:
 - a. In accordance with AWS requirements for the metals to be welded.
 - b. Weld only in accordance with approved welding procedure specifications.
 - c. Keep welding procedure specifications readily available for welders and inspectors during fabrication processes.
- B. Galvanized carbon steel:
 - 1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A123.
 - 2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by the Engineer.
 - 3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

- A. General:
 - 1. Fabricate structural and foundry items to true dimensions without warp or twist.
 - 2. Form welded closures neatly and grind off smooth where weld material interferes with fit or is unsightly.
 - 3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
 - 4. Do not shift out of alignment, re-drill, re-shape, or force fit fabricated items.
 - 5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
 - 6. Rigidly support and brace components to preserve straight, level, even, and smooth lines.
 - a. Install non-shrink grout as indicated on the Drawings.
 - b. Keep items braced until grout has hardened for 48 hours minimum.

7. Erect structural steel in accordance with AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
 8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
 9. Round off sharp or hazardous projections and grind smooth.
 10. Paint or coat steel items as specified in Section 09_91_00 - Painting and Section 09_96_01 - High-Performance Coatings.
- B. Stainless steel: Take necessary precautions to avoid iron contamination of stainless steel during delivery, storage, and handling.
1. Segregate stainless steel from iron.
 2. Tools and handling devices.
 - a. Do not use iron tools clamps, chokes, working surfaces, or brushes when fabricating, handling, and erecting stainless steel.
 - b. Do not use tools that have been contaminated by contact with iron.
 - c. Use stainless steel, polymer coated, or wood tools and handling equipment. Do not use tools that have been contaminated by contact with iron or steel.
- C. Welding: General:
1. Make welds full penetration type, unless otherwise indicated on the Drawings.
 2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.
- D. Welding: Carbon steel:
1. In accordance with AWS D1.1:
 - a. Weld ASTM A36 and ASTM A992 structural steel and ASTM A500 and ASTM A501 structural tubing with electrodes in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes.
 - b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.
- E. Welding: Stainless steel:
1. In accordance with AWS D1.6.
 2. Field welding of stainless steel will not be permitted.
 3. Passivation of field-welded surfaces:
 - a. Provide cleaning, pickling and passivating as specified in the Fabrication article of this Section. Clean using Derustit stainless steel cleaner, or equal.
- F. Interface with other products:
1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
- G. Fasteners: General:
1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.

2. Anchor bolts and anchor rods: Install as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry to the "snug-tight" condition.
 3. All thread rods in drilled holes bonded to concrete with adhesive: Install as specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.
 4. All thread rods in drilled holes bonded to masonry with adhesive: Install as specified in Section 04_05_18 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.
- H. Fasteners: High-strength carbon steel bolts:
1. Connections with high-strength bolts shall be in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts.
 2. Provide pre-tensioned joints at bolted connections, except where slip-critical or snug-tight connections are indicated on the Drawings.
 2. Joints: Slip-critical.
 - a. Confirm that faying surfaces at connections are free of dirt and other foreign material, have been blast cleaned, and are free of coatings and inadvertent overspray in accordance with the RCSC Specification.
 - b. Furnish hardened flat washers in accordance with ASTM F436:
 - 1) On outer plies with slotted holes.
 - 2) When one or more plies of the connected material has a yield strength less than 40 ksi.
 - 3) Under element, nut, or bolt head, turned in tightening.
 - c. Install tension indicator washers, placed in accordance with ASTM F959, Figure X1, to confirm adequate tightening of bolts.
 - d. Tighten bolts to full pretension.
 3. Joints: Pre-tensioned.
 - a. Joint preparation, assembly, and tightening shall be as specified for slip-critical connections, except that the requirements for un-coated faying surfaces shall not apply.
 5. Joints: Snug-tight:
 - b. Install bolts with washers where required in accordance with the RCSC Specification.
 - c. Tighten bolts to bring the connected plies into firm contact.
 - 1) Tightening shall progress systematically beginning with the most rigid part of the joint.
 - 2) More than 1 cycle through the bolt pattern may be required to achieve this condition.
 - d. Verify adequate tightening of bolts by visual observation to confirm that washers have been installed at locations required in accordance with the RCSC Specification and that the plies of the connected parts have been brought into firm contact.
- I. Fasteners: Stainless steel bolts:
1. Connections shall be snug-tight joints unless otherwise indicated on the Drawings.
 2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3. Rotate nuts using a slow, smooth action without interruptions. Avoid over-tightening.

3.03 FIELD QUALITY CONTROL

- A. As specified in Section 01_45_00 - Quality Control.

3.04 FIELD QUALITY ASSURANCE

- A. As specified in Section 01_45_00 - Quality Control.
- B. Special inspections, special tests, and structural observation:
 1. As specified in Section 01_45_24 - Regulatory Quality Assurance.

END OF SECTION

SECTION 05_14_05
STRUCTURAL ALUMINUM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Structural aluminum products, including sheet, pipe, extrusions, and associated accessories.

1.02 REFERENCES

- A. American Welding Society (AWS):
 - 1. A5.10 - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.
 - 2. D1.2 - Structural Welding Code - Aluminum.
- B. ASTM International (ASTM):
 - 1. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

1.03 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Quality Control Submittals:
 - 1. Test Reports: Certified copies of mill tests or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural metal or part thereof having common properties.
 - a. Tests and analyses shall be made in accordance with applicable ASTM standards.
 - 2. Welder's certificates.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
 - 2. Notify the Engineer 24 hours minimum before starting shop or field welding.
 - 3. Engineer may check materials, equipment, and qualifications of welders.
 - 4. Remove welders performing unsatisfactory work or require to requalify.
 - 5. Engineer may use gamma ray, magnetic particle dye penetrant, or other aids to visual inspection to examine any part of welds or all welds.

6. Contractor shall bear costs of retests on defective welds.
7. Contractor shall bear costs in connection with qualifying welders.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural sheet aluminum: ASTM B209, Alloy 6061-T6.
- B. Structural aluminum: ASTM B308, Alloy 6061-T6.
- C. Extruded aluminum: ASTM B221, Alloy 6063-T42.
- D. Isolating sleeves and washers:
 1. As indicated on the Drawings and as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
- E. Miscellaneous materials:
 1. Furnish supplementary parts necessary to complete each item even where such work is neither indicated on the Drawings nor specified.
 2. Size, form, attachment, and location shall conform to the best of current practice.
 3. In accordance with applicable ASTM standards for materials not otherwise specified.

2.02 FABRICATION

- A. Aluminum layout:
 1. Center punch hole centers, and punch or scribe cutoff lines, except where marks would remain on fabricated material.
 2. Apply temperature correction where necessary in layout of critical dimensions. Use a coefficient of expansion of 0.000013 per degree of Fahrenheit.
- B. Cutting aluminum:
 1. Material 1/2 inch thick or less: Shear, saw, or cut with a router.
 2. Material more than 1/2 inch thick: Saw or rout.
 3. Make cut edges true and smooth, free from excessive burrs or ragged breaks.
 4. Avoid reentrant cuts wherever possible. Where used, fillet by drilling prior to cutting.
 5. Do not flame cut aluminum alloys.
 6. Punch or drill rivet or bolt holes to finished size before assembly:
 - a. Make finished diameter of holes for bolts 1/16 inch maximum larger than nominal bolt diameter.
 - b. Make holes cylindrical and perpendicular to principal surface.
 - c. Do not permit holes to drift in a manner to distort metal.
- C. Aluminum forming and assembly:
 1. Do not heat structural aluminum, except as follows:
 - a. Heat aluminum to 400 degrees Fahrenheit for 30 minutes maximum, to facilitate bending or welding.

- b. Heat only when proper temperature controls and supervision can ensure that limitations on temperature and time are observed.
- D. Before assembly, remove chips lodged between contacting surfaces.
- E. Welding aluminum:
 - 1. Perform welding of aluminum in accordance with AWS D1.2.
 - 2. Preparation:
 - a. Remove dirt, grease, forming or machining lubricants, and organic materials from areas to be welded by cleaning with a suitable solvent or by vapor degreasing.
 - b. Additionally, etch or scratch brush to remove oxide coating just prior to welding when inert gas tungsten arc welding method is used.
 - c. Oxide coating may not need to be removed if welding is performed by automatic or semi-automatic inert gas shielded metal arc.
 - d. Suitably prepare edges to ensure 100 percent penetration in butt welds by sawing, chipping, machining, or shearing. Do not cut with oxygen.
 - 3. Filler metal: Aluminum alloys in accordance with AWS A5.10 and AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
 - 4. Perform welding of structures which are to be anodized using filler alloys which will not discolor when anodized, AWS ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
 - 5. Perform welding by using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG).
 - 6. Do not use welding process that requires use of a welding flux.
 - 7. Neatly make welded closures.
 - 8. Where weld material interferes with fit or is unsightly in appearance, grind it smooth.
 - 9. Make welds full penetration welds unless otherwise indicated on the Drawings.

2.03 FINISHES

- A. Coating for aluminum in contact with concrete or masonry:
 - 1. Epoxy mastic.
 - a. As specified in Section 09_96_01 - High-Performance Coatings, coating system EPX-M-5.
 - b. Manufacturers: One of the following or equal:
 - 1) Carboline, Carbomastic 15.
 - 2) International Paint, Bar-Rust 231.
 - 3) Tnemec, Series 135.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION

- A. Install structural aluminum products as indicated on the Drawings and specified.
- B. Install structural aluminum products accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
- C. Do not cock out of alignment, redrill, reshape, or force fit fabricated items.
- D. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and true to level.
- E. Rigidly support and brace components to preserve straight, level, even, smooth lines.
 - 1. Install non-shrink grout as indicated on the Drawings.
 - 2. Keep items braced until grout has hardened for a minimum of 48 hours.
- F. Interface with other products:
 - 1. Where aluminum comes in contact with dissimilar metals, use stainless steel bolts or anchors and separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - 2. Coat those parts of aluminum that will be cast into concrete or that will be in contact with concrete, grout, masonry, wood, or other materials that will cause the aluminum to corrode, as specified in Section 09_96_01 - High-Performance Coatings.

END OF SECTION

SECTION 05_21_19

OPEN WEB STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Open web steel joists, joist girders, and accessories.
 - 2. Welding and bolts for connections at joists and joist girders.

1.02 REFERENCES

- A. American Welding Society (AWS):
 - 1. A2.4 - Standard Symbols for Welding, Brazing, and Non-Destructive Examination.
 - 2. D1.1 - Structural Welding Code - Steel.
- B. ASTM International (ASTM):
 - 1. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 2. F436 - Standard Specification for Hardened Steel Washers.
 - 3. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
- C. Occupational Safety and Health Administration (OSHA):
 - 1. Code of Federal Regulations (CFR), Title 29 - Labor, Chapter XVII.
 - a. Part 1926.757 - Steel Erection; Open Web Steel Joists.
- D. Society for Protective Coatings (SSPC):
 - 1. Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
 - 2. SP 15 - Commercial Grade Power tool Cleaning.
- E. Steel Joist Institute (SJI):
 - 1. Code of Standard Practice:
 - a. COSP - Code of Standard Practice for Steel Joists and Joist Girders.
 - 2. Standard Specifications:
 - a. K Series - Standard Specifications for Open Web Steel Joists.
 - b. LH/DLH Series - Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.
 - c. JG Series - Standard Specification for Joist Girders.
 - 3. Standard Load Tables:
 - a. Standard Specification Load Tables and Weight Tables for Steel Joists and Joists Girders.
 - 4. Technical Digests:
 - a. TD 8 - Welding of Open-Web Steel Joists and Joist Girders.
 - b. TD 9 - Handling and Erection of Steel Joists and Joist Girders.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. SJI Standard Specifications: Refers to one or more of the following documents corresponding to the joist type indicated on the Drawings:
 - a. K Series - Standard Specifications for Open Web Steel Joists.
 - b. LH/DLH Series - Standard Specifications for Steel Joists, LH-Series and Deep Steel Joists, DLH-Series.
 - 2. SJI Standard Load Tables: Refers to one of the following documents corresponding to the joist type indicated on the Drawings:
 - a. Standard Load Tables, Open Web Steel Joists, K-Series (LRFD and ASD).
 - b. Standard Load Tables, Steel Joists, LH-Series (LRFD and ASD).
 - c. Standard Load Tables, Deep Steel Joists, DLH Series (LRFD and ASD).
 - 3. Steel joists: As referred to in this Section, includes joists, K series joist substitutes, joist girders, and joist headers.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Joist calculations.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Manufacturer's specifications and installation instructions for each type of joist and accessories.
 - 2. Coatings:
 - a. Shop coating: Manufacturer's product data sheets indicating type and characteristics of applied coatings, and recommendations for preparation and materials for finished coatings.
- C. Shop Drawings:
 - 1. General:
 - a. Fabrication drawings/schedules, and erection/layout drawings for joists and related miscellaneous metal work.
 - b. Clearly indicate the portion of the Work covered by each Submittal and location of each member in the Work.
 - c. Mark the number or tags on joists and fabrications shall be the same mark numbers indicated on fabrication schedules and erection drawings.
 - d. Indicate shop and field welds using symbols in accordance with AWS A2.4. Indicate net weld lengths.
 - 2. Fabrication drawings/schedules:
 - a. Detail each piece or assembly to be incorporated into the Work.
 - b. For each joist type and size, and for each accessory, indicate:
 - 1) SJI standard designations, including depth and chord size.
 - 2) Identification mark number.
 - 3) Loading criteria and camber.

- 4) Configuration and details, including joist elevation view, bearing seats, end conditions, chord extensions, and details of internal joints, welds, and splices (if any).
 - 5) Dimensions, both overall and internal.
 - 6) Field splice locations and details when required.
 - 7) Methods of connecting, anchoring, fastening, bracing, bridging, and attaching.
 - 8) Coatings and surface preparation.
 3. Erection/layout drawings:
 - a. Indicate placement of each piece shown in the fabrication drawings/schedules or listed in the bill of materials.
 - b. Show layout of joists with mark numbers; methods of framing at openings; locations, types, and connection details for bridging; details of connections between joists and supporting joist girders, joist headers, framing, or structures; and accessories.
 - c. Indicate erection sequence and requirements for temporary bracing.
 - d. Show requirements for field welding and bolting.
 - e. Details of and instructions for making field splices.
 - f. Show profiles and deflection criteria under live and total loads for joist configurations not specifically listed in SJI Standard Load Tables.
 - g. List loads used in the design of steel joists.
 - 1) Show loads and position of loads from mechanical and electrical equipment supported by the joists and framing.
- D. Delegated Design Submittals:
 1. Submit calculations for each joist type and span, documenting adequacy to resist uniform and concentrated loads indicated on the Drawings; locations, sizes and types of bridging for resisting downward and uplift loads; and adequacy of connections of joists and bridging.
- E. Certificates/certifications:
 1. SJI membership: Submit evidence of the manufacturer's current membership in SJI and of the manufacturer's qualifications to produce members of the types specified and required for the Work.
 2. SJI compliance: At the completion of manufacturer, for each joist type and load case provided, submit the manufacturer's certificate of compliance stating that design and fabrication of members was performed in accordance with SJI Standard Specifications and the approved Shop Drawings. Include manufacturer's statements that:
 - a. Welders performing shop welding for joists hold current qualification for the types of welding and welding positions required for the Work.
 - b. Manufacturer has completed in-plant before shipment to verify compliance of materials and workmanship with the requirements of SJI Standard Specifications for the products produced.
 3. Quality control program: Submit evidence of active participation in a nationally recognized program for quality control of steel fabrication.
 4. Field welding: Submit welder qualification certificates in accordance with AWS D1.1 for the types of welding and welding positions required for the Work.

- F. Test and inspection reports:
 - 1. Mill test reports: Submit manufacturer's certificates, indicating ASTM standards, structural strength, and material properties for steel used in the joists and bridging.
 - 2. Inspections:
 - a. Source quality control.
 - 1) Submit reports of manufacturer's in-plant inspections for compliance with SJI Standard Specifications.
 - b. Field quality control:
 - 1) Submit Installation and Welding Inspection Report as specified in Attachment A - Installation and Welding Inspection Report.
 - c. Field quality assurance:

1.06 QUALITY ASSURANCE

- A. Design and fabricate joists in compliance with the following and as specified in this Section:
 - 1. SJI Standard Specifications.
 - 2. SJI Standard Load Tables.
 - 3. SJI Code of Standard Practice.
- B. Qualifications:
 - 1. Manufacturers:
 - a. Holding current membership in the Steel Joist Institute and a recognized fabricator of structural steel joists conforming to the SJI Standard Specifications, the SJI Standard Load Tables, and the SJI Code of Practice.
 - 2. Installer/Erector:
 - a. Field welding: Qualified procedures and welders in accordance with AWS D1.1. Provide welders qualified within the last 12 months preceding the date of joist erection.
- C. Regulatory requirements:
 - 1. In accordance with OSHA requirements for steel erection, including specific requirements for joists and framing.
- D. Inspection:
 - 1. Inspect joists in accordance with SJI Standard Specifications.
 - 2. Inspect fabrication as specified in Part 2, Source Quality Control.
 - 3. Provide inspections for Field Quality Control and Field Quality Assurance as specified in Part 3, Execution.
- E. Pre-installation conference:
 - 1. Coordinate with the requirements of Section 05_31_00 - Steel Deck.
 - 2. Schedule and conduct pre-installation conference at least 2 weeks prior to installation of joists.
 - a. Provide additional conferences if necessary to discuss or coordinate specific conditions of installation.
 - 3. Required attendees:
 - a. Contractor.
 - b. Steel joist manufacturer's technical representative.
 - c. Steel joist installer's job superintendent.

- d. Subcontractor(s) providing and installing coatings under Division 9.
- 4. Agenda:
 - a. Joist Submittals.
 - b. Deck placing and fastening procedures.
 - c. Manufacturer's recommended inspections and inspection procedures.
 - d. Requirements and coordination for quality control inspections and quality assurance (including special inspections).
 - e. Other Specification requirements requiring coordination between parties to the Work.
- 5. Prepare and submit minutes of the pre-installation conference as specified in Section 01_31_19 - Project Meetings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Transport, deliver, store, and handle steel joists as recommended in SJI specifications, and as required to avoid stresses and to prevent damage to materials and coatings.
- B. Observe delivered materials for damage before and after unloading, and note any permanent bends, deformations, broken welds, or other damage on the receiving documents.
- C. Store joists off the ground, protected from weather and corrosion, and under watertight covering sloped to drain.
 - 1. Support by means that will protect members from distortion and damage.
 - 2. Store joists with top chord down and with plane of joist vertical.
 - 3. For deep joists that shipped on their sides, store joists as manufacturer recommends.

1.08 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.
- B. Special warranty:
 - 1. Duration: 5 years on joists.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Pre-engineered, pre-fabricated open-web steel joists, joist girders, and accessories designed and fabricated to the requirements of the SJI and details as specified in this Section and indicated on the Drawings.
- B. Design requirements:
 - 1. Design joists and bridging in accordance with current SJI Specifications and load tables to support loads indicated based on the depth, spacing, and deflections, indicated.
 - a. Maximum deflection under live load:
 - 1) Roof joists: Span divided by 240 (L/240).

- b. Minimum design loads as indicated on the Drawings:
 - 1) Dead load.
 - 2) Live load.
 - 3) Snow load.
 - 4) Wind load (net uplift).
 - 5) Axial tension and compression forces applied to the truss at end connections.
- c. Provide standard camber based on SJI Standard Specifications unless otherwise indicated on the Drawings.
 - 1) In no case shall joists be manufactured with negative (downward) camber.
 - 2) Where a joist will be installed parallel to and within 6 feet of a wall, decrease camber in that joist nearest the wall to one-half of the standard camber.
- 2. Joist chord extensions:
 - a. Top chord: Capable of withstanding the loads indicated for the joist plus any concentrated loads indicated. Brace to prevent lateral torsional buckling of the extension under loads.
 - b. Bottom chord: Capable of supporting weight of ceilings or other items indicated. Extending to within 1 inch of interior finished wall surface unless otherwise indicated on the Drawings.
- 3. Provide horizontal and diagonal bridging as required by the SJI Standard Specifications, as indicated on the Drawings, and as required to maintain stability under gravity, uplift, erection, and construction loadings.
- 4. Provide end anchorage details to secure and/or stabilize joists at supports, and to transfer any loads indicated on the Drawings.
- 5. Provide header units to support joists at openings in floor or roof framing not framed with structural steel shapes.
- 6. Accessories:
 - a. Provide miscellaneous items, including splice plates, reinforcing angles, and bolts required to complete the installation.
 - b. Provide supplemental steel framing to support steel deck where normal deck bearing is precluded by other framing members and minor openings.

2.02 MATERIALS

- A. Steel joists:
 - 1. Type, chord configuration, depth, and bearing as indicated on the Drawings.
 - 2. Comply with SJI Standard Specifications for joist series indicated.
 - 3. Details: Provide the following.
 - a. Chord members: Rolled double angle sections only. Rod or bar members are not permitted.
 - b. Chord extensions: Joists.
 - 1) Bottom chord (ceiling) extensions: Where indicated on the Drawings.
 - 2) Top chord extensions: "S-Type" or "R-Type" as indicated on the Drawings.
 - c. Chord extensions: Joist girders.
 - 1) Joist girder bottom chord extension with vertical slip connection at and stabilizer plate that is fastened to supporting structure.

- B. Bridging:
 - 1. In accordance with SJI Standard Specifications for type of joist, chord size, spacings, spans and uplift loads indicated on the Drawings.
 - 2. Anchored to walls, girders, and roof deck as indicated.
- C. Coatings:
 - 1. Shop paint. In accordance with SSPC-Paint 15.
- D. Fasteners:
 - 1. Anchor bolts and anchor rods to concrete and masonry: As specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - 2. Bolts: Pre-tensioned bolted connections.
 - a. Provide high-strength bolt assembly with hardened flat washers and nuts. Provide uncoated components unless galvanized coating is indicated on the Drawings.
 - b. Uncoated:
 - 1) Bolts: Plain, heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1.
 - 2) Nuts: Heavy hex nuts in accordance with ASTM A563, Grade C.
 - 3) Washers: Circular flat washers in accordance with ASTM F436.
- E. Accessories:
 - 1. Bearing plates: As specified in Section 05_12_00 - Structural Steel Framing.

2.03 FABRICATION

- A. Fabricate steel joist in accordance with SJI Standard Specifications to details indicated on the Drawings.
- B. Provide horizontal or diagonal type cross bridging for joists.
- C. Provide end anchorage, including bearing plates, to secure joists to adjacent construction as indicated on the Drawings.
- D. Coatings:
 - 1. Primer Coat:
 - a. Clean and prime joists and accessories in accordance with SSPC-Paint 15.
 - b. After delivery and install, remove shipping primer and prepare joists and accessories for re-priming and finish coating specified in Section 09_96_01 - High-Performance Coatings.

2.04 SOURCE QUALITY CONTROL

- A. Tests and inspections:
 - 1. Provide joist manufacturer's inspection as required by SJI Standard Specifications. Submit inspection results.
 - 2. Special inspection - Fabrication. Requirements of the building code specified in Section 01_45_00 - Regulatory Requirements for special inspection of fabricated structural items shall be considered to be satisfied when the

manufacturer is registered and approved to perform steel fabrication work in accordance with a quality control program that is certified by the Steel Joist Institute (SJI), the American Institute of Steel Construction (AISC), or similar program acceptable to building official and the Engineer.

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish and erect steel joists accordance with the requirements of SJI's Code of Standard Practice for Steel Joists and Joist Girders.

3.02 PREPARATION

- A. Field verify dimensions and elevations of structural elements supporting the joists and joist girders.
 - 1. Establish lines and elevations within tolerances before beginning erection.
 - 2. Make bearing surfaces true and uniform.
 - 3. Do not begin placement of steel joists until supporting work is in place and secured.
- B. Clean bearing surfaces of joists and supporting members before erection and as required during erection to maintain solid contact between members.
- C. Do not permit erection of steel deck until joists are connected and bridging is in place.

3.03 INSTALLATION

- A. Erection:
 - 1. Place and secure steel joists in accordance with SJI Standard Specifications, approved erection drawings, and these Specifications.
 - 2. Allow for loads from erection procedures, but do not load joists until fastening is complete.
 - 3. Provide sufficient temporary bracing to maintain joists and supporting framing safe, plumb, and in true alignment until completion of erection and installation of permanent bridging and bracing.
- B. Installation of joists and bridging:
 - 1. Do not start placement of steel joists until supporting work is in place, adjusted to specified tolerances, and secured.
 - 2. Do not field modify, alter, or repair joists unless specific written instructions have been received from the joist manufacturer and submitted to the Engineer. Such instructions shall bear the seal and signature of the joist manufacturer's registered design professional licensed in the state where the joists are installed.
 - 3. Place joists on supporting surfaces, adjust, and accurately align to required elevation, location and spacing before permanently fastening.
 - a. Set joists plumb and level (with indicated allowances for camber).
 - b. Set "tag end" of joists at location shown on the erection plans.

- c. Adjust bearing shoe elevations to provide full bearing after joists and supporting members have been plumbed and positioned, but before final tightening of connections and before any loads are imposed.
 - d. Solidly pack areas under bearing plates using materials and procedures indicated on the Drawings.
 - 4. Install bridging in accordance with OSHA 29 CFR-1926.757d and SJI Standard Specifications to provide lateral stability for the joists before slacking of hoisting lines. Quantity of bolted diagonal erection bridging shall be in accordance with SJI Standard Specifications.
 - 5. Install bridging simultaneously with joist erection and before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams. Quantity, size, and sequence for installing bridging shall be in accordance with SJI Standard Specifications.
 - 6. Erection stability and handling shall be in accordance with SJI Standard Specifications.
- C. Fastening joists:
- 1. Each joist must be attached at a minimum of one end immediately upon placement in the final erection position and before additional joists are placed.
 - 2. When field welding joists, weld to supporting steel framework in accordance with SJI Standard Specifications and as indicated on the Drawings.
 - a. Coordinate welding sequence and procedure with placing of joists.
 - b. In accordance with AWS D1.1.
 - c. Length of field welds applied to the top and bottom chords of joists shall not exceed 1/2 of the width of the steel member.
 - 3. When bolting joists, bolt to supporting steel framework in accordance with SJI Standard Specifications.
- D. Coating:
- 1. Deliver joists coated or uncoated as indicated on the Drawings and specified.
 - 2. Where members are painted or coated in place, do not begin preparation or coating until units are in place; properly, completely, and permanently fastened, and accepted by the Engineer.
 - 3. Prepare, prime, and finish as specified in Section 09_96_01 - High-Performance Coatings.
 - 4. Perform surface preparation and coating application under environmentally controlled field conditions, or in an off-site paint shop.

3.04 TOLERANCES

- A. As indicated in SJI Standard Specifications, unless otherwise noted.
- B. Deviation from straight line between opposite ends of any installed joist: Maximum 3/8 inch in 10 feet.

3.05 REPAIR

- A. Do not install damaged joists or accessories. Remove such materials from the Site and replace with new materials.

- B. Repair rust spots and coatings damaged by handling, welding, or other erection and fastening processes.
- C. After erection, touch-up rust spots, connections, field welds, and abraded areas of members using specified coatings.
 - 1. Clean and prepare damaged areas.
 - 2. Apply coating at the same thickness as that applied before erection.
 - 3. Feather edges of repairs to provide a uniform appearance after repair.
 - a. Clean and prepare surfaces using SSPC-SP 15 procedures.
 - b. Apply coating of same product and color as member. Apply primer and finish coat(s).

3.06 FIELD QUALITY CONTROL

- A. Provide field quality control over the Work of this Section as required by Section 01_45_00 - Regulatory Requirements.
- B. Field tests and inspections:
 - 1. High-strength bolting:
 - a. Confirm use of specified bolts and nuts.
 - b. Pre-tensioned connections:
 - 1) Confirm that plies of the connected elements have been brought into firm contact by the tightened connection.
 - 2) Confirm bolts pretension using turn-of-the nut method, twist-off type tension controlled nut, or direct-tension indicator washer. Do not use calibrated wrench.
 - 2. Welding - Field welds.
 - a. Perform observations and testing in the presence of the Engineer.
 - b. Visual observation:
 - 1) Visually examine welds in accordance with AWS D1.1.
 - 2) Quality of welds and standards for acceptance shall be in accordance with AWS D1.1, Visual Inspection Acceptance Criteria Table.
 - c. Test results:
 - 1) Submit records of testing to the Engineer within 24 hours after testing.
 - 3. After erection, observe installation for conformance with this Specification.

3.07 FIELD QUALITY ASSURANCE

- A. Provide field quality assurance over the Work of this Section as required by Section 01_45_00 - Regulatory Requirements.
- B. Special inspections, special tests and structural observation:
 - 1. Provide as required by Section 01_45_24 - Regulatory Quality Assurance.
- C. Field inspections:
 - 1. Required inspections:
 - a. Observe construction for conformance to the Contract Documents and the accepted Shop Drawings.
 - 1) Confirm that joist and accessory locations and tags (marks) match those indicated on the erection drawings.

- 2) Confirm that joists are installed in vertical alignment and without lateral sweep.
 - 3) Confirm that joist spacing conforms to erection drawings.
 - 4) Confirm that bridging lines, spacing, and connections/anchoring conform to erection drawings.
 - b. Visually inspect field bolting, including bolt tightness.
 - c. Visually inspect field welding using AWS certified welding inspectors in accordance with AWS D1.1.
 - 1) In accordance with AWS D1.1.
 - 2) Mark welds observed.
 - 2. Records of inspections:
 - a. Provide record of each inspection.
 - b. Submit copies to the Engineer upon request.
- D. Field testing.

END OF SECTION

ATTACHMENT A - INSTALLATION AND WELDING INSPECTION REPORT

INSTALLATION AND WELDING INSPECTION REPORT

Project:			
Client:			
Permit No.:		Structure:	
Contractor:			
Date:		Weather:	
Weather:		Temp (min/max):	
Dwg. Ref:			
Location:			

ELEMENTS INSPECTED	REF ⁽¹⁾	CONFORMS?		
		Yes	No	Comments ⁽²⁾
Member Installation:				
Joist and accessory locations, tags, and tagged end locations conform to erection drawings.	1			
Joist spacing conforms to erection drawings.	1			
Joists and accessories are installed in horizontal and vertical alignment and without lateral sweep.	1			
Joist bearing length on supporting members conforms to erection drawings and details.	1a			
Joist and accessory installations conform to specified tolerances.				
Bridging:				
Bridging locations, types (horizontal or diagonal), and member sizes conform to erection drawings.	1b			
Bridging connections to joists conforms to erection drawings.	1b			
Bridging connections to and terminations at ends/walls conforms to erection drawings.	1b			
Field Welding:				
Welds at locations indicated on erection drawings.				
Weld size and length as indicated on erection drawings.	1a			
Quality of welds complies with AWS D1.1 - Visual Inspection Acceptance Criteria Table	1a			
(Continued, next page)				

Inspector:

Name (printed): _____

Signature: _____

Date: _____

Company (printed): _____

SECTION 05_31_00

STEEL DECKING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Steel deck for floors and roofs, and associated accessories.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. American Welding Society (AWS):
 - 1. D1.3 - Structural Welding Code - Sheet Steel.

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection:
 - 1. Store steel deck at the site stacked on platforms or pallets and covered with tarpaulins or other suitable weathertight covering.
 - 2. Do not use steel deck for storage or working platform.
 - 3. Remove damaged, unlabeled, untagged, rusty, and deteriorated steel deck material from the job site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
 - 1. Vulcraft Division of Nucor Corp.
 - 2. Verco Decking, Inc.
 - 3. ASC Profiles, LLC.
 - 4. Canam Steel Corp.

2.02 MATERIALS

- A. Sheet steel: ASTM A653, G 90 minimum coating designation.

2.03 FABRICATION

- A. Steel deck shall be formed:
 - 1. So every sheet is identical and will register perfectly with adjacent sheets.
 - 2. In accordance with building code as specified in Section 01_41_00 - Regulatory Requirements.
- B. Decking used with concrete fill shall be deformed to develop composite action between the deck and the concrete.
- C. Furnish minimum gauge, deck thickness, section modulus, moment of inertia, and allowable diaphragm shear per foot of deck width that is not less than for type deck sections indicated on the Drawings.
- D. Treat exposed roof deck with phosphate.
- E. Furnish roof deck ready to receive field painting without further pretreatment. Paint exposed roof deck in accordance with Contract Documents.
- F. Accessories:
 - 1. Furnish all accessories indicated on the Drawings or needed to complete work.
 - 2. Minimum required gauges:
 - a. Sump pans: 14 gauge.
 - b. All other accessories: 20 gauge unless otherwise indicated on the Drawings.
- G. Welding and electrodes: In accordance with AWS D1.3.
- H. Furnish roof decking in lengths to minimize number of splices.
- I. Furnish steel deck complete, including cutting, shaping, fitting, drilling, welding, ridge plates, valley plates, reinforcing plates for openings, and miscellaneous pieces necessary for proper installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine work in place to verify that it is satisfactory to receive the work of this Section. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

- A. Decking shall span over at least 3 spans wherever possible.
- B. Do not damage or overload roof deck during installation.
- C. Do not use steel deck for storage or as a working platform until sheets have been welded in position.

- D. Do not exceed maximum uniformly distributed load of 20 pounds per square foot.
- E. Install decking in straight and continuous rows as far as practicable, with ribs at right angles to supporting members.
- F. For each end of deck section, provide 3 inches minimum bearing on supports. For sections that abut each other, each piece shall bear a minimum of 3 inches on the support. This requires a 6 inch minimum flange width. For cases where the minimum bearing cannot be obtained, notify the Engineer.
- G. Electric arc weld deck sections to bearing plates, supports at butt joints, at intermediate supports, side supports, and at end supports as indicated on the Drawings. Do not burn through the deck. Remove all slag.
- H. Fasten the longitudinal joints between deck sections together by the method indicated on the Drawings.
- I. Neatly cut and fit openings in roof deck, and reinforce with structural steel members as indicated on the Drawings.
- J. Paint welds as specified.
- K. Install roof deck free of dents and bent members.
- L. Reinforce all holes and openings in steel deck as indicated on the Drawings.
- M. Piping, conduit, equipment, and other services: Do not hang from decking.
- N. Install all accessories required to complete work.

3.03 REPAIR OF GALVANIZING AND COATING

- A. Touch-up damage to galvanized surfaces, including cut edges and holes, with zinc rich primer.
- B. Repair damage to factory-applied coating system in accordance with the manufacturer's printed recommendations.

3.04 CLEANUP

- A. After erection, remove weld spatter, grease, and oil from decking.

END OF SECTION

SECTION 05_50_00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Aluminum grating stair tread.
 - 2. Aluminum stair nosing.
 - 3. Cast iron stop plank grooves.
 - 4. Concrete inserts.
 - 5. Handrails and guardrails.
 - 6. Ladders.
 - 7. Manhole frames and covers.
 - 8. Metal gratings.
 - 9. Metal tread plate.
 - 10. Preformed channel pipe supports.
 - 11. Stairs.
 - 12. Miscellaneous metals.
 - 13. Associated accessories to the above items.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45: Designations from Start to Finish.
 - a. M12-C22-A41.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- C. American Welding Society (AWS):
 - 1. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- D. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A48 - Standard Specification for Gray Iron Castings.
 - 3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
 - 4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
 - 6. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 7. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

8. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 9. A489 - Standard Specification for Carbon Steel Lifting Eyes.
 10. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 11. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 12. A635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 13. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 14. A992 - Standard Specification for Structural Steel Shapes.
 15. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 16. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 17. B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 18. B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 19. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
 20. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
- E. National Association of Architectural Metal Manufacturers (NAAMM):
1. Metal Finishes Manual.
- F. Occupational Safety and Health Administration (OSHA).

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
1. Passivation: Removal of exogenous iron or iron compounds from the surface of a stainless steel by means of chemical dissolution resulting from treatment with an acid solution that removes the surface contamination but does not significantly affect the stainless steel itself.

1.04 SUBMITTALS

- A. Product data:
1. Aluminum grating stair tread.
 2. Aluminum stair nosing.
 3. Cast iron stop plank grooves.
 4. Handrails and guardrails.
 5. Manhole frames and covers.
 6. Metal grating.

- B. Shop Drawings:
1. Handrails and guardrails:
 - a. Including details on connection attachments, gates, kick plates, ladders, and angles.
 - b. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - c. Include erection drawings, elevations, and details where applicable.
 - d. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 2. Ladders.
 3. Metal grating.
 4. Metal tread plate.
 5. Stairs.
 6. Miscellaneous metals.
- C. Samples:
1. Guardrails with specified finishes.
- D. Quality Control Submittals:
1. Design data.
 2. Test reports:
 - a. Guardrails: 3 copies of certified tests performed by an independent testing laboratory certifying that guardrails meet current state and OSHA strength requirements.
 - b. Gratings:
 - 1) Grating manufacturers' calculations showing that gratings will meet specified design load, stress, and deflection requirements for each size grating for each span.
 - 2) Reports of tests performed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals in accordance with the standards of the ASTM, including the following:

Item	ASTM Standard No.	Class, Grade Type, or Alloy No.
Cast Iron		
Cast iron	A48	Class 40B
Steel		
Galvanized sheet iron or steel	A653	Coating G90
Coil (plate)	A635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes)	A36	--
Rolled W shapes	A992	Grade 50

Item	ASTM Standard No.	Class, Grade Type, or Alloy No.
Standard bolts, nuts, and washers	A307	--
High strength bolts, nuts, and hardened flat washers	F3125, Grade A325	--
Eyebolts	A489	Type 1
Tubing, cold-formed	A500	--
Tubing, hot-formed	A501	--
Steel pipe	A53	Grade B
Stainless Steel		
Plate, sheet, and strip	A240	Type 304* or 316**
Bars and shapes	A276	Type 304* or 316**
Bolts (Type 304)	F593	Group 1 Condition CW
Bolts (Type 316)	F593	Group 2 Condition CW
Aluminum		
Flashing sheet aluminum	B209	Alloy 5005-H14, 0.032 inches minimum thickness
Structural sheet aluminum	B209	Alloy 6061-T6
Structural aluminum	B209, B308	Alloy 6061-T6
Extruded aluminum	B221	Alloy 6063-T42
Notes: * Use Type 304L if material will be welded. ** Use Type 316L if material will be welded.		

1. Stainless steels are designated by type or series defined by ASTM.
2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANUFACTURED UNITS

- A. Aluminum grating stair tread:
 1. Manufacturers: One of the following or equal:
 - a. Harsco Industrial IKG, Aluminum Grating Stair Tread with Mebac® nosing.
 - b. McNichols Co., Type A-Standard with corrugated angle nosing.
 2. Material: Welded aluminum grating tread with non-slip nosing and integral end plates for bolt on attachment to stair stringers.
 3. Size:
 - a. Tread width: To equal tread spacing plus 1 inch minimum.
 - b. Tread length: Length to suit stringer-to-stringer dimension indicated on the Drawings.
 - c. Depth: 1-3/4 inches.
 4. Bolts: Type 316 stainless steel.
- B. Aluminum stair nosing:
 1. Manufacturers: One of the following or equal:
 - a. American Safety Tread Co., Inc., Style 801 nosing.

- b. Wooster Products, Inc., Type 101 nosing.
 - 2. Material: Cast aluminum abrasive nosings with aluminum oxide granules integrally cast into metal, forming permanent, nonslip, long-wearing surface.
 - 3. For installation in cast-in-place stairs.
 - 4. Configuration: 4 inches wide, fabricated with integrally cast stainless steel anchors at approximately 12-inch centers. Length to extend within 3 inches of stair edge on each side.
- C. Cast iron stop plank grooves:
 - 1. Manufacturers: One of the following or equal:
 - a. McKinley Iron Works, Type L.
 - b. Neenah Foundry Co., R-7500 Series, Type A.
 - 2. Size: 2-inch wide groove opening by 1-1/2 inch deep, unless otherwise indicated on the Drawings.
 - 3. Recess groove with the cast iron surface of the groove set flush with the concrete surface.
- D. Concrete inserts:
 - 1. For supporting pipe and other applications are specified in Section 40_05_07.01 - Pipe Supports.
- E. Handrails and guardrails:
 - 1. General:
 - a. Design and fabricate assemblies shall be in accordance with current local, state, and OSHA standards and requirements.
 - b. Coordinate layout of assemblies and post spacings to avoid conflicts with equipment and equipment operators:
 - 1) Indicate on the Shop Drawings locations of such equipment.
 - 2) Highlight locations where railings cannot be made continuous, and obtain the Engineer's directions on how to proceed before fabricating or installing railings.
 - 2. Aluminum handrails and guardrails (nonwelded pipe):
 - a. Rails, posts, and fitting-assembly spacers:
 - 1) In accordance with ASTM B429, 6005, 6063 or 6105, minimum Schedule 40, extruded aluminum pipe of minimum 1.89-inch outside diameter and 0.14-inch wall thickness.
 - b. Kick plates: 6061 or 6105 aluminum alloy.
 - c. Fastenings and fasteners: As recommended or furnished by the manufacturer.
 - d. Other parts: 6063 extruded aluminum, or F214 or F514.0 aluminum castings:
 - 1) Fabrications: In accordance with ASTM B209 or ASTM B221 extruded bars:
 - a) Bases: 6061 or 6063 extruded aluminum alloy.
 - 2) Plug screws or blind rivets: Type 305 stainless steel.
 - a) Other parts: Type 300 series stainless steel.

- e. Finish of aluminum components:
 - 1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting.
 - a) AA DAF-25 Specification M12-C22-A41: Mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
 - 2) Pretreat aluminum for cleaning and removing markings before anodizing.
- f. Fabrication and assembly:
 - 1) Fabricate posts in single, unspliced pipe length.
 - 2) Perform without welding.
 - 3) Do not epoxy bond the parts.
 - 4) Maximum clear opening between assembled railing components as indicated on the Drawings.
- g. Manufacturers: One of the following or equal:
 - 1) Craneveyor Corp. Enerco Metals, C-V Rail.
 - 2) Golden Railings, Riveted System.
 - 3) Moultrie Manufacturing Co., Wesrail.
- 3. Guardrail gates:
 - a. Supplied by the guardrail manufacturer:
 - 1) Of same material, quality, and workmanship as specified for guardrail system in which they will be installed.
 - 2) Of design similar to that of handrail or railing system in which they will be installed.
 - b. Components: Gate frame, stainless steel self-closing device, hinges, gate stops, and durable self-locking type latch. Fabricate components in accordance with OSHA minimum strength requirements.
- 4. Fastenings and fasteners: As recommended or furnished by the guardrail manufacturer for use with this system.

F. Ladders:

- 1. General:
 - a. Type: Safety type in accordance with local, state, and OSHA standards as minimum. Furnish guards for ladder wells.
 - b. Size: 18 inches wide between side rails of length, size, shape, detail, and location indicated on the Drawings.
- 2. Aluminum ladders:
 - a. Material: 6063-T5 aluminum alloy.
 - b. Rungs:
 - 1) 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides.
 - 2) Capable of withstanding 1,000-pound load without failure.
 - c. Side rails: Minimum 4-inch by 1/2-inch flat bars.
 - d. Finish of aluminum components:
 - 1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting.
 - a) AA DAF-45 Specification M12-C22-A41: Mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
 - 2) Pretreat aluminum for cleaning and removing markings before anodizing.

- e. Fabrication:
 - 1) Welded construction, of size, shape, location, and details indicated on the Drawings.
 - 2) For fixed ladders over 24 feet high, provide a fall prevention system designed in accordance with state and OSHA requirements.
 - f. Fall prevention system: Including, but not limited to, railing, brackets, clamps, 2 sleeves, and 2 belts, in accordance with OSHA safe climbing requirements:
 - 1) Manufacturers: One of the following or equal:
 - a) North Consumer Products, Saf-T-Climb.
 - b) Swager Communications, Climbers Buddy System.
- G. Manhole frames and covers:
- 1. Material: Gray iron castings, in accordance with ASTM A48, Class 30-B.
 - 2. Type: Heavy-duty traffic type, with combined minimum set weight of 265 pounds.
 - 3. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.
 - 4. Frame:
 - a. Bottom flange type.
 - b. Approximately 4-1/2-inches frame height.
 - c. Dimensions as indicated on the Drawings.
 - 1) Minimum inside clear dimension may not be smaller than nominal diameter minus 2 inches.
 - 5. Cover:
 - a. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as ELECTRICAL, SEWER, TELEPHONE, or WATER.
 - b. Solid type without ventilation holes.
 - 6. Finish: Unpainted.
- H. Metal gratings:
- 1. General:
 - a. Fabricate grating to cover areas indicated on the Drawings.
 - b. Unless otherwise indicated on the Drawings, grating over an opening shall cover entire opening.
 - c. Make cutouts in grating where required for equipment access or protrusion, including valve operators or stems, and gate frames.
 - d. Band ends of grating and edges of cutouts in grating:
 - 1) End banding: 1/4 inch less than height of grating, with top of grating and top edge of banding flush.
 - 2) Cutout banding: Full-height of grating.
 - 3) Use banding of same material as grating.
 - 4) Panel layout: Enable installation and subsequent removal of grating around protrusions or piping.
 - 5) Openings 6 inches and larger: Lay out grating panels with edges of 2 adjacent panels located on centerline of opening.
 - 6) Openings smaller than 6 inches: Locate opening at edge of single panel.

- 7) Where an area requires more than 1 grating section to cover area, clamp adjacent grating sections together at 1/4-points with fasteners acceptable to the Engineer.
 - 8) Fabricate steel grating sections in units weighing not more than 50 pounds each.
 - 9) Fabricate aluminum grating sections in units of weighing not more than 50 pounds each.
 - 10) Gaps between adjacent grating sections shall not be more than the clear spacing between bearing bars.
 - e. When requested by the Engineer, test 1 section of each size grating for each span length involved on the job under full load:
 - 1) Furnish a suitable dial gauge for measuring deflections.
 - f. Grating shall be aluminum, unless otherwise specified or indicated on the Drawings.
2. Aluminum grating:
 - a. Material for gratings, shelf angles, and rebates: 6061-T6 or 6063-T6 aluminum alloy, except crossbars may be 6063-T5 aluminum alloy.
 - b. Shelf angle concrete anchors: Type 304 or Type 316 stainless steel.
 - c. Grating rebate rod anchors: 6061-T6 or 6063-T6 aluminum alloy.
 - d. Bar size and spacing: As determined by the manufacturer to enable grating to support design load.
 - e. Design live load: A minimum of 100 pounds per square foot uniform live load on entire grating area, but not less than the live load indicated on the Drawings for the area where grating is located.
 - f. Maximum fiber stress for design load: 12,000 pounds per square inch.
 - g. Maximum deflection due to design load: 1/240 of grating clear span.
 - h. Maximum spacing of main grating bars: 1-1/8 inches clear between bars.
 - i. Minimum grating height: 1-1/2 inches.
 - j. Manufacturers: The following or equal:
 - 1) Harsco Industrial IKG, Swaged Aluminum I-Bar with striated finish.
 3. Heavy-duty steel grating:
 - a. Fabricated from structural steel and designed in accordance with AASHTO Standard Specifications for Highway Bridges, using H-20 loading.
 - b. Hot-dip galvanized after fabrication in accordance with ASTM A123.
 - c. Manufacturers: One of the following or equal:
 - 1) Reliance Steel Products Co., Heavy-Duty Steel Grating.
 - 2) Seidelhuber Metal Products, Inc., equivalent product.
- I. Metal tread plate:
 1. Having a raised figured pattern on one surface to provide improved traction.
 - J. Preformed channel pipe supports:
 1. As specified in Section 40_05_07.03 - Preformed Channel Pipe Support System.
 - K. Stairs:
 1. Aluminum stairs:
 - a. Stringers: 6061-T6 aluminum alloy.
 - b. Stair treads:
 - 1) Aluminum of same type specified under aluminum grating.

- 2) Of sizes indicated on the Drawings, and 1-3/4 inch minimum depth with cast abrasive type safety nosings.
 - c. Provide a vertical close piece between each riser. Fabricate, install, and fasten close pieces as indicated on the Drawings.
 - d. Handrails and guardrails: Aluminum pipe specified under the aluminum handrails and guardrails (nonwelded pipe) article.
 - e. Fasteners: Type 304 or Type 316 stainless steel.
- L. Miscellaneous aluminum:
- 1. Fabricate aluminum products, not covered separately in this Section, in accordance with the best practices of the trade and field assemble by riveting or bolting.
 - 2. Do not weld or flame cut.
- M. Miscellaneous cast iron:
- 1. Tough, gray iron, free from cracks, holes, swells, and cold shuts.
 - 2. Quality such that hammer blow will produce indentation on rectangular edge of casting without flaking metal.
 - 3. Before leaving the foundry, clean castings and apply 16-mil dry film thickness coating of coal-tar epoxy, unless otherwise specified or indicated on the Drawings.
- N. Miscellaneous stainless steel:
- 1. Provide miscellaneous stainless steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
 - a. Fabricate and install in accordance with the best practices of the trade.
 - 2. Cleaning and passivation:
 - a. Following shop fabrication of stainless steel members, clean and passivate fabrications.
 - b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a passive finished surface.
 - c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
 - 1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
 - d. Pre-clean, chemically descale (pickle), and final clean fabrications in accordance with the requirements of ASTM A380 to remove deposited contaminants before shipping.
 - 1) Passivation by citric acid treatment is not allowed.
 - a) If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible; however, these treatments shall be followed by inorganic cleaners such as nitric-hydrofluoric acid.
 - 2) Provide acid descaling (pickling) in accordance with Table A1.1 of Annex A1 of ASTM A380.
 - 3) After pickling, final cleaning of stainless steel shall be in accordance with Part II of Table A2.1 of Annex A2 of ASTM A380.
 - e. After cleaning, inspect using methods specified for "gross inspection" in ASTM A380.

- f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the job site.
- O. Miscellaneous structural steel:
 - 1. Provide miscellaneous structural steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
 - a. Fabricate and install in accordance with the best practices of the trade.
- P. Isolating sleeves and washers:
 - 1. As indicated on the Drawings and as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 - 1. Examine work in place to verify that it is satisfactory to receive the Work of this Section.
 - 2. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Install products as indicated on the Drawings, and in accordance with Shop Drawings and the manufacturer's printed instructions, as applicable, except where specified otherwise.
 - 2. Interface between materials:
 - a. Dissimilar metals: Where steel comes in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals.
 - 1) Make application so that the isolating or protective barrier is not visible in the completed construction.
 - 2) Isolating sleeves and washers: As specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - b. Aluminum in contact with concrete or masonry: Coat aluminum surfaces as specified in Section 09_96_01 - High Performance Coatings.
 - c. Aluminum in contact with concrete or masonry.
- B. Aluminum stair nosing:
 - 1. Install on treads of concrete stairs, including top tread on upper concrete slab.
 - 2. Omit where concrete is submerged.
 - 3. Cast in fresh concrete, flush with tread and riser faces. Install nosing in center of step.
- C. Cast iron stop plank grooves:
 - 1. Recess stop plank grooves with cast iron surfaces of groove set flush with concrete surface.

D. Handrails and guardrails:

1. General:

- a. Fasten pipe rails to fittings with Series 300 stainless steel pop rivets or flush set screws.
- b. Make pipe cuts clean and straight, free of burrs and nicks, and square and accurate for minimum joint-gap.
- c. Drill and countersink holes to proper size, as required for a tight flush fit of screws and other component parts.
- d. Space attachment brackets as indicated in the manufacturer's instructions.

2. Aluminum pipe handrails and guardrails:

- a. During construction, keep exterior surfaces of handrails and guardrails covered with minimum 0.4 millimeters of heat shrink polyethylene film.
- b. Do not remove protective film before handrails and guardrails have been accepted by the Engineer or before other work in proximity of handrails and guardrails has been completed.
- c. Discontinue handrails and guardrails at lighting fixtures.
- d. Provide 1/8-inch diameter weep hole at base of each post.
- e. Space posts as indicated on the Drawings.
- f. Anchor posts into concrete by grouting posts into formed holes in concrete, into stainless steel sleeves cast in concrete; or bracket mount to face of concrete surfaces as specified and indicated on the Drawings.
- g. Space rails as indicated on the Drawings.
- h. Make adequate provision for expansion and contraction of kick plates and rails.
 - 1) Make provisions for removable sections where indicated on the Drawings.
- i. Make lower rails a single, unspliced length between posts, or continuous.
- j. Make top rails continuous whenever possible, and attach single, unspliced lengths to 3 posts minimum.
- k. Draw up fasteners tight with hand wrench or screwdriver.
- l. Space attachment brackets as indicated on the Drawings or in the manufacturer's installation instructions.
- m. Completed installation shall have handrails and railings rigid and free of play at joints and attachments.
- n. Protect handrail and guardrail finish from scratches, gouges, dents, stains, and other damage.
- o. Replace damaged or disfigured handrails and guardrails with new.
- p. Shortly before final acceptance of the Work, and after removal of protective polyethylene film, clean handrails and guardrails with mild detergent or with soap and water.
 - 1) After cleaning, thoroughly rinse handrails and guardrails and wipe with soft cloth.
- q. Erect guardrail straight, level, plumb, and true to the positions as indicated on the Drawings. Correct deviations from true line of grade, which are visible to the eye.

3. Guardrail gates:

- a. Install gate to be a vertical plane with the guardrail when in the closed position.
- b. Install hinges so that each gate can swing 180 degrees from the closed position to the fully open position.

- c. Install so that the gates swing to the walkway side of the guardrail only.
 - 1) Install gate stops on the stationary railing posts to prohibit gates from swinging in the wrong direction.
 - d. Install gate frames, hinges, stops, and latches in accordance with OSHA minimum strength requirements.
- E. Ladders:
 - 1. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.
 - 2. Where exit from ladder is forward over top rung, extend side rails 3 feet-3 inches minimum above landing, and return the rails with a radius bend to the landing.
 - 3. Where exit from ladder is to side, extend ladder 5 feet-6 inches minimum above landing and rigidly secure at top.
 - 4. Erect rail straight, level, plumb, and true to position indicated on the Drawings:
 - a. Correct deviations from true line or grade which are visible to the eye.
- F. Manhole frames and covers:
 - 1. Installation: As recommended by the manufacturer.
- G. Metal gratings:
 - 1. General:
 - a. Allow 1/8-inch maximum clearance between ends of grating and inside face of vertical leg of shelf angles.
 - b. Horizontal bearing leg of shelf angles shall be 2 inches minimum.
 - c. Install aluminum plate or angles where necessary to fill openings at changes in elevation and at openings between equipment and grating.
 - d. Install angle stops at ends of grating.
 - e. Installed grating shall not slide out of rebate or off support.
 - f. Weld stops in place, unless otherwise specified or indicated on the Drawings.
 - g. Top surfaces of grating sections adjacent to each other shall lie in same plane.
 - 2. Aluminum grating:
 - a. Support on aluminum shelf angles or rebates.
 - 3. Heavy-duty steel grating:
 - a. Support on hot-dip galvanized structural steel rebates embedded and anchored in concrete.
 - b. Use for roadways, traffic areas, and where indicated on the Drawings.
- H. Stairs:
 - 1. Install guard railings around stair wells as indicated on the Drawings or specified.
- I. Stainless steel:
 - 1. Welding:
 - a. Passivate field-welded surfaces:
 - 1) Provide cleaning, pickling and passivating as specified in this Section.
 - 2) Clean using Derustit stainless steel cleaner, or equal.

END OF SECTION

SECTION 07_11_00

DAMPPROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Dampproofing.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation meeting:
 - 1. As specified in Section 01_31_19 - Project Meetings.
 - 2. Prior to beginning Work, convene a meeting to review conditions, installation procedures, schedules, and coordination with other Work.
 - 3. Convene a minimum of 2 weeks prior to starting Work.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data.
 - 1. Manufacturer's data sheets on each product to be used, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
- C. Warranty:
 - 1. Sample warranty identifying the terms and conditions stated in the warranty article.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in original, unopened containers in accordance with the manufacturer's printed instructions.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply bituminous dampproofing when temperatures are 40 degrees Fahrenheit or lower, or when rain is forecast for the 24 hours following application.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Dampproofing: ASTM D1227, Asbestos Free, Emulsified Asphalt Coatings:
 - 1. Manufacturers: One of the following or equal:
 - a. Karnak Corp., Karnak 220 AF.
 - b. W.R. Meadows, Inc., Sealmatic Type 2 Asphalt Emulsion Dampproofing.
- B. Sealing mastic:
 - 1. Compatible with dampproofing and free of toxic solvents with thick mastic consistency and smooth and uniform in composition.
 - 2. As recommended by the dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are satisfactory for application of products in accordance with the manufacturer's recommendations.
- B. Verify that surfaces to receive dampproofing are clean, dry, reasonably smooth, free of dust, dirt, voids, cracks, or sharp projections.

3.02 APPLICATION

- A. Completely cover surfaces to receive dampproofing with 2 coats:
 - 1. Applied by brush or spray.
 - 2. Apply dampproofing at the manufacturer's recommended rate of application or minimum 2 gallons per 100 square feet, whichever is greater.
- B. Extend dampproofing to 6 inches above finish grade.
- C. Apply each coat evenly so surfaces have uniform black appearance.
- D. Apply second coat at right angles to first, allowing not less than 24 hours between coats.
- E. Seal around items and services projecting through dampproofing surfaces in accordance with the manufacturer's recommendations.
- F. Ensure sealed areas are moisture tight.
- G. Backfill completely against dampproofing application within time recommended by the manufacturer.

END OF SECTION

SECTION 07_19_00

WATER REPELLENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Water repellent for brick.

1.02 REFERENCES

- A. International Union of Testing and Research Laboratories for Materials and Structures:
 - 1. RILEM Test Method No. 11.4 - Measurement of Water Absorption Under Low Pressure.

1.03 DEFINITIONS

- A. Water Repellent: Resistance to penetration of water from rainfall.

1.04 SUBMITTALS

- A. Product Data.
- B. Samples: Water repellent applied on 8-inch by 8-inch substrates to receive water repellent, marked with application date and application rate.
- C. Manufacturer's Application Instructions.

1.05 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of water repellents for minimum of 5 years with satisfactory performance record.
- B. Applicator qualifications: Trained, approved, and accepted by water repellent manufacturer.
- C. Spray personnel qualifications: Minimum 2 years of experience spraying exotic coatings.
- D. Regulatory requirements: Comply with volatile organic compound regulations.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original containers with seals unbroken and labeled with manufacturer's batch number.
- B. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Apply water repellent under temperature and relative humidity conditions before, during, and after application in accordance with manufacturer's instructions.
- B. Allow surfaces to dry for minimum 5 days after rains.

1.08 PROJECT CONDITIONS

- A. Make proper material allowance based upon substrate material and surface configuration when determining quantities of material.

1.09 WARRANTY

- A. Warrant to furnish and apply water repellent on walls that experience water penetration because of failure of water repellent for minimum 5 years.

1.10 MAINTENANCE

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Water repellent sealer:
 - 1. One of the following or equal:
 - a. Rainguard Products.
 - b. ProSoCo, Inc.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Performance requirements: Surfaces with water repellent shall be uniform in color with unaltered texture.

2.03 MATERIALS

- A. Water repellent sealer for brick, clay brick tile, brick veneer, stone, and wood: Silane/siloxane; volatile organic compound compliant; free of silicone oils, paraffin wax, or urethanes.
 - 1. Manufacturers: The following or equal:
 - a. Rainguard, STD-E.

2.04 EQUIPMENT

- A. Spray equipment: High-volume, low-pressure, airless, with maximum 60 pounds per square inch pressure:
 - 1. Pump: Non-atomizing, able to flow material on walls at minimum 1 to 1-1/2 gallons per minute.
 - 2. Orifice size for concrete, slump block, exposed concrete aggregate, and cement plaster: 0.060 to 0.110 inches.
 - 3. Orifice size for brick, clay brick tile, brick veneer, stone, and wood: 0.060 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Carefully inspect installed construction. Verify that construction is ready for repellent application.
- B. Require manufacturer's representative to verify that water repellent may be installed.

3.02 PREPARATION

- A. Allow concrete or masonry walls to cure at least 30 days before applying water repellent.
- B. Clean wall surfaces of soil, mud, efflorescence, or other detrimental materials.
- C. Tuck-point or caulk cracks, other than hairline cracks.
- D. Route out defective mortar joints, point with mortar and tool.
- E. Moisture content: Apply water repellent sealer when moisture content of substrate is 15 percent or less.

3.03 APPLICATION ON BRICK, CLAY BRICK TILE, BRICK VENEER, STONE, AND WOOD

- A. Apply water repellent in accordance with manufacturer's printed instructions.
- B. Apply wet coat in horizontal passes using low-pressure spray equipment with or without rundown.
- C. Overlap each following pass by approximately 50 percent.
- D. Trigger gun off at the end of each pass to avoid an excessive amount of material being applied.
- E. Keep surface wet for 5 to 10 minutes and damp for over 1 hour.
- F. Do not apply in hot or windy weather. Over-application can result in whitish residue on surface.

3.04 FIELD QUALITY CONTROL

- A. 20 days after application, test water repellent on CMU surfaces using RILEM Test Method No. 11.4:
 - 1. Contractor shall perform a 20-minute RILEM baseline test on dry untreated CMU units of each type to receive water repellent. Test results (water loss in milliliter) shall be compared to CMU units in walls after water repellent application.
 - 2. On water repellent coated CMU, a RILEM tube test resulting in 5 milliliter or less after 20 minutes is necessary to qualify for 5-year warranty.

- B. Notify the Engineer and manufacturer at least 72 hours in advance of test.
- C. Where tested wall areas fail to pass RILEM tube test, apply additional coat of water repellent on entire wall from corner to corner.
- D. Test all locations where directed by the Engineer.

3.05 CLEANING

- A. Concrete, concrete masonry, exposed concrete aggregate, and cement plaster: Clean drips, runs, and overspray residue while still wet, using detergent and water. Clean application and spray equipment with detergent and water immediately following use.
- B. Brick, clay brick tile, brick veneer, stone, and wood: Clean drips, runs, and overspray residue with petroleum type thinner following application.
- C. Clean application and spray equipment according to the manufacturer's recommendations.
- D. Remove excess materials, equipment, and debris incidental to water repellent application upon completion.

3.06 PROTECTION

- A. During application, protect water repellent treated and adjacent surfaces from damage.
- B. Protect glass, aluminum, and other surfaces from overspray.
- C. Protect concrete sidewalks from runoff. Soak with water immediately prior to application on adjacent walls.
- D. Repair damaged areas promptly.

END OF SECTION

SECTION 07_22_00
ROOF AND DECK INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Roof and deck insulation and associated accessories.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 2. D41- Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 3. D312 - Standard Specification for Asphalt Used in Roofing.
- B. National Roofing Contractors Association (NRCA).
- C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

- A. Product data.
- B. Samples. Include 6-inch square samples of each type and thickness of insulation required.
- C. State thickness and R-value of insulation to be provided at each building.
- D. Manufacturer's installation instructions: Include the following:
1. Indicate special environmental conditions required for installation.
 2. Indicate adhesive recommendations.
 3. Indicate fastener recommendations and attachment pattern to meet specified FM 1-90 requirements.
 4. Indicate installation techniques.
- E. Certificates:
1. Certify that products meet or exceed specified requirements.
 2. Certify that insulation is approved by manufacturer for use with specified roofing materials.
- F. Manufacturer's field reports.
- G. Warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.
- B. Installer qualifications:
 - 1. Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.
 - 2. Committed to complying with manufacturer's specifications and NRCA recommendations.
 - 3. Committed to assuming undivided responsibility for roof insulation, roofing membrane and sheet metal flashing, and trim associated with roofing.
- C. Product compatibility: Provide roofing manufacturer approved roof insulation.
- D. Pre-installation conference: Conduct as specified in Section 01_31_19 - Project Meetings

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with manufacturer's instructions.
- B. Label asphalt containers with certification of full compliance with requirements of ASTM D312, Table 1, and indicating equiviscous temperature, finished flowing temperature, and flash point.
- C. Store roof system materials on pallets or dunnage at least 4 inches above ground and suitably covered to protect from weather.

1.06 SEQUENCING AND SCHEDULING

- A. Apply no more insulation than can be completely covered with roofing membrane on the same day.
- B. When installation of insulation and roof membrane cannot be completed within same day, install temporary water cutoffs at end of day's work and remove cutoffs prior to resumption of work.

1.07 WARRANTY

- A. Furnished by metal roof manufacturer, as specified in Section 07_61_13 - Roof and Deck Insulation.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Roof insulation system: As follows with UL Class A and FM Class 1A fire classification and meeting FM 1-90 wind up-lift requirements.
 - 1. Where 5-inch rigid foam roof insulation is indicated on the Drawings, insulation shall be as follows:
 - a. First layer: 1.5-inch thick foam insulation having an R-Value of 9.0.
 - b. Second layer: 3.4-inch thick foam insulation having an R-Value of 21.1.
 - c. Total system thickness shall be 4.9 inches and have a minimum R-Value of 30.0.

2.02 MATERIALS

- A. Vapor retarder: ASTM D2178, Type IV; asphalt impregnated glass fiber sheet with nominal tensile strength 30 percent higher than required by ASTM D2178 for Type IV felts:
 - 1. Manufacturers: One of the following or equal:
 - a. John Manville, Inc., GlasPly Premier.
 - b. Atlas Roofing Corp., equivalent product.
- B. Rigid foam roof insulation:
 - 1. Closed cell polyisocyanurate foam core bonded to universal fiberglass reinforced facers.
 - 2. Utilizing environmentally compliant blowing agent.
 - 3. Manufacturers: One of the following or equal:
 - a. Johns Manville, Inc., ENRGY 3.
 - b. Atlas Roofing Corp., AC Foam II.
- C. Roof crickets and saddles: Tapered Perlite Roof Insulation or as otherwise recommended by roofing manufacturer to meet warranty requirements.
- D. Primer: ASTM D41, asphalt primer.
- E. Bitumen: ASTM D312, Type II, III, or IV petroleum asphalt, free from inorganic matter; as recommended by manufacturer for interply moppings to suit particular slope limitations.

2.03 ACCESSORIES

- A. Screw fastener system for steel decks:
 - 1. Self-drilling and self-tapping, zinc plated or stainless steel screws, sized for 1/2- to 3/4-inch exposure on exposed to view underside of deck, with minimum 3-inch square or diameter ribbed steel stress plates, hot-dip galvanized with minimum G-60 coating in accordance with ASTM A123.
 - 2. Manufacturers: One of the following or equal:
 - a. Tru Fast.
 - b. TW Buildex.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck is properly graded to outlets.
- B. Verify that deck surfaces are clean, dry, and where required, coated with primer.

3.02 PREPARATION

- A. Embed 1 ply of roofing felt over roof drains and minimum 6 inches over adjacent surface in solid uniform layer of plastic cement.

3.03 HEATING OF ASPHALT AND APPLICATION TEMPERATURES

- A. Equip kettles and tankers with accurate, fully readable thermometers.
- B. Do not heat asphalt to or above their flash points.
- C. Avoid heating at or above finished flowing temperature.
- D. When accepted, heat above finished flowing temperature for no more than 4 hours.
- E. Apply asphalt at maximum 25 degrees Fahrenheit below finished flowing temperature or above equiviscous temperature.
- F. Do not cut or alter bitumens.

3.04 INSTALLATION OVER STEEL DECK

- A. Install roof insulation in accordance with manufacturer's specifications.
- B. Secure wood nailers to roof deck adjoining eaves, at roof curbs for attachment of flashing and counterflashing, and at other locations indicated on the Drawings.
 - 1. Nailers shall be built up of pressure treated wood to match the thickness of the insulation.
- C. Apply first layer of roof insulation with long joints continuous, either parallel or at right angles to ribs of deck.
- D. Form joints parallel to ribs over solid bearing.
- E. Stagger end joints.
- F. Secure with approved mechanical fasteners in FM I-90 pattern:
 - 1. Space fasteners as recommended by insulation manufacturer.
 - 2. Drive fasteners through tin caps or plastic fastener/cap assemblies, unless they are provided with integral flat cap not less than 1 inch across.
 - 3. Install screw fastener system in top rib of steel deck in accordance with manufacturer's instructions. Where underside of metal deck is exposed to view, size fasteners to penetrate deck from 1/2- to 3/4-inch, unless otherwise recommended by fastener manufacturer.

- G. Vapor retarder:
 - 1. Apply one 18 inch wide layer of vapor retarder, then continue with full 36 inch widths, lapping each course 2 inches over preceding one.
 - 2. Install each felt so felt is firmly and uniformly set, without voids, into hot asphalt applied just before felt at nominal uniform 23 pounds per square over entire surface.
 - 3. Turn up edges of felts on, but not connected to, vertical surfaces and extend beyond roof edges for coverage sufficient to permit minimum 4 inch return over top surface of insulation.
- H. Apply second layer of roof insulation with both long and short joints offset from joints of first layer. Firmly set in full width mopping of hot asphalt applied at approximately 33 pounds per square.
- I. Install cant strips at curbs, parapets, and intersections of roofs and vertical walls, when recommended by membrane manufacturer. Place on top of insulation and set in solid mopping of asphalt.
- J. Roof crickets:
 - 1. Install as required to achieve drainage pattern indicated on the Drawings, and as otherwise required to obtain roof warranty. Set in full mopping of hot asphalt. Feathered edges of crickets and tapered insulation shall be formed of perlite or fiber board.
 - 2. Mop 12-inch wide felt strip into solid asphalt at valley formed by installation of roof crickets to provide additional membrane reinforcement.
- K. Before application of roofing, turn over and solidly mop projecting felt to insulation at vertical surfaces and edges.
- L. Do not leave insulation exposed to weather.

3.05 FIELD QUALITY CONTROL

- A. Roof insulation which becomes wet or damaged shall be removed and replaced with solid, dry insulation, unless installer provides written acceptance of the damaged insulation from the roofing manufacturer, whose warranty shall cover the system.
- B. Inspections: Roof membrane manufacturer, whose warranty shall cover complete roof assembly, shall provide supervision and inspection necessary to secure warranty.

END OF SECTION

SECTION 07_61_13

STANDING SEAM SHEET METAL ROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Preformed metal roofing, fascia, and associated accessories.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. B32 - Standard Specification for Solder Metal.
 - 3. D2626 - Standard Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing.
- B. NSF International (NSF).

1.03 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Provide delegated design for the following:
 - 1. Roofing sheet material thickness.
 - 2. Connection of roofing sheets to support/hold-down clips.
 - 3. Strength, details, and locations of roofing support/hold-down clips.
 - 4. Connection of roofing support/hold-down clips to supporting structural elements.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings: Include thicknesses and dimensions of parts, fastening and anchoring methods, details and locations of seams, joints, and other provisions for thermal movement. Show plans and elevations at minimum scale of 1/4 inch to 1 foot, and details at minimum scale of 3 inches to 1 foot.
- C. Product data: Include standard color and finish options.
- D. Samples: Include 8-inch square samples of color and finish on specified substrate.
- E. Manufacturer's installation instructions.
- F. Certificates.
- G. Manufacturer's approval of installer and shop drawings.

- H. Maintenance data.
- I. Warranty.

1.05 QUALITY ASSURANCE

- A. Installer qualifications: Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.
- B. Exposed sheet metal material used for roofing including roofing panels, fascia, flashings, closures, and other trim shall be product of 1 manufacturer.
- C. Other materials shall be products approved or recommended by roofing system manufacturer.

1.06 DELIVER, STORE, AND HANDLE PRODUCTS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS WARRANTY

- A. Roofing: Warrant to maintain roof, including flashings, in watertight condition and to maintain finish free from change in color or physical deterioration for minimum 5 years limited to ordinary wear and tear by elements or defects due to faulty materials and workmanship.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Regulatory requirements:
 - 1. Comply with the building code specified in Section 01_41_00 - Regulatory Requirements.
- B. Design and detailing:
 - 1. Design to withstand the following loads, and additional loads indicated on the Drawings.
 - a. Dead loads.
 - b. Live loads: Minimum 20 pounds per square foot.
 - 1) Reductions in uniform live load based on tributary area are not allowed.
 - c. Loads specified in Section 01_81_50 - Design Criteria.
 - 1) Seismic load.
 - 2) Wind load.
 - 3) Snow load.
 - 4) Atmospheric icing load.
 - 2. Load combinations: As required by the building code.
 - 3. Roofing system shall be suitable for wet reservoir environment.

2.02 MANUFACTURERS

- A. Preformed metal roofing:
 - 1. One of the following or equal:
 - a. IMSA Building Products.
 - b. Metal Sales Manufacturing Corp.
 - c. Berridge Manufacturing Co.

2.03 PREFORMED METAL ROOFING

- A. Batten type, sheet steel roofing system including:
 - 1. Fascia, flashing, and sealants.
 - 2. Fasteners and support clips.
- B. Roofing system shall be suitable for installation over, and exposure to, wet reservoir environment with chlorine concentration of 4 parts per million.

2.04 EXPOSED COMPONENTS

- A. Sheet steel:
 - 1. ASTM A653, G90 minimum coating designation, minimum 22 gauge.
- B. Finish:
 - 1. Top: Precoated, factory-finished aliphatic polyurethane over epoxy-based primer, minimum total dry film thickness 1.5 mil within 0.20 mil.
 - 2. Bottom: NSF approved 2 coat epoxy coating, minimum total dry film thickness 8.0 mil within 0.2 mil.
 - 3. Color: To match color of existing metal roof and fascia in use at major buildings on site.

2.05 ACCESSORIES

- A. Underlayment: ASTM D2626, asphalt-saturated and coated organic felt, minimum 28 pounds.
- B. Hold-down clips: Stainless steel of type that will allow thermal movement of roof panels.
- C. Snow Guards: Match existing.
- D. Closures: System manufacturer's standard neoprene blocks shaped to fit roof metal profile.
- E. Solder: ASTM B32 alloy composition SN 50.
- F. Fasteners:
 - 1. Nails, screws, rivets, and other fasteners: Stainless steel or alloy appropriate to roofing metal.
 - 2. Nails: Ringed or twisted shank type, of lengths required.
 - 3. Screws: Stainless steel pan head wood or sheet metal screws for use with hold-down clips.

- G. Sealant: As specified in Section 07_92_00 - Joint Sealants, unless recommended otherwise by panel manufacturer.

2.06 FABRICATION

- A. Panels:
 - 1. Fabricate with upturned edges to form standing seam joints to match existing roofing and fascia in use on site.
 - 2. Fabricate to extend from eaves to ridge in a single length, with no end laps.
- B. Battens: Sized to match existing standing seam roof on site, and evenly spaced approximately 24 inches on center.
- C. Ridge, hips, eaves, rakes, fascia, coping, and other exposed flashings: Form of sheet steel matching roofing to provide weathertight roofing system.
- D. Form sheets, battens, strips, cleats, valleys, ridges, edge treatments, integral flashings, gutters, downspouts, and other components to profiles indicated on the Drawings and required for permanent leakproof construction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions at structure where roofing will be installed.
- B. Verify that substrate is firm, dry, and free of foreign materials.

3.02 PREPARATION

- A. Clean and repair adjoining surfaces when necessary for proper installation of preformed metal roofing panels.

3.03 ROOFING

- A. Install roofing in accordance with manufacturer's recommendations.
- B. Lay out pattern to place batten seams equidistant from corners and aligned with seams on other side of hip or ridge.
- C. Start installation from eaves.
- D. Secure roofing panels in place with concealed clips and fasteners.
 - 1. Exposed fasteners through roof panels, batten covers, and flashings shall not be used.
- E. Locate clips in joints within 6 inches of panel ends.
- F. At eaves, cut upturned edges and bend panel down to form fascia.

- G. At intersections of roof slope with ridge and hips, turn up edges of roof panels 1 inch.
- H. Form cross seams with 3/4-inch fold-under on lower end and 2-inch fold-over on upper end.
- I. Slit folds in cross seams at each corner 1 inch in from batten to form tab.
- J. Hook hold-down cleats, fold on lower end of panel into fold on upper end of underlaying panel.
- K. Exposed batten ends to have neoprene closures or watertight cap.
- L. Form valleys of sheets not exceeding 10 feet in length.
- M. Lap joints 6 inches in direction of drainage.
- N. Extend valley sheet minimum of 6 inches under roofing sheets.
- O. At valley, double fold valley and roofing sheets and secure with cleats spaced 18 inches on center.
- P. Install ridge and hip covers securely in place using Z closer clips and fasteners.
- Q. Seal joints where necessary for watertightness.
- R. Completed roof shall be watertight.
- S. Exposed surfaces shall be free of dents, scratches, abrasions, stains, and other visible defects.

END OF SECTION

SECTION 07_92_00

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Acrylic-latex sealant.
 - 2. Silicone sealant.
 - 3. Synthetic rubber sealing compound.
 - 4. Synthetic sponge rubber filler.
 - 5. Related materials.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C920 - Standard Specification for Elastomeric Joint Sealants.
 - 2. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
 - 3. C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 - 4. D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - 5. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

1.03 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product Submittals:
 - 1. As specified in Section 01_60_00 - Product Requirements.
 - 2. Product data.
 - 3. Shop Drawings.
 - 4. Samples, include color selections.
 - 5. Manufacturer's instructions.
 - 6. Calculations.
 - 7. Schedules.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of proposed product for minimum of 5 years with satisfactory performance record.
- B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as the Project with satisfactory performance record.

1.05 PROJECT OR SITE CONDITIONS

- A. Do not apply sealant on wet or frosty surfaces or when surface temperature is higher than 100 degrees Fahrenheit or lower than recommended by the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with the manufacturer's recommendations.
- B. Code date packages:
 - 1. Do not use material older than the manufacturer's published shelf life.
 - 2. Store materials at temperatures lower than 80 degrees Fahrenheit.
 - 3. Condition materials in accordance with the manufacturer's instructions prior to installation.

1.07 SEQUENCING AND SCHEDULING

- A. Caulk joints prior to painting.

1.08 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.
- B. Warrant to correct defective products for a minimum of 1 year in accordance with the manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 SEALANTS

- A. General:
 - 1. Provide colors matching materials being sealed.
 - 2. Where compound is not exposed to view in finished work, provide the manufacturer's color which has best performance.
 - 3. Nonsagging sealant for vertical and overhead horizontal joints.
 - 4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
 - 5. Joint cleaner, primer, bond breaker: As recommended by the sealant manufacturer.
 - 6. Sealant backer rod and/or compressible filler made from closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by the sealant manufacturer to:
 - a. Control joint depth.
 - b. Break bond of sealant at bottom of joint.
 - c. Provide proper shape of sealant bead.
 - d. Serve as expansion joint filler.

2.02 ACRYLIC-LATEX SEALANT

- A. Permanently flexible, nonstaining, and nonbleeding latex modified acrylic sealant compound, colors as selected by the Engineer from the manufacturer's standard options.
 - 1. Manufacturers: One of the following or equal:
 - a. Pecora Corp., AC-20.
 - b. Sonneborn, Sonolac.
 - c. Tremco, Tremflex 834.

2.03 SILICONE SEALANT

- A. ASTM C920, Type S, Grade NS, Class 25, single component silicone sealant.
 - 1. Manufacturers: One of the following or equal:
 - a. Dow Corning, 795.
 - b. General Electric, 1200 Series.
 - c. Pecora Corp., 864.
 - d. Tremco, Proglaze.

2.04 SYNTHETIC RUBBER SEALING COMPOUND

- A. Manufacturers: One of the following or equal:
 - 1. Pacific Polymers, Elastothane 227R.
- B. Material: In accordance with ASTM C920, Type M, Grade P (pourable), Class 25; and Type M, Grade NS (non-sag), Class 25; multi-part polyurethane; able to cure at room temperature to firm, highly resilient polymer; able to perform satisfactory when continuously submerged in water or sewage and exposed to direct sunlight in dry condition; with the following properties determined at 75 degrees Fahrenheit and 50 percent relative humidity.
 - 1. Base: Polyurethane rubber.
 - 2. Application time: Minimum 2 hours.
 - 3. Cure time: Maximum 3 days.
 - 4. Tack free time: Maximum 24 hours.
 - 5. Ultimate hardness: Non-sag 25, pourable/SL 40, within 5 Shore A.
 - 6. Tensile strength: Non-sag 95 pounds per square inch minimum and self-leveling minimum 170 pounds per square inch when tested in accordance with ASTM D412.
 - 7. Ultimate elongation: Minimum 340 percent when tested in accordance with ASTM D412.
 - 8. Tear resistance: Non-sag 45 pounds per inch minimum and self-leveling minimum 85 pounds per inch when tested in accordance with ASTM D624, Die C.
 - 9. Service temperature range: -25 degrees to 158 degrees Fahrenheit.
- C. Color: Gray to match concrete, unless indicated on the Drawings.

2.05 SYNTHETIC SPONGE RUBBER FILLER

- A. Closed-cell expanded sponge rubber manufactured from synthetic polymer neoprene base, or resilient polyethylene foam backer rod. In accordance with ASTM C1330, Type C.
 - 1. Manufacturers: The following or equal:
 - a. Presstite, No. 750.3 Ropax Rod Stock.
- B. Characteristics:
 - 1. Suitable for application intended.
 - 2. Strength: As necessary for supporting sealing compound during application.
 - 3. Resiliency: Resistance to environmental conditions of installation.
 - 4. Bonding: No bonding to the sealing compound.
 - 5. Structure: Cellular, prevents absorption of water.
 - 6. Compatibility with other materials in joint and acceptance by the manufacturer of the sealing compound.
 - 7. Size: Minimum 25 percent greater than nominal joint width.

2.06 RELATED MATERIALS

- A. Primer: Nonstaining type, recommended by the sealant manufacturer to suit application.
- B. Joint cleaner: Noncorrosive, nonstaining, compatible with joint forming materials and as recommended by the sealant manufacturer.
- C. Bond breaker tape: Pressure-sensitive tape recommended by the sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify acceptability of joint dimensions, physical, and environmental conditions.
- B. Verify that surfaces are dry, clean, and free of dirt, grease, curing compound, and other residue which might interfere with adhesion of sealants.

3.02 PREPARATION

- A. Allow concrete to cure thoroughly before caulking.
- B. Synthetic sponge rubber filler:
 - 1. Prepare surfaces designated to receive filler in accordance with the manufacturer's installation instructions.
 - 2. Do not stretch filler beyond its normal length during installation.
- C. Caulking:
 - 1. Verify that surfaces are dry, clean, and free of dirt, grease, curing compounds, and other residue that might interfere with adhesion of sealant.

2. Concrete, masonry, wood, and steel surfaces: Clean and prime in accordance with the manufacturer's instructions prior to caulking.
- D. Synthetic rubber sealing compound:
 1. Ensure surfaces to which synthetic rubber must bond are dry and free of dust, dirt, and other foreign residue.
 2. Heavy sandblasted caulking groove to sound surface and prime with the manufacturer's recommended primer for particular surface.
- E. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 5/8 inches deep nor less than 3/8 inches deep.
- F. For normal moving building joints sealed with elastomeric sealants not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
- G. For joints sealed with acrylic-latex sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.
- H. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- I. Prepare surfaces and install synthetic sponge rubber filler in accordance with the manufacturer's recommendations.
- J. Do not stretch filler beyond normal length during installation.
- K. Apply bond breaker when recommended by the joint sealer manufacturer.

3.03 INSTALLATION

- A. Synthetic sponge rubber filler: Install in accordance with the manufacturer's installation instructions.
- B. Caulking, joints, and sealing:
 1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
 2. Install pipe and conduit in structures as indicated on the Drawings.
 3. Caulk doors, windows, louvers, and other items installed in or over concrete openings inside and out.
 4. Use synthetic rubber sealing compound for caulking where indicated on the Drawings or as specified, except for masonry construction and where specified otherwise.
 5. Complete caulking prior to painting.
 6. Verify that concrete is thoroughly cured prior to caulking.
 7. When filler compressible material is used, use untreated type.
 8. Apply caulking with pneumatic caulking gun.
 9. Use nozzles of proper shape and size for application intended.

10. Maintain continuous bond between caulking and sides of joint to eliminate gaps, bubbles, or voids and fill joint in continuous operation without layering of compound.
11. Employ experienced applicators to caulk joints and seams in neat workmanlike manner.
12. To hasten curing of compound when used on wide joints subject to movement, apply heat with infrared lamps or other convenient means.
13. Apply synthetic rubber sealing compound with pneumatic caulking tool or other acceptable method.

3.04 CLEANING

- A. Clean surfaces adjacent to sealant as work progresses.
- B. Remove excess uncured sealant by soaking and scrubbing with sealant cleaning solvent.
- C. Remove excess cured sealant by sanding with No. 80 grit sandpaper.
- D. Leave finished work in neat, clean condition.

3.05 SCHEDULE

- A. Acrylic latex:
 1. Use where indicated on the Drawings.
 2. Interior joints with movement less than 7.5 percent and not subject to wet conditions.
- B. Silicone:
 1. Use where indicated on the Drawings.
 2. Joints and recesses formed where window, door, louver and vent frames, and sill adjoin masonry, concrete, stucco, or metal surfaces.
 3. Door threshold bedding.
 4. Moist or wet locations, including joints around plumbing fixtures.
 5. Stainless steel doors and frames, including joints between applied stops and frames, and around anchor bolts.
 6. Plenum joints.
- C. Synthetic rubber sealing compound, non-sag Type II:
 1. Use where indicated on the Drawings.
 2. Water-bearing and earth-bearing concrete structures.
 3. Joints in masonry, concrete vertical surfaces, and metal-faced panels in vertical surfaces.
 4. Joints between sheet metal flashing and trim.
 5. Joints between sheet metal flashing and trim, and vertical wall surfaces.
 6. Small voids between materials requiring filling for weathertight performance in vertical surfaces.
 7. Perimeters of frames of doors, windows, louvers, and other openings where bonding is critical to airtight performance.
 8. Expansion and control joints in masonry vertical surfaces.

- D. Synthetic rubber sealing compound, self-leveling Type I:
 - 1. Use where indicated on the Drawings.
 - 2. Expansion and control joints in masonry, concrete horizontal surfaces, and metal panels in horizontal surfaces.
 - 3. Small voids between materials requiring filling for weathertight performance in horizontal surfaces.
 - 4. Pavement joints.
 - 5. Perimeters of frames of doors, windows, louvers, and other openings in horizontal surfaces where bonding is critical to airtight performance.

3.06 FIELD QUALITY CONTROL

- A. Adhesion testing:
 - 1. Perform adhesion tests in accordance with ASTM C1521 and the following criteria:
 - a. Water bearing structures: 1 test per every 1,000 linear feet of joint sealed.
 - b. Chemical containment areas: 1 test per every 1,000 linear feet of joint sealed.
 - c. Building expansion joints: 1 test per every 500 linear feet of joint sealed.
 - d. All other type of joints, except butt glazing joints: 1 test per every 3,000 linear feet of joint sealed.
 - e. Manufacturer's authorized factory representative provide written recommendations for remedial measures on failing tests.

END OF SECTION

SECTION 08_11_13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Steel Fire Resistive Rated and Non-Fire Resistive Rated:
 - 1. Doors.
 - 2. Door frames.
 - 3. Combination door frames with transom bars.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A250.6 - Hardware on Steel Doors (Reinforcement Application).
 - 2. A250.8 - Recommended Specification for Standard Steel Doors and Frames.
- B. ASTM International (ASTM):
 - 1. A653 - Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 3. A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy With Improved Formability, Solution Hardened, and Bake Hardenable.
 - 4. A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength.
 - 5. E413 - Classification for Rating Sound Insulation.
- C. National Association of Architectural Metal Manufacturers (NAAMM)/Hollow Metal Manufacturers Association (HMMA):
 - 1. HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.
- D. National Fire Protection Association (NFPA):
 - 1. 80 - Standard for Fire Doors and Other Opening Protectives.
 - 2. 252 - Standard Methods of Fire Tests of Door Assemblies.
- E. Steel Door Institute (SDI):
 - 1. SDI-111 - Recommended Details for Standard Steel Doors, Frame, Accessories and Related Components.
 - 2. SDI-117 - Manufacturing Tolerances Standard Steel Doors and Frames.
- F. Underwriters' Laboratories, Inc., (UL):
 - 1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
 - 2. UL 102 - Sustainability Assessment for Swinging Door Leafs.

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings: Show the following with references to the Engineer's door marks and hardware groups:
 - 1. Location of door and frame types.
 - 2. Details of fabrication, including core construction, glass lights, louvers, weatherstripping, and factory finish for each door.
 - 3. Cutouts and reinforcements for hardware.
 - 4. Methods of installation and anchorage to adjacent construction.
- C. Certificates documenting:
 - 1. Fire-rated units have been successfully tested as specified in this Section.
- D. Manufacturer's instructions: Submit manufacturer's installation instructions.
- E. Pre-Submittal Conference:
 - 1. Conduct conference in compliance with requirements in Section 01_31_19 - Project Meetings with attendance by representatives of Supplier, Installer.
 - 2. Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.04 QUALITY ASSURANCE

- A. Testing agency qualifications: Approved by ultimate enforcing authority for the Project; regularly engaged in inspection of materials and workmanship at factory.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Before delivery, identify type and size of each door and frame in such a way that markings will not damage finish.
- B. Preassemble doorframes in shop and deliver to Project site with spreader bar at sill or tie them in pairs to form box.
- C. Protect doors and frames with resilient packaging sealed with heat shrunk plastic. Break seal on-site to permit ventilation.
- D. Protect doors and frames during shipment and storage to prevent warping, bending, and corrosion.

1.06 SEQUENCING AND SCHEDULING

- A. Ensure timely delivery of reviewed hardware schedule and hardware templates such that no delay occurs in the work of the Contract.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sheet steel: ASTM A1008, commercial quality, level, cold rolled steel, or ASTM A1011, hot rolled, pickled and oil rolled steel. Galvanize by hot-dip process with zinc-coating in accordance with ASTM A924 or with ASTM A653 and the coating designation A60 or G60.
- B. Clips, bolts, screws, and rivets: sized as recommended by manufacturer.
- C. Primer: Rust- inhibitive epoxy primer compatible with high-solids epoxy finish coating system as specified in Section 09_96_01 - High-Performance Coatings.
- D. Touch-up materials: Primer as recommended by manufacturer.
- E. Door hardware: As specified in Section 08_71_00 - Door Hardware.
- F. Grout: As specified in Section 04_22_00 - Concrete Unit Masonry.
- G. Glass and glazing materials: As specified in Section 08_80_00 - Glazing.

2.02 DOOR AND FRAME TYPES

- A. Interior doors: ANSI 250.8, Grade III, Model 3 or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 18-gauge face sheets.
- B. Exterior doors: ANSI 250.8, Grade III, Model 3, or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 16-gauge face sheets.
- C. Interior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames, minimum 16-gauge, sizes and shapes as indicated on the Drawings.
- D. Exterior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames HMMA 861, except minimum 14-gauge sizes and shapes as indicated on the Drawings.

2.03 FABRICATION OF FRAMES

- A. Galvanize all frames installed in exterior openings.
- B. Frames: Sheet steel, integral type, welded continuous to full depth of frames with minimum 5/8-inch deep stops, unless otherwise indicated on the Drawings.
- C. Hardware reinforcements: Fabricate according to SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Jamb Anchors: As required for adjacent wall construction, minimum 3 per jamb, unless otherwise indicated on the Drawings.
- E. Floor anchors: Fixed type, except where adjustable anchors are indicated on the Drawings, 1 per jamb, with minimum 2 holes for anchorage. Where floor fill occurs,

terminate bottom of frames at indicated finished floor level and support by adjustable extension clips resting on and anchored to structural slabs.

- F. Anchors at masonry: Adjustable strap and stirrup, minimum 16-gauge corrugated or perforated steel at maximum of 30 inches on center and extending minimum 8 inches into masonry.
- G. Anchors at previously placed concrete: Countersink machine screws through the frame into expansion devices spaced at maximum 30 inches on center.
- H. Anchors at structural steel framing: Welded or otherwise securely fastened with stainless steel screws.
- I. Anchors for fire resistive frames: Conform to requirements of labeling authority having jurisdiction.
- J. Masonry angle stiffeners: Factory welded into heads of frames for installation in openings more than 48 inches wide.
- K. Mullions, muntins, and transom bars: Minimum 18-gauge, tubular sheet steel matching, and butt-welded to head and jamb members.
- L. Removable stops: Fasten at approximately 12 to 16 inches on center.

2.04 FABRICATION OF DOORS

- A. Galvanize all doors installed in exterior openings.
- B. Reinforce face sheets with steel rib stiffeners, spaced at maximum 6 inches apart, and securely attached to face sheets by spot welds at maximum 5 inches on center.
- C. Fill voids between face sheets and stiffeners with fiberglass insulation having a minimum density of 0.8 pounds per cubic foot.
- D. Edges: Full weld without visible joints. Bevel striking edge 1/8 inch in 2 inches.
- E. Door cores:
 - 1. Stiffeners: Vertical steel ribs formed from minimum 22-gauge plain sheet steel, spaced at maximum 6 inches apart and securely attached to face sheets by spot welds at maximum 5 inches on center.
 - 2. Core fillers: Insulation, minimum 0.60 pound density noncombustible type, installed in spaces between stiffeners for full height of door; labeled door core material shall conform to requirements of labeling authority.
- F. Tops and bottoms of doors: Close with continuous recess steel channel of minimum 16-gauge, extending full width of door and spot welded to both faces.
- G. Tops and bottoms of exterior doors: Flush closing channels welded to make tops and bottoms waterproof with weep holes for escape of moisture.
- H. Hardware reinforcements: Fabricate according to SDI A250.6 with reinforcing plates from same material as door face sheets.

- I. Astragals:
 - 1. Install on active leaf of double doors in accordance with UL listing requirements for fire resistive ratings as indicated on the Drawings, and for exterior pairs of doors.
 - 2. Do not install on doors swinging in pairs with rating of 90 minutes or less in means of egress where both leaves are required to provide building code required exiting widths.
 - 3. Do not provide astragal cutouts for hardware operations.
- J. Astragal clearances for fire resistive rated doors:
 - 1. Door bottoms at doors designated to receive non-combustible threshold: Not to exceed 3/8 inch between threshold and door bottom.
 - 2. Door bottoms where there is no threshold: Maximum clearance between door and floor not to exceed 1/2 inch.
 - 3. Door bottoms at doors designated to receive combustible floor coverings: Not to exceed 1/2 inch between floor covering and door bottom.
 - 4. Clearance between door and frame and between meeting edges of pairs of doors: Not to exceed 1/8 inch.
- K. Astragal clearances for non-fire resistive rated doors: Same as fire resistive rated doors, unless otherwise indicated on the Drawings.

2.05 FABRICATION OF FIRE RATED DOORS AND FRAMES

- A. Fabricate to meet requirements of the building code as specified in Section 01_41_00 - Regulatory Requirements, UL 10C, UL 102, and NFPA 252, except hose stream test shall not be required for opposite swing double egress exit doors and for doors of fire endurance rating of less than 45 minutes with or without approved glass lites.
- B. Temperature rise requirements of doors at exit enclosures and exit passageways: Maximum transmitted temperature end point of less than 450 degrees Fahrenheit above ambient at end of 30 minutes when tested in accordance with the building code as specified in Section 01_41_00 - Regulatory Requirements.
- C. Apply approved testing agency labels on fire rated doors and frames.
- D. Fabricate oversized fire rated doors in accordance with requirements for ratings indicated on the Drawings.

2.06 ACCESSORIES

- A. Mullions and transom bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout guards: Formed from same material as frames, not less than 0.016 inches thick.

- C. Silencers:
 - 1. Drill single leaf doorframe jamb stops for minimum 3 silencers.
 - 2. Drill double-leaf doorframe head stops for minimum 2 silencers.
 - 3. Do not drill doorframes for silencers when weatherstripping is to be installed.

2.07 FINISHING

- A. Thoroughly clean surfaces of oil, grease, and other impurities; touch-up abraded galvanizing; and chemically etch.
- B. Fill irregularities and sand smooth finish surface. Apply 1 coat of manufacturer's standard rust inhibitive baked-on primer.
- C. Finishing: High solids epoxy polyurethane system:
 - 1. Exterior doors and interior doors: As specified in Section 09_96_01 - High-Performance Coatings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine reviewed hardware schedules and verify proper coordination of hardware and doors and frames.
- B. Examine opening locations and verify the following:
 - 1. Correctness of dimensions, backing, or support conditions.
 - 2. Absence of defects that would adversely affect frame or door installation.

3.02 INSTALLATION

- A. Install doors and frames in accordance with approved shop drawings and manufacturer's instructions.
- B. Frames:
 - 1. Set accurately in position, plumb, align, and attach securely to structure.
 - 2. Set in place before construction of adjacent masonry or framed walls.
 - 3. Anchor frames to previously placed concrete.
 - 4. Set frames before removing spreader bars.
 - 5. Fully grout frames in masonry as the Work progresses.
 - 6. Grout frames at concrete through keyways provided at head and jambs.
- C. Doors:
 - 1. Install at correct openings, ensure smooth swing and proper closure with frame.
- D. Fire resistive frames and doors:
 - 1. Install to conform to NFPA 80 for fire resistive rated class as indicated on the Drawings.

- E. Door hardware:
 - 1. Install in accordance with Section 08_71_00 - Door Hardware.
 - 2. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- F. Separate or isolate dissimilar metals with neoprene gaskets, sleeves, and washers, or with coatings acceptable to the Engineer.

3.03 TOLERANCES

- A. Manufacturing and installation tolerances: As indicated on the Drawings or in conformance to SDI 117 as minimum.

3.04 ADJUSTING AND CLEANING

- A. Prime coat touch-up: Immediately after installation, sand smooth and touch-up rust areas, and other areas where primer has been damaged, with prime touch-up paint.
- B. Make adjustments as required for correct, proper, and free function and smooth operation without binding of hardware or doors and frames.
- C. Protect doors and frames from damage to surface or profile.

END OF SECTION

SECTION 08_31_14
FLOOR ACCESS DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Non-fire-rated floor access doors.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- B. ASTM International (ASTM):
 - 1. C1802 - Standard Specification for Design, Testing, Manufacture, Selection, and Installation of Fabricated Metal Horizontal Access Hatches for Utility, Water, and Wastewater Structures.
- C. Occupational Safety and Health Administration (OSHA):
 - 1. 29 CFR 1910 - Occupational Safety and Health Standards.

1.03 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data.
- C. Shop Drawings that include the following:
 - 1. Floor access door installation recommendations.
 - 2. Locations of floor access doors.
 - 3. Door size and configuration.
 - 4. Live load capacity.
 - 5. Materials of construction and finishes provided.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements and the manufacturer's instructions.
- B. Identify type and size of each floor access door in way not to damage finish prior to delivery.
- C. Deliver products only after proper facilities are available.
- D. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

- E. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area.
 - 1. Do not dump onto ground.
- F. Protect floor access doors during shipment and storage to prevent warping, bending, and corrosion.

1.05 WARRANTY

- A. Provide manufacturer's warranty against defects in material and workmanship for a period of 5 years.

1.06 MAINTENANCE

- A. Deliver 2 keys for each cylinder lock to the Owner.

PART 2 PRODUCTS

1.

2.02 HEAVY-DUTY STEEL OFF-STREET FLOOR ACCESS DOORS

- A. Manufacturers: One of the following or equal:
 - 1. The Bilco Co., Model JH-20 or JDH-20 (double leaf) with FPG fall protection grating.
 - 2. Nystrom, Model FDDH_X_S-WL, FDDH_X_D-WL (double leaf) or FDNHA with SGT fall protection grating.
- B. Style: Single leaf or double leaf as indicated on the Drawings, capable of withstanding minimum AASHTO Standard Specifications for Highway Bridges, H-20 wheel load with a maximum deflection of 1/150th of the span, live load channel frame, with drainage couplings.
- C. Material: Unless otherwise specified elsewhere, steel.
- D. Door leaf: Minimum 1/4-inch, diamond-pattern plate reinforced with stiffeners as required to meet specified live load.
- E. Frame: 1/4-inch channel with anchor flange around perimeter.
- F. Hardware:
 - 1. Hinges: Each leaf equipped with a minimum of 2 heavy duty butt hinges, Type 315 stainless steel (hinge and pin) or heavy forged-brass hinges with stainless steel pins.
 - 2. Lock: Snap lock with removable handle mounted on door leaf.
 - 3. Grip handle: Provide vinyl grip handle designed to release cover for closing.
 - 4. Operating mechanism: Spring operators designed for ease of operation and automatic hold-open arm with release handle.
 - 5. Drainage assembly: Provide 1-1/2-inch drainage coupling located in corner of the channel frame.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine construction to receive floor access door and verify correctness of dimensions and other supporting or adjoining conditions.

3.02 PREPARATION

- A. Coordinate details with other work supporting, adjoining, or requiring floor access doors.
- B. Verify dimensions and profiles for each opening.
- C. Verify that location will serve portion of work to which access is required.
 - 1. Where proposed functional location conflicts with other work, notify the Engineer before installation.
- D. Apply coating to aluminum surfaces that will be in contact with dissimilar metals or concrete when there is none.

3.03 INSTALLATION

- A. Install in accordance with the manufacturer's instructions.
- B. Ensure correct types and adequate sizes at proper locations.
- C. Securely attach frames to supporting work and ensure doors, frames, and hardware operate smoothly and are free from warp, twist, and distortion.
- D. Attach drain pipe to coupling provided.
 - 1. Provide necessary fittings to connect and route at least 5 feet away from door and vault perimeter.
 - 2. Terminate drain line 1 foot below final grade with 3 cubic feet of drain rock beneath the termination point of the drain line.

3.04 ADJUSTING

- A. Adjust doors, frames, and hardware to operate smoothly, freely, and properly without binding.

3.05 CLEANING

- A. Thoroughly clean surfaces of grease, oil, or other impurities; touch up abraded prime coat where applicable.

END OF SECTION

SECTION 08_71_00

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Door hardware.

1.02 REFERENCES

- A. Builders Hardware Manufacturers Association (BHMA):
1. A156.1 - Butts and Hinges.156.2 - Bored and Preassembled Locks and Latches.
 2. A156.3 - Exit Devices.
 3. A156.4 - Door Controls.
 4. A156.13 - Mortise Locks and Latches.
 5. A156.14 - Sliding and Folding Door Hardware.
 6. A156.16 - Auxiliary Hardware.
 7. A156.18 - Materials and Finishes.
 8. A156.23 - Electromagnetic Locks.
 9. A156.26 - Continuous Hinges.
 10. A156.31 - Electric Strikes and Frame Mounted Actuators.
 11. A156.36 - Auxiliary Locks.
- B. International Building Code (ICC):
1. A117.1 - Accessible and Usable Buildings and Facilities.
- C. National Fire Protection Association (NFPA):
1. 80 - Fire Doors and Windows.
 2. 105 - Installation of Smoke Door Assemblies.
 3. 252 - Standard Methods of Fire Tests of Door Assemblies.
- D. Underwriters Laboratories, Inc. (UL):
1. 10C - Positive Pressure Fire Tests of Door Assemblies.
 2. 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

1.03 SUBMITTALS

- A. Product data:
1. Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
 2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

B. Hardware schedule:

1. Include references to Engineer's hardware group number, door type designations, locations, other pertinent data, and manufacturer names or suitable abbreviation opposite items scheduled.
2. Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - b. Organization:
 - 1) Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 - 2) Organize door hardware sets in same order as in the Door Hardware Sets at the end of this Section.
 - 3) Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - c. Content: Include the following information:
 - 1) Type, style, function, size, label, hand, and finish of each door hardware item.
 - 2) Manufacturer of each item.
 - 3) Fastenings and other pertinent information.
 - 4) Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) Door and frame sizes and materials.
 - 8) Warranty information for each product.
 - d. Submittal Sequence:
 - 1) Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule.
 - 2) Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying schedule:

1. After a keying meeting with the owner has taken place prepare a separate keying schedule detailing the final instructions.
2. Submit the keying schedule in electronic format.
3. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions.
4. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

- D. Keying schedule: Include list giving key code and numbers of doors which can be opened by each key.
- E. Samples: Include for each different type and manufacturer for review of finish.
- F. Construction key distribution list: Submit upon Owner's request.
- G. Templates:
 - 1. Furnish hardware templates to fabricators of doors, frames, and other work to be factory-prepared for hardware.
 - 2. Check shop drawings of other work to confirm that adequate hardware backing is available.
- H. Project record documents: Include corrected hardware schedule.
- I. Operating and Maintenance Manuals:
 - 1. Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation.
 - 2. As specified in Section 01_78_24 - Operation and Maintenance Manuals.

1.04 REGULATORY REQUIREMENTS

- A. Provide hardware for fire-resistive rated openings that complies with UL and listed by UL.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hardware where directed in unopened packages with items packed separately, complete and ready for installation with necessary fittings, trim, fasteners, and accessories.
- B. Provide packages bearing the manufacturers' labels with each item or group of items identified according to the accepted hardware schedule.

1.06 QUALITY ASSURANCE

- A. Certified products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- B. Installer qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door hardware supplier qualifications:
 - 1. Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project.

2. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity.
 3. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Source limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Pre-submittal conference:
1. Conduct coordination conference in compliance with requirements in Section 01_31_19 - Project Meetings with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 2. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products.
 3. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 4. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 5. Review sequence of operation narratives for each unique access controlled opening.
 6. Review and finalize construction schedule and verify availability of materials.
 7. Review the required inspecting, testing, commissioning, and demonstration procedures.

1.07 MAINTENANCE

- A. Require lockset manufacturers to deliver permanent removable cylinder cores and keys to Owner directly.

1.08 SCHEDULING AND SEQUENCING

- A. Upon receipt of accepted hardware schedule, coordinate accepted hardware schedule, templates, reinforcing units, and template instructions to door and frame sections.
- B. Restrict distribution of construction keys to superintendents and foremen. Maintain record of persons who have received keys on construction distribution list.

1.09 MAINTENANCE TOOLS AND INSTRUCTIONS

- A. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.10 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.
 - 1. Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of the hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Electrical component defects and failures within the systems operation.
- B. Special warranty:
 - 1. Duration for electromechanical door hardware: 2 years.
 - 2. Duration for standard duty cylindrical (bored) locks and latches: 5 years.
 - 3. Duration for exit hardware: 5 years.
 - 4. Duration for mortise locks and latches: 10 years.
 - 5. Duration for manual overhead door closer bodies: 10 years.
 - 6. Duration for heavy duty floor closers: 10 years.

PART 2 PRODUCTS

2.01 GENERAL

- A. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Automatic operators.
 - 4. Cylinders.

2.02 FASTENERS

- A. Types:
 - 1. To concrete, marble, or masonry: Machine screws and flush shells.
 - 2. To wood: Wood screws.
 - 3. On gypsum board or plaster: Screws of sufficient length to provide solid connection to framing or backing behind gypsum board or plaster.
 - 4. To mineral and hollow core doors: Hex bolts.
 - 5. Of exit devices to doors: Thru-bolts, unless otherwise specified.
- B. Screws exposed: Phillips-head type, full-threaded screws, not combination type.
- C. Sizes: Suitable for heavy use.

- D. Finish: Stainless steel, unless otherwise required to match material and hardware finish.

2.03 HANGING DEVICES

- A. Hinges: BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. 2 Hinges: For doors with heights up to 60 inches.
 - b. 3 Hinges: For doors with heights 61 to 90 inches.
 - c. 4 Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - e. Hinge size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - 1) Widths up to 3 feet 0 inches: 4-1/2 inches standard or heavy weight as specified.
 - 2) Sizes from 3 feet 1inch to 4 feet 0 inched: 5inches standard or heavy weight as specified.
 - f. Hinge weight and base material: Unless otherwise indicated, provide the following:
 - 1) Exterior doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - 2) Interior doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - g. Hinge options: Comply with the following:
 - 1) Non-removable pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 - h. Manufacturers: One of the following or equal:
 - 1) Hager Companies (HA).
 - 2) Ives (IV).
 - 3) McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
 - i. Manufacturers: One of the following or equal:
 - 1) Hafele Manufacturing (HF).
 - 2) Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.04 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 - 1. Manufacturers: One of the following or equal:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.
 - c. Schlage (SC) - L9000 Series.

- B. Cylindrical Locksets, Grade 1 (Heavy Duty): BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
 - 1. Furnish with solid cast levers, standard 2-3/4 inch backset, and 1/2 inch (3/4 inch at rated paired openings) throw brass or stainless steel latchbolt.
 - 2. Locks are to be non-handed and fully field reversible.
 - 3. Manufacturers: One of the following or equal:
 - a. Corbin Russwin Hardware (RU) - CL3300 Series.
 - b. Sargent Manufacturing (SA) - 10 Line.
 - c. Schlage (SC) - ND Series.

2.05 AUXILIARY LOCKS

- A. Mortise deadlocks, small case:
 - 1. BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel.
 - 2. Steel or stainless steel bolts with a 1 inch throw and hardened steel roller pins.
 - 3. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
 - a. Manufacturers: One of the following or equal:
 - 1) Corbin Russwin Hardware (RU) - DL4100 Series.
 - 2) Sargent Manufacturing (SA) - 4870 Series.
 - 3) Schlage (SC) - L460 Series.
- B. Cylindrical deadlocks:
 - 1. BHMA A156.36, Grade 1, cylindrical type deadlocks to fit standard ANSI 161 preparation and 1-3/8 inch to 1-3/4 inch thickness doors.
 - 2. Provide tapered collars to resist vandalism and 1 inch throw solid steel bolt with hardened steel roller pins.
 - 3. Deadlocks to be products of the same source manufacturer and keyway as other locksets.
 - a. Manufacturers: One of the following or equal:
 - 1) Corbin Russwin Hardware (RU) - DL3200 Series.
 - 2) Sargent Manufacturing (SA) - 480 Series.
 - 3) Schlage (SC) - B600 Series.

2.06 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-lip strikes: For locks with 3-piece antifriction latch-bolts, as recommended by manufacturer.
 - 2. Extra-long-lip strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-frame strike box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes:
 - a. For locks at double acting doors.
 - b. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.07 CONSTRUCTION KEYING

- A. Type: Removable core system.

2.08 PERMANENT CYLINDERS AND KEYING

- A. Manufacturers: One of the following or equal:
 - 1. Corbin Russwin Hardware (RU).
 - 2. Sargent Manufacturing (SA).
 - 3. Schlage (SC).
- B. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-lock type: Cylinders with tailpieces to suit locks.
 - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 5. Keyway: Manufacturer's Standard. Match Facility Standard.
- C. Removable cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- D. Keying system: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. New system: Key locks to a new key system as directed by the Owner.
- E. Key quantity: Provide the following minimum number of keys:
 - 1. Change keys per cylinder: 2.
 - 2. Master keys (per master key level/group): 5.
 - 3. Construction control keys (where required): 2.
 - 4. Permanent control keys (where required): 2.
- F. Construction keying: Provide temporary keyed construction cores.
- G. Key registration list (biting list):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.09 CLOSERS

- A. Manufacturers:
 - 1. Features:
 - a. Heavy-duty.
 - b. Non-handed and non-sized.
 - c. Adjustable spring power from size 1 through 4.
 - d. Hold open feature where specified.
 - 2. One of the following or equal:
 - a. Sargent, 351 Series.
 - b. LCN, Super Smoothee Model 4041 Series.
 - c. Norton Door Controls, Multi-Size Door Closers Model 7500BF Series.
- B. Type: Full rack and pinion type with steel spring and non-gumming, non-freezing hydraulic fluid.
- C. Controls: Separate set for regulating sweep speed, latch speed, backcheck and backcheck positioning, or where schedules, spring power.
- D. Sizes: As recommended by accepted manufacturer.
- E. Covers: Metal, capable of receiving finishes to match adjacent hardware finishes, unless otherwise specified.
- F. Narrow frame provisions: Drop plates.
- G. Effort to operate: As follows:
 - 1. Exterior: Maximum 8-1/2 pounds.
 - 2. Interior: Maximum 5 pounds.
 - 3. Fire-resistive rated doors: Maximum 15 pounds.
- H. Adjust closers in accordance with manufacturer's directions for size of door.

2.10 EXIT DEVICES

- A. Lever design:
 - 1. Manufacturers: The following or equal:
 - a. Von Duprin, Lever Model 06.
- B. Rim device, non-fire resistive rated:
 - 1. Manufacturers: One of the following or equal:
 - a. Von Duprin Inc., Model Series 98.
 - b. Sargent Essex Ind., Model Series 8800.
- C. Rim device, fire-resistive rated:
 - 1. Manufacturers: One of the following or equal:
 - a. Von Duprin Inc., Model Series 98-F.
 - b. Sargent Essex Ind., Model Series 12-8800.

- D. Mortise lock device, non-fire-resistive rated:
 - 1. Manufacturers: The following or equal:
 - a. Von Duprin Inc., Model Series 9875L.
- E. Mortise lock device, fire-resistive rated:
 - 1. Manufacturers: The following or equal:
 - a. Von Duprin Inc., Model Series 9875L-F.
- F. Material: As scheduled.
- G. Corrosive environment provisions: Zinc dichromate coated internal parts.

2.11 MISCELLANEOUS DOOR HARDWARE

- A. Wall stops: As scheduled.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- B. Floor stops: As scheduled with strike of suitable height to compensate for clearance between door and floor.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- C. Mechanical holders: Foot-operated plunger with instant release by touch of toe and integral spring to keep constant shoe pressure against floor; brass.
 - 1. Manufacturers: The following or equal:
 - a. Glynn-Johnson.
- D. Flush bolts and surface bolts:
 - 1. BHMA A156.3 and A156.16, Grade 1, certified.
 - a. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately 6 feet from the floor.
 - b. Furnish dust proof strikes for bottom bolts.
 - c. Surface bolts to be minimum 8 inches in length, UL listed for labeled fire doors, and UL listed for windstorm components where applicable.
 - d. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 - e. Manufacturers: One of the following or equal:
 - 1) Ives (IV).
 - 2) Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - 3) Trimco (TC).
- E. Architectural seals:
 - 1. General:
 - a. Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets.

- b. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated.
 - c. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
 - 2. Manufacturers: One of the following or equal:
 - a. National Guard Products (NG).
 - b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
 - c. Zero (ZE).
- F. Thresholds:
 - 1. As scheduled, extruded aluminum, maximum 1/2-inch high, maximum slope of 1 foot in 2 feet.
 - 2. Manufacturers: One of the following or equal:
 - a. National Guard Products Inc.
 - b. Pemko Mfg. Co.
- G. Dustproof strike:
 - 1. As scheduled.
 - 2. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
- H. Door bottoms:
 - 1. As scheduled, extruded aluminum with vinyl insert, surface mounted, length equal to door width minus 2 inches, automatic, recessed in bottom of door.
 - 2. Manufacturers: One of the following or equal:
 - a. Pemko.
 - b. Reese.
- I. Astragals:
 - 1. As specified in Section 08_11_13 - Hollow Metal Doors and Frames and Section 08_14_16 - Flush Wood Doors.
- J. Silencers:
 - 1. As scheduled, pneumatic gray rubber.
 - 2. Manufacturers: One of the following or equal:
 - a. Trimco.
 - b. Ives.
 - c. Rockwood.

2.12 FINISHES

- A. Brass and bronze: BHMA A156.18 626 (US26D), satin chrome.
- B. Steel: BHMA A156.18 652 (US26D), satin chrome.
- C. Stainless steel: BHMA A156.18 630 (US32D), satin stainless steel.
- D. Aluminum: BHMA A156.18 628 (US28).
- E. Plastic closer covers: Spray paint to match typical door hardware finish.

- F. Metal closer covers: Plate covers to match typical door hardware finish.
- G. Electromagnetic hold open devices: Manufacturer's standard brushed zinc finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect doors and door frames for damage or defects and examine hardware for compatibility with receiving conditions and suitable to intended use.
- B. Verify that required wall backing has been installed.

3.02 INSTALLATION

- A. Install finish hardware in accordance with manufacturer's templates and instructions.
 - 1. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 2. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: Hanging devices; locking devices; closing devices; and seals.
- B. Accurately and properly fit hardware.
- C. Securely fasten fixed parts for smooth, trouble-free, non-binding operation.
- D. Fit faces of mortise parts snug and flush.
- E. Ensure that operating parts move freely and smoothly without binding, sticking, or excessive clearance.
- F. Mounting heights:
 - 1. Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 2. Standard steel doors and frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 3. Wood doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 4. Where indicated to comply with accessibility requirements, in accordance with ICC A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 5. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

- G. Retrofitting:
 - 1. Install door hardware to comply with manufacturer's published templates and written instructions.
 - 2. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Section 09_96_01 - High-Performance Coatings.
 - 3. Do not install surface-mounted items until finishes have been completed on substrates involved.
- H. Protection:
 - 1. Protect door hardware from damage or marring of finish during construction, use strippable coatings, removable tapes, or other acceptable means.
 - 2. Ensure door hardware displays no evidence of finish paint after final building cleanup.
- I. Latch guard and dead bolts: Install so that bolts automatically engage in keeper, whether activated by closer or by manual pressure.
- J. Closers:
 - 1. Mount on opposite sides of corridors or vestibules, except at exterior doors.
 - 2. Mount for 180 degree swing wherever possible.
 - 3. Mount with drop plates at narrow top rail doors.
 - 4. Adjust to operate noiselessly and evenly.
 - 5. Have closer manufacturer regulate closers prior to final acceptance of project.
- K. Kick plates: Screw on push side of doors, unless otherwise indicated on the Drawings.
- L. Gasketing: Mount to provide complete contact between door and frame, finished floor, or both; and weathertight enclosure.
- M. Thresholds:
 - 1. Install immediately before inspection for final acceptance or protect from heavy traffic damage during construction.
 - 2. Cope to fit door frame profile and drill to suit required flush bolts and panic bolts.
 - 3. Unless indicated on the Drawings to be set in grout, set in double bead of sealant, tightly fit at jambs, and make waterproof.
 - 4. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07_90_00 - Joint Sealants.
 - 5. Fasten to concrete slab with 5/16-inch stainless steel flat head countersunk machine screws and concrete anchors at 8-inch centers.
- N. Silencers:
 - 1. Insert into predrilled holes in frames.
- O. Storage:
 - 1. Provide a secure lock up for hardware delivered to the project but not yet installed.

2. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.03 DOOR HARDWARE SETS

- A. They are a guideline only and should not be considered a detailed hardware schedule.
- B. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- C. Quantities listed are for each pair of doors, or for each single door.
- D. The Supplier is responsible for handling and sizing all products.
- E. Where multiple options for a piece of hardware are given in a single line item, the Supplier shall provide the appropriate application for the opening.
- F. Provide a list of Manufacturer's Abbreviations.

3.04 CONSTRUCTION KEYING

- A. Insert construction cores in cylinders of exterior doors, and doors requiring security and access for workman, unless otherwise directed by the Engineer.

3.05 ADJUSTING

- A. Examine hardware in place for complete and proper installation. Lubricate bearing surfaces for proper function.
- B. Replace, rework or otherwise correct defective door hardware, including incorrect hand or function.

3.06 CLEANING

- A. Remove protective materials and devices and thoroughly clean exposed surfaces of hardware.
- B. Check for surface damage prior to final cleaning for acceptance of project.

3.07 PERMANENT KEYING

- A. Insert permanent cylinders with cores.
- B. Inspect each lockset to ensure permanent cylinders with cores are operating satisfactorily.
- C. Test keys for proper conformance with keying system.

3.08 HARDWARE SCHEDULE

- A. Refer to Drawing 65A01 - Sludge Pump Station Code Compliance, Egress Plan and Schedule for door hardware schedule.

END OF SECTION

SECTION 08_91_00

LOUVERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. A variety of stationary, operable, and combination louvers. Also, includes stationary door louvers.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA):
 - 1. 500-L - Laboratory Methods of Testing Louvers for Rating.
 - 2. 500-D - Laboratory Methods of Testing Dampers for Rating.
 - 3. 511 - Certified Ratings Program - Product Rating Manual for Air Control Devices.
- B. American Society of Civil Engineers (ASCE):
 - 1. 7 - Minimum Design Loads and Associated Criteria for Building and Other Structures.
- C. ASTM International (ASTM):
 - 1. E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - 2. E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 - 3. D4385 - Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products.
- D. Testing Application Standard (TAS):
 - 1. 100A - Standard Test Procedure for Wind and Wind Driven Rain Resistance and/or Increased Windspeed Resistance of Soffit Ventilation Strip and Continuous or Intermittent Ventilation System Installed.
- E. Underwriters Laboratories, Inc. (UL).

1.03 TERMINOLOGY

- A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
 - 1. Drainable-blade louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.04 SUBMITTALS

- A. As specified in Section 23_05_00 - Common Work Results for HVAC.

1.05 QUALITY ASSURANCE

- A. Provide louvers with the following, unless otherwise specified:
 - 1. AMCA certification and rating in accordance with AMCA 511 for air performance and water penetration.
- B. Louvers shall be factory engineered to withstand the specified seismic loads.
 - 1. Minimum design loads shall be calculated to comply with ASCE 7, or local requirements of Authority Having Jurisdiction (AHJ).

PART 2 PRODUCTS

2.01 GENERAL

- A. Louver types: As indicated on the Drawings.
 - 1. Identify louvers with a letter L followed by a number referring to a louver type in this Section.
 - 2. Identify individual louver size and airflow rates.
- B. Accessories:
 - 1. Provide installation clips and flanged or jamb-mounting styles suitable for the mounting locations.
 - 2. As indicated on the Drawings.
 - 3. Provide extended sills for louvers indicated as installed recessed from the exterior wall surface.
 - 4. Provide stainless steel fasteners unless noted otherwise.
 - 5. Corrosion protection.
 - 6. Provide gravity damper for outside air intake and exhaust louvers, unless noted otherwise.
- C. Protective coatings for aluminum in contact with concrete or masonry:
 - 1. Manufacturers: One of the following or equal:
 - a. Koppers Co., Inc.
 - b. Porter Coatings.
 - c. Tarmastic 100.

2.02 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Performance: In accordance with AMCA 511 when tested in accordance with AMCA 500.
- B. Designed for 20 pounds per square foot wind load.

- C. Provide instrumentation and controls to meet the equipment operating requirements as specified in Section 23_09_13 - Instrumentation and Control Devices for HVAC.
 - 1. Shall resist wind driven rain in accordance with:
 - a. TAS 100A:
 - 1) Louvers shall not require the use of a manual damper to meet the certification requirements.

2.03 COMBINATION LOUVERS, TYPE L-10

- A. Manufacturers: One of the following or equal:
 - 1. Arrow.
 - 2. Greenheck.
 - 3. Ruskin.
- B. Requirements:
 - 1. Type: Combination drainable blade weather louver with adjustable rear blades.
 - 2. Frame: 6-inches deep, minimum 0.125-inch thick 6063-T5 aluminum; provide downspouts, caulking slots and flexible aluminum jamb seals.
 - 3. Front stationary blades: Minimum 0.081-inch (12-gauge) thick 6063-T5 aluminum, spaced at 6.5-inch centers, mounted at 37 degrees, drainable J style design.
 - 4. Rear adjustable blades: Minimum 0.14-inch thick 6063-T5 aluminum double skin air foil 0.14 with vinyl edge seals.
 - 5. Bearings and axles: Stainless steel sleeve bearing pressed into the frame; 0.5-inch plated steel hex axle.
 - 6. Linkage and actuator: Concealed linkage with motorized actuator; provide 2-position, spring-return, 120 volts alternating current to open actuator with torque to match louver requirements, 60-inch pound minimum.
 - 7. Mullions: Hidden.
 - 8. Screens: Removable aluminum screen in frame; insect screens on intakes and bird screens on exhausts.
 - 9. Water penetration: Maximum 0.01 ounce water per square foot at 1,020 feet per minute free area velocity.
 - 10. Pressure drop (without screen): Maximum 0.12-inch water column for intake service and 0.15-inch water column for exhaust service at 1,000 feet per minute free area velocity.
 - 11. Finish: Kynar, color as selected Owner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect areas to receive louvers.
 - 1. Notify the architect of conditions that would adversely affect the installation or subsequent utilization of the louvers.
 - 2. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Clean opening thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install louvers at locations indicated on the Drawings and in accordance with manufacturer's instructions.
- B. As specified in Section 23_05_00 - Common Work Results for HVAC.

3.04 FIELD QUALITY CONTROL

- A. Test equipment performance and balance equipment as specified in Section 23_05_93 - Testing, Adjusting, and Balancing for HVAC.

END OF SECTION

SECTION 09_29_00

GYPSUM BOARD

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Gypsum board and associated accessories.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. C475 - Standard Specification for Joint compounds and Joint Tape for Finishing Gypsum Board.
 2. C514 - Standard Specification for Nails for the Application of Gypsum Wallboard.
 3. C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard in Wood Framing.
 4. C840 - Standard Specification for Application and Finishing of Gypsum Board.
 5. C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 6. C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Based to Wood Studs or Steel Studs.
 7. C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 8. C1396 - Standard Specification for Gypsum Board.
 9. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Gypsum Association:
1. GA 216 - Application and Finishing of Gypsum Board.
- C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

- A. Product Data: Include manufacturer's instructions for sealing openings, penetrations, and cut edges of water-resistant gypsum board.
- B. Samples: Include texture samples on minimum 6 inch square specified materials.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Provide gypsum board products from single manufacturer or from manufacturers recommended by manufacturer of gypsum board.
- B. Regulatory requirements: When indicated, provide UL listed and labeled fire-rated components or by other recognized rating service.

- C. Pre-installation conference: Convene with affected entities to review coordination and sequencing of construction to ensure that everything that will be concealed by gypsum board has been installed, and that chases, openings, supplementary framing and blocking have been completed.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum board under cover, stacked flat, off floor.
- B. Store adhesives in dry place, protected against freezing.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform room temperature between 55 and 70 degrees Fahrenheit in cold weather during application of wallboard and joint treatment until joint treatment is completely dry or building is occupied.
- B. Provide adequate ventilation.

PART 2 PRODUCTS

2.01 GYPSUM BOARD

- A. Regular board:
 - 1. ASTM C1396; 5/8 inches thick; tapered edge; Type X where required for fire rating.
- B. Moisture resistant board:
 - 1. ASTM C1396; 5/8 inches thick; tapered edge; Type X where required for fire rating.
- C. Insulating gypsum board: Gypsum board as specified with aluminum foil on back surface; ends square cut; tapered edges.
- D. Exterior ceiling board:
 - 1. ASTM C1396; 5/8 inch thick; weather and sag resistant type with water-repellent face paper; eased tapered edge.
 - 2. Flame spread: Maximum 20 flame spread.
 - 3. Smoke developed: Maximum 0 smoke developed.

2.02 ACCESSORIES

- A. Square corner bead reinforcement:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, Dur-A-Bead.
 - b. Gold Bond National Gypsum Co., Wallboard corner bead with 1-1/4 inch flanges.
- B. Metal casing bead:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, No. 200A Metal Trim.

- b. Gold Bond National Gypsum Co., No. 100 wall board casing.
- C. Control joints:
 - 1. Manufacturers: One of the following or equal:
 - a. USF, No. 093.
 - b. Gold Bond National Gypsum Co., 0.093 zinc control joint.

2.03 FASTENERS

- A. Screws for metal studs: ASTM C1002, Type S; self-drilling, self-tapping, bugle head, for use with power driven tool, minimum 1-1/4 inches long or length to suit application.
- B. Screws for wood framing: ASTM C1002, Type W, minimum 1-1/4 inches.
- C. Nails: ASTM C514; minimum 1-1/4 inch long, 12-1/2 gauge, 1/4 inch diameter head.
- D. Staples:
 - 1. Manufacturers: The following or equal:
 - a. Bostitch, Type G; 1/2 inch.

2.04 LAMINATING ADHESIVES

- A. Gypsum board to metal framing:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, Durabond® 200 or 300.
 - b. Gold Bond National Gypsum Co., Sta-Smooth setting type compound.
- B. Gypsum board to wood framing: ASTM C557.
- C. Gypsum board to gypsum board:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, Durabond® 600.
 - b. Gold Bond National Gypsum Co., Gypsum board laminating adhesive.
- D. Gypsum board to concrete or masonry:
 - 1. Manufacturers: The following or equal:
 - a. USG, Durabond® 500.

2.05 ACOUSTICAL SEALANT

- A. Type: ASTM C919; Architecture Sealant:
 - 1. Manufacturers: The following or equal:
 - a. USG.

2.06 FINISHING MATERIALS

- A. Moisture or water resistant sealant:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, Sheetrock W/R Sealant.
 - b. Gold Bond National Gypsum Co.

- B. Joint compound and tape: ASTM C475:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, Sheetrock joint system consisting of Sheetrock Reinforcement Tape and Sheetrock All Purpose Ready Mixed Compound for embedding, fill, and finishing.
 - b. Gold Bond National Gypsum Co., Sta-Smooth HS tape and Sta-Smooth joint compound.
- C. Texturing compound for walls:
 - 1. Manufacturers: One of the following or equal:
 - a. USG, Spray Texture Finish.
 - b. Gold Bond National Gypsum Co., Perfect Spray EM, orange peel finish.
- D. Texturing compound for exterior ceilings:
 - 1. Manufacturers: The following or equal.
 - a. USG, Duracal® Exterior Spray Texture Finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install gypsum board systems in accordance with ASTM C840 and GA 216.

3.02 GYPSUM BOARD INSTALLATION ON WALLS

- A. Cut gypsum wallboard by scoring and breaking or by sawing, working from face side.
- B. Use boards of maximum practical length to minimize end joints.
- C. Apply board with long dimension at right angles to framing or furring members with ends on studs. Attach upper boards first.
- D. Bring boards into contact with each other but do not force into place.
- E. Do not place butt ends against tapered edges.
- F. Stagger end joints. Locate joint on opposite sides of partition on different studs.
- G. Do not align joints with edges of openings, except for control joints. Cut board neatly to fit around openings. Locate joints at least 8 inches from openings. Center vertical end joints above openings.
- H. Extend board to within 1/4 inch of floor.
- I. Install fasteners proceeding from center portion of gypsum board toward edges and ends.
- J. On non-fire rated walls, screw board to framing at maximum 12 inches on center in field of board at bearings and along abutting edges. Nail board to framing at maximum 8 inches on center in field at bearings and along edges.

- K. On fire rated walls, nail or screw board to framing at maximum 8 inches on center in field of board at bearings and along edges, unless indicated otherwise by UL assembly requirements.
- L. Drive fasteners home with maximum 1/32 inch dimple in wall surface. Avoid breaking face paper of wallboard. Remove improperly driven nails.
- M. Thoroughly seal openings, penetrations and cut edges of water-resistant wallboard in accordance with manufacturer's recommendations.
- N. Double stud partitions:
 - 1. Install strips of gypsum board 12 inches wide and of length to span partition depth by screwing to webs of opposing studs.
 - 2. Space strips approximately 42 inches on center.
- O. Double layer partitions:
 - 1. Install first layer vertically then second layer horizontally.
 - 2. Stagger joints between layers and on opposite sides as far as is practical.
- P. Sound control partitions:
 - 1. Apply full running beads of acoustical sealant at perimeter of sound control partitions.
 - 2. Apply acoustical sealant with air operated equipment.
 - 3. Inspect joints to receive sealant to be sure they are clean, dry and free of dust, dirt and other foreign matter.
 - 4. Seal around light boxes, outlets, and switches, with continuous bead of sealant.
 - 5. Remove excess of sealant or smears as construction progresses.
- Q. Perimeter relief where non-load bearing gypsum board partitions abut structural decks or ceilings or vertical structural elements:
 - 1. Allow not less than 1/4 inch, nor more than 1/2 inch gap between gypsum board and structure.
 - 2. Finish edges of board face layer with metal casing bead and caulk space between casing bead and structure with continuous sealant bead.
 - 3. Attach board to studs not less than 1/2 inch below bottom edge of ceiling track flanges and to first stud adjacent to vertical tracks. Do not attach boards directly to tracks.

3.03 GYPSUM BOARD INSTALLATION ON FRAMED OR FURRED CEILINGS

- A. Apply board with long dimension at right angles to framing or furring members with abutting ends and edges occurring over flanges.
- B. Use board to maximum practical length to minimize end joints.
- C. Cut gypsum board neatly to fit around openings.
- D. Neatly fit a stagger end joints.

- E. Nail field of boards at bearing, and along abutting edges at maximum 7 inches on center. Drive nails up to form slight dimple in board.
- F. Screw field of boards, at bearings, and along abutting edges at maximum of 8-inches on center.

3.04 INSTALLATION OF CASING AND CORNER BEADS

- A. Install casing beads wherever board terminates against dissimilar materials or where edges of board are exposed. Provide:
 - 1. Type with face flange to receive joint compound except where semi-finishing is indicated.
 - 2. L-type trim where gypsum board is tightly abutted to other construction.
 - 3. Special kerf-type where other construction is kerfed to receive long leg of L-type trim.
 - 4. U-type trim where edge is exposed, revealed, gasketed, or sealant filled, including expansion joints.
- B. Install metal corner bead reinforcement at outside corners.
- C. Where board partitions intersect masonry walls:
 - 1. Provide control joints no less than 1/4 inch nor more than 3/8 inch wide between board and masonry.
 - 2. Finish exposed edges of board with square-nose metal casing bead and caulk space between casing bead and masonry with continuous sealant.
- D. Secure corner beads with same fasteners used for applying wallboard, spaced 8 inches maximum apart on each flange of bead with nails opposite.

3.05 JOINT COMPOUND

- A. Mix joint and topping compound in accordance with instructions on package.
- B. Apply thin layer of joint compound uniformly approximately 4 inches wide over each joint.
- C. Center tape over joint and embed into compound, leaving sufficient joint compound under tape to provide proper bond.
- D. Reinforce wall angles and inside corner angles with tape folded to conform to angle and embedded into compound.
- E. Apply skim coat of compound immediately after embedding tape.
- F. After compound is thoroughly dry, cover tape with coat of joint compound or topping compound. Spread over tape and approximately 3 inches beyond edges of tape. Feathered out edge.
- G. After compound is thoroughly dry, cover tape with coat of joint compound or topping compound. Spread over tape and approximately 3 inches beyond edges of previous coat. Feathered out edge.

- H. Coat inside corners with minimum of one coat of joint compound or topping compound with edges feathered out.
- I. Apply 3 coats of compound to nail and screw head dimples.
- J. Conceal flanges of wallboard corner beads with minimum of 2 coats of compound:
 - 1. Apply joint compound for first coat.
 - 2. Apply joint compound or topping compound for second coat.
 - a. Feathered out second coat approximately 9 inches on both sides of exposed metal nose of corner bead.
- K. Clean excess compound from board surface.
- L. Sand coats as necessary after each application of compound has dried.
 - 1. Leave board uniformly smooth ready to receive texturing, to extent that after painting, board shows no distinguishable difference in appearance between taped and untaped surfaces.

3.06 TEXTURING

- A. Verify that gypsum board surfaces have been primed in accordance with Section 09_91_00 - Painting.
- B. Clean surfaces of dust, dirt, and oil before application.
- C. Mix and apply specified materials in accordance with manufacturer's recommendation to produce texture similar to accepted sample.
- D. Apply sprayed knockdown, texture to interior walls.
- E. Remove texture droppings or overspray from adjacent completed construction.

3.07 TOLERANCES

- A. Offsets between planes of board faces: Maximum 1/16 inch.
- B. Flatness: Maximum 1/8 inch in 96 inches.
- C. Variation from plumb: Maximum 1/8 inch in 96 inches.

END OF SECTION

SECTION 09_91_00

PAINTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Field applied paints and coatings for normal exposures.
 - 2. Painting Accessories.

1.02 DEFINITIONS

- A. Paints: Manufacturer's best ready-mixed coatings, except when field catalyzed, with fully ground pigments having soft paste consistency and capable of being readily and uniformly dispersed to complete homogeneous mixture, having good flowing and brushing properties, and capable of drying or curing free of streaks or sags.
- B. Volatile Organic Compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon.

1.03 SUBMITTALS

- A. General: Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings: Include schedule of where and for what use coating materials are proposed in accordance with requirements for Product Data.
- C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips.
- D. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.
- E. Manufacturer's instructions: Submit in accordance with requirements for Product Data. Include:
 - 1. Special requirements for transportation and storage.
 - 2. Mixing instructions.
 - 3. Shelf life.
 - 4. Pot life of material.
 - 5. Precautions for applications free of defects.
 - 6. Surface preparation.
 - 7. Method of application.
 - 8. Recommended number of coats.
 - 9. Recommended thickness of each coat.
 - 10. Recommended total thickness.

11. Drying time of each coat, including prime coat.
12. Required prime coat.
13. Compatible and non-compatible prime coats.
14. Recommended thinners, when recommended.
15. Limits of ambient conditions during and after application.
16. Time allowed between coats.
17. Required protection from sun, wind and other conditions.
18. Touch-up requirements and limitations.

1.04 QUALITY ASSURANCE

- A. Products: First line or best grade.
- B. Materials for each paint system: By single manufacturer.
- C. Applicator qualifications: Applicator of products similar to specified products with minimum 3 years of experience.
- D. Regulatory requirements: Comply with by using paints that do not exceed governing agency's VOC limits or do not contain lead.
- E. Field samples:
 1. Paint 1 complete surface of each color scheme to show colors, finish texture, materials, and workmanship.
 2. Obtain approval before painting other surfaces.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as specified in Section 01_60_00 - Product Requirements.
- B. Remove unspecified and unapproved paints from Project site immediately.
- C. Deliver containers with labels identifying:
 1. Manufacturer's name.
 2. Brand name.
 3. Product type.
 4. Batch number.
 5. Date of manufacturer.
 6. Expiration date or shelf life.
 7. Color.
 8. Mixing and reducing instructions.
- D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards.
 1. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- E. Take precautions to prevent fire and spontaneous combustion.

1.06 ENVIRONMENTAL CONDITIONS

- A. Surface moisture contents: Do not paint surfaces that exceed manufacturer specified moisture contents, or when not specified by the manufacturer, the following moisture contents:
 - 1. Plaster and gypsum wallboard: 12 percent.
 - 2. Masonry, concrete and concrete block: 12 percent.
 - 3. Interior located wood: 15 percent.
 - 4. Concrete floors: 7 percent.
- B. Do not paint or coat:
 - 1. Under dusty conditions.
 - 2. When light on surfaces measures less than 15 foot-candles.
 - 3. When ambient or surface temperature is less than 50 degrees Fahrenheit or unless manufacturer allow a lower temperature.
 - 4. When relative humidity is higher than 85 percent, unless manufacturer allows a higher relative humidity.
 - 5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
 - 6. When surface temperature exceeds the manufacturer's recommendation.
 - 7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
 - 8. Apply clear finishes at minimum 65 degrees Fahrenheit.
- C. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 50 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

1.07 PROTECTION

- A. Protect adjacent surfaces from paint and damage. Repair damage resulting from inadequate or unsuitable protection.
- B. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
- C. Place cotton waste, cloths, and material that may constitute fire hazard in closed metal containers and remove daily from site.
- D. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations.
 - 1. Carefully store, clean and replace on completion of painting in each area.
 - 2. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

1.08 EXTRA MATERIALS

- A. Extra materials: Deliver as specified in Section 01_77_00 - Closeout Procedures. Include minimum 1 gallon of each type and color of coating applied:
 - 1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
 - 2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints: One of the following or equal:
 - 1. Carboline: Carboline.
 - 2. PPG Paints/PMC.
 - 3. S/W: Sherwin-Williams Co.
 - 4. Tnemec: Tnemec Co.
- B. Submit requests for substitutions as specified in Section 01_60_00 - Product Requirements:
 - 1. Include certified ingredient analyses.
 - 2. Provide colors that match specified colors.

2.02 PRETREATMENT, PRIMERS, PRIMER-SEALERS, AND WOOD STAIN

- A. Aluminum primer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carbocrylic 120.
 - b. PPG: Pitt-Tech® Plus 4020 PF Interior/Exterior Primer/Finish, 4020PF.
 - c. Sherwin-Williams Co.: DTM Wash Primer.
- B. Concrete masonry filler/primer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 100.
 - b. PPG: Perma-Crete® Interior/Exterior Block & Masonry Surfacers/Filler, 4-100XI.
 - c. Sherwin-Williams Co.: HD Block Filler, B42W46.
 - d. Tnemec:
 - 1) Series 130, Envirofill.
 - 2) Series 180, Tneme-crete.
- C. Concrete, porous, filler/primer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 100.
 - b. PPG: Perma-Crete® Interior/Exterior Block & Masonry Surfacers/Filler, 4-100XI.
 - c. Sherwin-Williams Co.: HD Block Filler, B42W46.

- d. Tnemec:
 - 1) Series 130, Envirofill.
 - 2) Series 180, Tneme-crete.
- D. Concrete, smooth, filler/primer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 100.
 - b. Carboline Co.: Carbocrylic 120.
 - c. PPG:
 - 1) Perma-Crete® Interior/Exterior Block & Masonry Surfacers/Filler, 4-100XI.
 - 2) Seal Grip® Hydrosealer Exterior Bonding Primer/Sealer, 17-6001.
 - d. Sherwin-Williams Co.:
 - 1) HD Block Filler, B42W46.
 - 2) Epoxy Masonry Tilt Primer White B42WW49.
 - e. Tnemec: Series 180, Tneme-Crete.
- E. Ferrous metal primer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carboguard 890.
 - b. PPG: PITT-GUARD® Rapid-Coat Direct-to-Rust Epoxy Mastic Coating, 95-245 Series.
 - c. Sherwin-Williams Co.: Macropoxy 646.
 - d. Tnemec: Series 104.
- F. Galvanized metal surface pretreatment materials:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Surface Cleaner 3.
 - b. PPG: Duraprep® Concentrated Degreaser, Prep125.
- G. Galvanized metal surface primer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carboguard 890.
 - b. PPG: PITT-GUARD® Rapid-Coat Direct-to-Rust Epoxy Mastic Coating, 95-245 Series Sherwin-Williams Co.: Macropoxy 646.
 - c. Tnemec: Series 104.
- H. Plaster sealer:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 120.
 - b. PPG: Seal Grip® Gripper® Universal Interior/Exterior Primer/Sealer, 17-921XI.
 - c. Sherwin-Williams Co.:
 - 1) Promar 200 Primer B28W8200.
 - 2) Loxon Masonry Primer A24W300.
- I. Plywood, latex finishes:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 120.

- b. PPG:
 - 1) Exterior: Seal Grip® Hydrosealer Exterior Bonding Primer/Sealer, 17-6001.
 - 2) Interior: PPG Seal Grip Gripper Interior/Exterior 100 percent Acrylic Latex Primer, 17-921XI Series.
 - c. Sherwin-Williams Co.: A100 Latex Primer B42W8041.
 - J. Wood primer for opaque finish paint, interior exposure:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 120.
 - b. PPG: PPG Seal Grip Gripper Interior/Exterior 100 percent Acrylic Latex Primer, 17-921XI Series.
 - c. Sherwin-Williams Co.: PrepRite Latex Primer B28W111.
 - K. Wood primer for opaque finish paint, exterior exposure:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Sanitile 120.
 - b. Sherwin-Williams Co.: A-100 Primer B42W.
 - c. PPG: Seal Grip® Hydrosealer Exterior Bonding Primer/Sealer, 17-6001.
 - L. Wood stain:
 - 1. Manufacturers: One of following or equal:
 - a. Sherwin-Williams Co.:
 - 1) Interior: Wood Classic.
 - 2) Exterior: Woodscapes.
 - b. PPG:
 - 1) Interior: DEFT.
 - 2) Exterior: PROLUXE.

2.03 PAINTS, INTERIOR EXPOSURE

- A. Latex, flat:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carbocrylic 3359 flat.
 - b. PPG:
 - 1) Speedhide® Zero Interior Flat, 6-5110 Series.
 - 2) Ultralast Interior Matte, 13-210 Series.
 - c. Sherwin-Williams Co.: Promar 200, B30W200.
- B. Latex, semi-gloss:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carbocrylic 3359.
 - b. PPG:
 - 1) Speedhide® Zero Interior Semi-Gloss, 6-5510 Series.
 - 2) Copper Armor Interior Latex Paint + Primer Semi-Gloss, 29-1510.
 - c. Sherwin-Williams Co.: Promar 200, B77W3402D.

- C. Alkyd, gloss:
 - 1. Manufacturers: One of following or equal:
 - a. PPG:
 - 1) 7-Line Interior/Exterior Industrial Gloss Oil, 7-282 Series.
 - 2) Break-Through!® 250 Interior/Exterior Gloss, V70-6102500.
 - b. Sherwin-Williams Co.:
 - 1) Industrial Enamel, B54Z.
 - 2) Water based Industrial Enamel, B53W311.
- D. Acrylic, semi-gloss:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carbocrylic 3359.
 - b. PPG:
 - 1) Speedhide® Zero Interior Semi-Gloss, 6-5510 Series.
 - 2) Copper Armor Interior Latex Paint + Primer Semi-Gloss, 29-1510.
 - c. Sherwin-Williams Co.: Promar 200, B77W3402D.
 - d. Tnemec: Series 1029, Enduratone.
- E. Urethane varnish, clear:
 - 1. Manufacturers: One of following or equal:
 - a. PPG: DEFT Clear Wood Finish Waterborne Acrylic, DFT107.
 - b. Sherwin-Williams Co.: Wood Classics Waterborne Polyurethane Varnish Gloss Clear A68V91.
- F. Oil:
 - 1. Manufacturers: The following or equal:
 - a. Watco Danish Oil.

2.04 PAINTS, EXTERIOR EXPOSURE

- A. Latex, flat:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carbocrylic 3359 flat.
 - b. PPG:
 - 1) Speedhide® Exterior Flat, 6-6510XI.
 - c. Sherwin-Williams Co.: A-100, Flat Exterior Latex A6-100.
 - d. Tnemec: 1028 Enduratone.
- B. Alkyd, gloss:
 - 1. Manufacturers: One of following or equal:
 - a. PPG:
 - 1) 7-Line Interior/Exterior Industrial Gloss Oil, 7-282 Series.
 - 2) Break-Through! 250 Interior/Exterior Gloss, V70-6102500.
 - b. Sherwin-Williams Co.:
 - 1) Industrial Enamel, B54Z.
 - 2) Water based Industrial Enamel B53W311.
- C. Acrylic latex, semi-gloss:
 - 1. Manufacturers: One of following or equal:
 - a. Carboline Co.: Carbocrylic 3359 flat.

- b. PPG:
 - 1) Speedhide® Exterior Semi-Gloss, 6-901XI.Sherwin-Williams Co.: A-100, Flat Exterior Latex A6-100.
 - c. Tnemec: 1028 Enduratone.
- D. Urethane varnish, clear:
 - 1. Manufacturers: One of following or equal:
 - a. PPG: FLOOD Spa-N-Deck Waterborne System.

PART 3 EXECUTION

3.01 INSPECTION

- A. Thoroughly examine surfaces scheduled to be painted before starting work.
- B. Start painting when unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Prepare surfaces in accordance with paint manufacturer's instructions or when none, the following:
 - 1. Aluminum:
 - a. Remove surface contamination by steam, high-pressure water, or degreasers.
 - b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
 - c. Apply etching primer.
 - 2. Reinforced concrete panels:
 - a. Remove dirt, powdery residue, and foreign matter.
 - b. Paint immediately; both sides when applicable.
 - 3. Canvas and cotton insulation coverings: Remove dirt, grease, and oil.
 - 4. Concrete floors:
 - a. Remove contamination, abrasive blast or acid etch and rinse with clear water.
 - b. Ensure required acid-alkali balance is achieved. Allow to dry thoroughly.
 - 5. Copper for paint finish:
 - a. Remove contamination by steam, high-pressure water, or degreasers.
 - b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
 - c. Apply vinyl etch primer.
 - 6. Copper for oxidized finish:
 - a. Remove contamination.
 - b. Apply oxidizing solution of copper acetate and ammonium chloride in acetic acid.
 - c. Rub on repeatedly for correct effect.
 - d. Once attained rinse surfaces well with clear water and allow to dry.
 - 7. Gypsum wallboard:
 - a. Remove contamination and prime to show defects.
 - b. Repair and prime defects.

8. Galvanized surfaces:
 - a. Remove surface contamination and oils and wash with degreasers.
 - b. Apply coat of etching type primer.
9. Zinc coated surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
10. Concrete and concrete masonry:
 - a. Remove dirt, loose mortar, scale, powder and other foreign matter.
 - b. Remove oil and grease with solution of tri-sodium phosphate.
 - c. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate.
 - d. Rinse well and allow to thoroughly dry.
 - e. Spot prime exposed metal with alkyd primer.
11. Plaster:
 - a. Fill hairline cracks, small holes and imperfections with patching plaster.
 - b. Smooth off to match adjacent surfaces.
 - c. Wash and neutralize high alkali surfaces where they occur.
12. Unprimed steel and iron: Remove grease, rust, scale, dirt and dust by wire brushing, sandblasting or other necessary method.
13. Shop primed steel:
 - a. Sand and scrape to remove loose primer and rust.
 - b. Feather out edges to make touch-up patches inconspicuous.
 - c. Clean surfaces.
 - d. Prime bare steel surfaces.
14. Wood and millwork:
 - a. Sandpaper to smooth even surface.
 - b. Wipe off dust and grit prior to priming.
 - c. Spot coat knots, pitch streaks, and sappy sections with sealer.
 - d. Fill nail holes and cracks after primer has dried and sand between coats.
15. Exterior wood siding:
 - a. Remove dust, grit, and foreign matter.
 - b. Seal knots, pitch streak, and sappy sections.
 - c. Fill nail holes with exterior caulking compound after prime coat has been applied.
16. Mildew:
 - a. Remove by scrubbing with solution of tri-sodium phosphate and chlorine bleach.
 - b. Rinse with clean water and allow surface to dry completely.
17. Glue laminated woods:
 - a. Remove grease and dirt.
 - b. Wash down surfaces with degreasers.

3.03 APPLICATION

- A. Apply each coat at proper consistency.
- B. Tint each coat of paint slightly darker than preceding coat.
- C. Sand lightly between coats to achieve required finish.
- D. Do not apply finishes on surfaces that are not sufficiently dry.

- E. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.
- F. Where clear finishes are required ensure tint fillers match wood.
 - 1. Work fillers well into grain before set.
 - 2. Wipe excess from surface.
- G. Backprime exterior woodwork, which is to receive paint finish, with exterior primer paint.
- H. Backprime interior woodwork, which is to receive paint or enamel finish, with enamel undercoat paint.
- I. Backprime interior and exterior woodwork, which is to receive stain or varnish finish, with gloss varnish reduced 25 percent with mineral spirits.
- J. Prime top and bottom edges of wood and metal doors with enamel undercoat when they are to be painted.
- K. Prime top and bottom edges of wood doors with gloss varnish when they are to receive stain or clear finish.

3.04 MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Identify equipment, ducting, piping, and conduit in accordance with Related Sections.
- B. Remove grilles, covers, and access panels for mechanical and electrical system from location and paint separately.
- C. Finish paint primed equipment with color selected by the Engineer.
- D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are plated or covered with prefinished coating.
- E. Replace identification markings on mechanical or electrical equipment when painted over or spattered.
- F. Paint interior surfaces of air ducts, convector, and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.
- G. Paint dampers exposed immediately behind louvers, grilles, convector, and baseboard cabinets to match face panels.
- H. Paint exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
- I. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

- J. Color code equipment, piping, conduit, exposed ductwork, and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with the Contract Documents.

3.05 SURFACES NOT REQUIRING FINISHING

- A. Stainless steel, brass, bronze, copper, Monel®, chromium, anodized aluminum: Specially finished articles such as porcelain enamel, plastic coated fabrics, and baked enamel.
- B. Finished products such as ceramic tile, windows, glass, brick, resilient flooring, acoustical tiles, board and metal tees; other architectural features, such as finish hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items that are installed prefinished.
- C. Items completely finished at factory, such as preformed metal roof and wall panels, aluminum frames, toilet compartments, sound control panels, acoustical tiles, shower compartments, folding partition, and flagpole.

3.06 CLEANING

- A. As work proceeds and upon completion, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of work, keep premises free from unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Upon completion of work, leave premises neat and clean.

3.07 INTERIOR PAINT SCHEDULE

- A. Concrete masonry: 2 coats of following finish paints over block filler:
 - 1. Latex, semi-gloss:
 - a. Walls.
- B. Gypsum board: 2 coats of following finish paints:
 - 1. Latex, flat:
 - a. Ceilings.
 - 2. Latex, semi-gloss:
 - a. Walls and partitions.

END OF SECTION

SECTION 09_96_01

HIGH-PERFORMANCE COATINGS

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ATTACHMENT A - SCHEDULE OF SURFACES TO BE COATED

ATTACHMENT B - COATING DETAIL SHEETS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Coatings, including coating systems, surface preparation, application requirements, and quality control requirements.

1.02 REFERENCES

- A. Abbreviations:
 - 1. CMU - Concrete masonry units.
 - 2. CSA - Coating system applicator. Specialty subcontractor retained by the Contractor to perform surface repairs, surface preparations, and apply coating systems as specified in this Section.
 - 3. CSM - Coating system manufacturer.
 - 4. CTR - Coating system manufacturer's technical representative.
 - 5. DFT - Dry-film thickness. Thickness of cured film, usually expressed in mils (0.001 inch).
 - 6. VOC - Volatile organic compound. The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing; expressed in grams per liter (g/l) or pounds per gallon (lb/gal). VOC is determined by EPA Method 24.
 - 7. WFT - Wet film thickness. Coating thickness as measured immediately after application. Usually expressed in mils (0.001 inch).
- B. Standards:
 - 1. ASTM International (ASTM):
 - a. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - b. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - c. D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - d. D2200 - Standard Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces.
 - e. D3359 - Standard Test Methods for Rating Adhesion by Tape Test.
 - f. D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
 - g. D4262 - Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - h. D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - i. D4285 - Standard Test Method for Indicating Oil or Water in Compressed Air.
 - j. D4414 - Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
 - k. D4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast-Cleaned Steel.
 - l. D4787 - Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.

- m. D5162 - Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates.
- n. D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
- o. E337 - Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
- p. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- q. F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-situ Probes.
- 2. International Concrete Repair Institute (ICRI):
 - a. 310.2 - Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- 3. NACE International (NACE):
 - a. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
 - b. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- 4. National Association of Pipe Fabricators (NAPF):
 - a. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.
- 5. NSF International (NSF):
 - a. 61 - Drinking Water System Components - Health Effects.
 - b. 600 - Health Effects Evaluation and Criteria For Chemicals In Drinking Water.
- 6. Occupational Safety and Health Administration (OSHA).
- 7. Society for Protective Coatings (SSPC):
 - a. Glossary - SSPC Protective Coatings Glossary.
 - b. Guide 6 - Guide for Containing Surface Preparation Debris Generated during Paint Removal Operations.
 - c. PA 1 - Shop, Field, and Maintenance Painting of Steel.
 - d. PA 2 - Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - e. PA 9 - Measurement of Dry Coating Thickness Using Ultrasonic Gages.
 - f. QP 1 - Field Application of Coatings to Complex Industrial and Marine Structures.
 - g. QP 3 - Shop Application of Complex Protective Coating Systems.
 - h. SP 1 - Solvent Cleaning.
 - i. SP 2 - Hand Tool Cleaning.
 - j. SP 3 - Power Tool Cleaning.
 - k. SP 5 - White Metal Blast Cleaning.
 - l. SP 7 - Brush-Off Blast Cleaning.
 - m. SP 10 - Near-White Metal Blast Cleaning.
 - n. SP 11 - Power Tools Cleaning to Bare Metal.
 - o. SP 13 - Surface Preparation of Concrete.
 - p. SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
 - q. SP VIS 1 - Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.

1.03 TERMINOLOGY

- A. Definitions used in this Section are in accordance with definitions referenced in ASTM D16, ASTM D3960, and SSPC Glossary of Definitions.
- B. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Abrasive: Material used for blast cleaning, such as sand, grit, or shot.
 - 2. Abrasive blast cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
 - 3. Anchor pattern: Profile or texture of prepared surface(s).
 - 4. Biogenic sulfide corrosion: Corrosion caused by sulfuric acid formed when *Thiobacillus* bacteria metabolizes hydrogen sulfide.
 - 5. Bug holes: Small cavities resulting when air bubbles are entrapped in the surface of formed concrete during placement and consolidation.
 - 6. Dew point: Temperature a given air/water vapor mixture starts to condense.
 - 7. Dry to recoat: Time interval between material application and its ability to receive the next coat.
 - 8. Dry to touch: Time interval between material application and its ability to tolerate a light touch without coating damage.
 - 9. Drying time: Time interval between application and material curing.
 - 10. Exposed surface: Any indoor or outdoor surface not buried or encased.
 - 11. Feather edging: Reducing coating thickness at its edge to blend with existing surrounding coating.
 - 12. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys, except stainless steel.
 - 13. Field coat: Application of a surface coating system at the work site.
 - 14. Finish coat: Final coat in a paint system, including texture, color, smoothness of surface, and other properties affecting appearance.
 - 15. Hold point: A defined point, specified in this Section, at which Work shall be halted for inspection.
 - 16. Holiday: A discontinuity, skip, void, or pinhole in coating or coating system film that exposes the substrate.
 - 17. Honeycomb: Segregated and porous surface of hardened concrete due to insufficient consolidation.
 - 18. Hydroblast: High or ultra-high-pressure water jet surface preparation.
 - 19. Immersed/Immersion: A service condition in which substrate is submerged, is immediately above liquids, or is subject to frequent wetting, splashing, or washdown.
 - 20. Incompatibility: One coating's inability to overlay another coating or surface as evidenced by bleeding, poor bonding, or lifting of old coating; inability of a coating to bond to a substrate.
 - 21. Laitance: A thin, weak, brittle layer of cement and aggregate fines on a concrete surface.
 - 22. Mil: 0.001 inch.
 - 23. Overspray: Dry spray, particularly paint bonded to an unintended surface.
 - 24. Pinhole: A small diameter discontinuity in a coating or coating system film, created by off gassing from a void in a concrete or masonry substrate causing a void between coats or exposing the substrate. Usually caused by coating application while temperature is rising.

25. Pot life: Time interval after components are mixed and coating can be satisfactorily applied.
26. Prime coat: First full paint coat applied to a surface when using a multicoat system. Primers adhere to a new substrate, protect the substrate, and promote adhesion of subsequent coats of paint. The prime coat on metal surfaces is the first full coat and does not include solvent wash, grease emulsifiers, or other pretreatment applications.
27. Resurfacer/Resurfacing material: A layer of cementitious and/or resin-based material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
28. Shop coat: One or more coats applied in an off-site shop or plant before shipment to work site where field or finishing coat(s) are applied.
29. Stripe coat: A separate brush coat of paint applied to all weld seams, pits, nuts/bolts/washers, and edges. This coat shall not be applied until the previous coats have cured. Once applied, the coat shall be allowed to cure before subsequent coats are applied.
30. System: Protective film with one or more coats applied in a predetermined order, including surface preparation and quality control requirements.
31. Thick film coating system: A coating system applied with a minimum dry film thickness of 25 mils.
32. Touch-up painting: Application of paint on previously painted surfaces to repair marks, scratches, and deteriorated or damaged areas to restore the appearance and performance of the coating.
33. Water blast: An alternative to air abrasive blast cleaning that can be used with or without abrasive injection. Water cleaning at pressures up to 5,000 pounds per square inch is called low-pressure water cleaning or power washing. High-pressure water cleaning uses water pressures between 5,000 and 10,000 pounds per square inch. Water jetting is water blasting with added abrasive at pressures between 10,000 and 25,000 pounds per square inch. Ultra-high-pressure water jetting is water blasting at pressures above 25,000 pounds per square inch.
34. Weld splatter: Beads of non-structural weld metal that adhere to the surrounding surface, removed as part of surface preparation.

1.04 SUBMITTALS

- A. As specified in Section 01_33_00 - Submittal Procedures, submit the following:
 1. Schedule of proposed coating materials.
 2. Schedule of surfaces to be coated with each coating material.
 3. Dehumidification and heating plan.
 4. Methods for tenting blasting areas and methods to protect existing equipment from dust and debris.
 5. Abrasives and abrasive blast cleaning disposal.
 6. Product data, application, and safety data sheets.
 7. NSF certification of coatings for potable water supply systems, including NSF 600 and/or NSF 61.
 8. Compliance with regulatory requirements:
 - a. VOC limitations.
 - b. Hazardous lead compounds and polychlorinated biphenyls (removal and disposal methods).
 9. Manufacturer's standard color samples.

10. Include 8-inch square drawdowns or brushouts of topcoat finish when requested. Identify each sample as to finish, formula, color name and number, sheen name, and gloss units.
11. Affidavits signed by an officer of the CSM's corporation attesting to full compliance of each coating system component with current federal, state, and local air pollution control regulations and requirements.
12. Thick film coating systems (greater than 25 mils):
 - a. CSM's detailed written instructions for coating system treatment and graphic details for coating system terminations in coated structures, including pipe penetrations, metal embedments, gate frames, and other terminations encountered.
 - b. Include detailed treatment for coating system at concrete joints.
13. Quality assurance Submittals:
 - a. Quality assurance plan.
 - b. Qualifications:
 - 1) Field coating applicator includes:
 - a) Provide a minimum of 5 project references where similar coating work has been performed by the company in the past 5 years:
 - (1) Name and address of project.
 - (2) Year of installation.
 - (3) Year placed in operation.
 - (4) Point of contact: Name and phone number.
 - b) SSPC-QP 1 certified as required.
 - 2) Shop coating applicator includes:
 - a) Provide a minimum of 5 project references where similar coating work has been performed by the company in the past 5 years:
 - (1) Name and address of project.
 - (2) Year of installation.
 - (3) Year placed in operation.
 - (4) Point of contact: Name and phone number.
 - b) SSPC-QP 3 certified as required.
 - c. Field Quality Control:
 - 1) Provide certification letters from NACE Certified Level 3 Coating Inspector for surface preparation and coating application conformance with these specifications for any field-applied procedures performed as may be applicable to the Project.
 - 2) Indicate results of applicators furnished tests and inspections, including, but not limited to, ambient environmental conditions, surface cleanliness, surface profile, DFT measurements, holiday testing, etc.
 - d. CSA reports:
 - a) Written daily quality control inspection reports.
 - b) Reports to observe and approve surface preparation of structures to be coated.
 - c) Reports to observe and approve coating application procedures.
 - d) Reports on visits to plants to observe and approve surface preparation and coating application on shop-coated items.
 14. For each substituted coating material "equal" to specified product in the coating tabulation:
 - a. List of not less than 5 similar successful material applications:
 - 1) Project name, location, type of structure, and application dates.

- 2) Owner's name, address, and telephone number.
- b. Certification that material meets or exceeds specified requirements:
 - 1) Manufacturer's certification, including technical representative's signature and date of signature.
 - 2) Independent laboratory's certified test reports.

1.05 QUALITY ASSURANCE

- A. Coating inspector:
 1. CSA inspector and/or third-party inspector shall be trained and knowledgeable in the specified coating's application.
 2. Provide calibrated inspection instruments and demonstrate use as required.
 3. Applicator's quality assurance inspector foreman shall oversee all aspects of coating work and shall be NACE Level III certified or an SSPC Protective Coatings Inspector (PCI).
 - a. Oversees lesser qualified inspectors and provides them training and guidance for testing and report preparations, provides documentation for all inspection equipment showing calibrations, and verifies the equipment is free from damage and is in proper working condition.
- B. Regulatory requirements: Comply with governing agencies' regulations by using coatings in accordance with their VOC limits.
 1. Lead-based coatings are not permitted.
 2. Do not use coal-tar epoxy in contact with drinking water or exposed to ultraviolet radiation.
- C. Pre-installation conference: Conduct as specified in Section 01_31_19 - Project Meetings.
 1. Coordinate Hold Point schedule.
- D. Field samples:
 1. Prepare and coat a minimum 100-square-foot area of each system between corners or limits such as control or construction joints.
 2. Approved field sample may be part of the Work.
- E. Obtain approval before coating other surfaces. Use products by the same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise. Coatings must be compatible with one another and complete a cohesive coating system.
- F. CSM services:
 1. CSA shall arrange for CTR to attend pre-installation conferences.
 2. Visit the Project Site periodically to consult on and inspect specified surface preparation and application Hold Points.
 3. Visit coating plants to observe and approve surface preparation procedures and coating application of items to be shop primed and coated.
 4. CTR shall provide written inspection reports.

- G. Quality control requirements:
1. Applicator shall be responsible for the workmanship and quality of the coating system installation.
 - a. Inspections by the Owner, Engineer, or CTR will not relieve or limit the CSA's responsibilities.
 2. In accordance with this Specification's requirements and the standards referenced in this Section. Changes in the coating system application requirements will be allowed only with the Engineer's written acceptance.
 3. Specially trained crews with experience applying the specified coating system coating are required for:
 - a. Coating application using plural component spray equipment or other specialty equipment.
 - b. Coating with specialty linings for severe service conditions, including floor coatings, and with linings for corrosive headspaces or secondary containment areas.
 4. CTR shall specially train personnel for coating systems as specified in Attachment B - Coating Detail Sheets.
 - a. CSM shall approve personnel in writing applying the coating system.
 5. Do not use contaminated, outdated, diluted materials, and/or materials from previously opened containers.
 6. Identify inspection access points used by the Owner's or Engineer's personnel.
 7. Provide ventilation, ingress, egress, or other means as necessary for the Owner's or Engineer's personnel to safely access the work areas.
 8. Conduct and continually inspect Work so the coating system is installed as specified. CSM shall provide written directions to correct coating work not in accordance with the specifications or is otherwise unacceptable.
 9. Provide written daily reports summarizing test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system application.
 - a. Determine relative humidity in accordance with ASTM E337. Confirm other conditions, such as proper protective measures for surfaces not to be coated and safety requirements for personnel.
 - 1) Measure daily at the shift's beginning and end and at intervals not to exceed 4 hours during the shift.
 - 2) Determine the acceptability of weather and/or environmental conditions within the structure in accordance with the CSM's requirements.
 - b. Monitoring surface preparation: Spot check cleanliness, surface profile, and surface pH testing at least 3 times daily. Check each surface at least once. In accordance with:
 - 1) ASTM D4262.
 - 2) ASTM D4263.
 - 3) ASTM D4417.
 - 4) ICRI 310.2 requirements.
 - 5) SSPC surface preparation standards.
 - c. Confirm that compressed air used for surface preparation or blow-down cleaning is free of oil and moisture.
 - d. Monitor surface preparation daily at the shift's beginning and end and at intervals not to exceed 4 hours during the shift.
 - e. Do not apply coatings when environmental conditions are outside of the CSM's published limits.

- f. Monitoring coatings application: Continuously inspect, measure, and record the wet film thickness and general film quality (visual inspection) for runs, sags, pinholes, holidays, etc., during coating.
 - 1) Perform WFT measurements in accordance with ASTM D4414.
 - g. Post cure evaluation: Measure and inspect the overall dry film thickness on all surfaces.
 - 1) Conduct a DFT survey and perform adhesion testing, holiday detection, or cure testing as specified in this Section and/or the CSM's written instructions.
 - 2) Perform applicable tests in accordance with ASTM D4541, ASTM D4787, ASTM D5162, ASTM D7234, SSPC-PA 1, SSPC-PA 2, SSPC-PA 9, and other pertinent standards and recommended practices.
- H. Inspection at Hold Points:
- 1. Conduct inspections at Hold Points during the coating system application and record the results.
 - 2. Coordinate Hold Points with the Engineer so the Engineer can observe the Contractor's inspections on a scheduled basis.
 - 3. Provide the Engineer with a minimum of 24 hours of notice before conducting Hold Point inspections.
 - 4. Hold Points shall be as follows:
 - a. Conditions before surface preparation: Before starting surface preparation, observe, record, and confirm that oil, grease, and/or soluble salts are gone from the surface.
 - b. Post surface preparation: After completing surface preparation, measure and inspect for cleanliness and proper surface profile as specified in this Section and in the CSM's written instructions.
 - c. Coatings application: At the beginning of any coating system application, measure, record, and confirm acceptability of surface and ambient air temperature and humidity. Inspect applicator's equipment for serviceability and suitability for coatings application.
 - d. Post application inspection: Identify defects in application work on all surfaces, including pinholes, holidays, excessive runs, or sags, inadequate or excessive film thickness, and other problems.
 - e. Follow-up corrective actions and final inspection: Measure and re-inspect corrective coating work performed to repair defects at prior Hold Points and repeat until the surface condition is acceptable. Conduct final visual inspection with follow-up tests, such as holiday detection, adhesion tests, and DFT surveys.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Immediately remove unspecified and unapproved coatings from the Project Site.
- C. Deliver new, labeled, unopened containers:
 - 1. Do not deliver materials after the manufacturer's expiration date or over 12 months from manufacturing date, whichever is more stringent. Store

- materials in well-ventilated enclosed structures and protect from weather and excessive heat or cold in accordance with the CSM's recommendations.
- a. Store flammable materials in accordance with federal, state, and local requirements.
 - b. Store rags and cleanup materials appropriately to prevent fire and spontaneous combustion.
2. Store and dispose of hazardous waste in accordance with federal, state, and local requirements. This requirement specifically applies to waste solvents and coatings.
 3. Container labels shall show the following:
 - a. Brand name or product title.
 - b. CSM's batch number.
 - c. CSM's manufacture date.
 - d. CSM's name.
 - e. Generic material type.
 - f. Application and mixing instructions.
 - g. Hazardous material identification label.
 - h. Shelf-life expiration date.
 - i. Color.
 - j. Mixing and reducing instructions.
 4. Clearly mark containers to indicate safety hazards associated with the use of or exposure to materials.

1.07 PROJECT CONDITIONS

- A. Apply coatings to dry surfaces.
 1. Surface moisture: In accordance with the manufacturer's requirements or as specified in this Section.
 - a. Plaster and gypsum wallboard: 12 percent.
 - b. Masonry and concrete blocks: 12 percent.
 - c. Interior located wood: 15 percent.
 - d. Concrete floors: Moisture vapor transmission rate of no more than 3.0 pounds per 1,000 square feet per 24 hours in accordance with ASTM F1869 or relative humidity no greater than 80 percent if tested in accordance with ASTM F2170, unless the CSM's recommendations are more restrictive.
 - e. Concrete structures: Negative results from plastic sheet test in accordance with ASTM D4263, and maximum of 80 percent relative humidity in accordance with ASTM F2170.
- B. Do not apply coatings when the following conditions exist. If such conditions exist, provide containment, covers, environmental controls, and other necessary measures.
 1. During rainy, misty, or damp weather, or to surfaces with frost or condensation.
 2. When the surface temperature is below 10 degrees Fahrenheit above the dew point.
 3. When ambient or surface temperature:
 - a. Is less than 55 degrees Fahrenheit unless the manufacturer allows a lower temperature.
 - b. Is less than 65 degrees Fahrenheit for clear finishes unless the manufacturer allows a lower temperature.

- c. Exceeds 90 degrees Fahrenheit unless the manufacturer allows a higher temperature.
 - d. Exceeds the manufacturer's recommendation.
 - 4. When relative humidity is higher than 85 percent.
 - 5. Under dusty or adverse environmental conditions.
 - 6. When light on surfaces measures less than 15-foot candles.
 - 7. When wind speed exceeds 15 miles per hour.
- C. Apply coating only under evaporation conditions rather than condensation.
 - 1. Use dehumidification equipment, fans, and/or heaters inside enclosed areas to maintain required atmospheric and surface temperature requirements for proper coating application and cure.
 - 2. Measure and record relative humidity and air and surface temperatures at the start and end of each shift to confirm proper humidity and temperature levels inside the work area.
 - a. Submit test results.
- D. Continuously ventilate, dehumidify, and heat enclosed spaces with high humidity during surface preparation, coating application, and curing.
 - 1. Maintain minimum air temperature of 55 degrees Fahrenheit and 10 degrees Fahrenheit above the dew point.
 - 2. Maintain dew point of at least 10 degrees Fahrenheit less than the temperature of the coldest part of the structure where work is performed.
 - 3. Reduce dew point temperature in conditioned space by at least 10 degrees Fahrenheit within 20 minutes.
 - 4. Seal work areas and maintain positive pressure in accordance with the dehumidification equipment supplier's recommendations.
 - 5. Maintain these conditions before, during, and after application to ensure proper adhesion and cure of coatings for no less than:
 - a. Entire curing period.
 - b. 8 hours after coating.
- E. Systems:
 - 1. Site electrical power availability as specified in Section 01_50_00 - Temporary Facilities and Controls.
 - 2. Internal combustion engine generators may be used.
 - a. Obtain required permits and provide air pollution and noise control devices on equipment as required by permitting agencies require.
 - b. Comply with state, federal, and local fire and explosion protection measures when locating and operating generators.
 - c. Locate engine generator outside hazardous classified areas in accordance with NFPA 820.
 - d. Provide daily fuel service for generators for duration of use.
 - 3. Dehumidification:
 - a. Provide desiccant or refrigeration drying.
 - b. Use only desiccant types with a rotary desiccant wheel capable of continuous operation.
 - c. Liquid, granular, or loose lithium chloride drying systems are not acceptable.
 - 4. Heating:
 - a. Use electric, indirect combustion, or steam coil.

- b. Direct-fired combustion heaters are not acceptable heat sources during abrasive blasting, coating application, or coating cure.
 - 5. Filters:
 - a. Use a filtration system for dust removal designed to not interfere with the dehumidification equipment's ability to control dew point and relative humidity inside the reservoir.
 - b. Do not allow air from the working area or dust filtration equipment to recirculate through their dehumidifier during coating application or when solvent vapors are present.
 - 6. Design and Submittals:
 - a. Prepare and submit dehumidification and heating plan, including all equipment, and operating procedures.
 - b. Suppliers of services and equipment shall have at least 3 years of experience in similar applications.
- F. Provide containment and ventilation system components in accordance with SSPC-Guide 6, Level 3, and as required for hazardous materials.

1.08 MAINTENANCE

- A. Provide extra materials:
- 1. Minimum 1 gallon of each type and color of coating applied or provide additional quantities if specified in the Contract Documents:
 - a. Deliver unopened factory-labeled cans when the manufacturer packages material in gallon cans.
 - b. Deliver material in new gallon containers, properly sealed and identified with permanently affixed, durable, printed labels indicating brand, type, and color, when the manufacturer does not package material in gallon cans.

1.09 TECHNICAL REPRESENTATIVES' RESPONSIBILITIES

- A. General:
- 1. Attend pre-installation conference.
 - 2. Perform on-site application training.
- B. Coating system installation training:
- 1. Provide a minimum of 8 hours of classroom and off-site training for application personnel and supervisory personnel in one of the following ways:
 - a. Train a minimum of 2 supervisory personnel and 2 application personnel.
 - b. Submit a letter from the CSM stating that CSM approves the supervisory and application personnel, listed by name and responsibility, and no additional training is required.
 - 2. CTR can train up to 14 application personnel and 3 supervisory personnel at a time.
 - 3. Minimum training requirements:
 - a. Explain in detail the mixing, application, curing, and termination requirements.
 - b. Provide hands-on demonstration of coating system mixing.
 - c. Explain in detail the ambient condition requirements for temperature and humidity.

- d. Explain in detail the surface preparation requirements.
- e. Explain in detail the re-coat times, cure times, and related ambient condition requirements.
- f. Write a letter stating that training was satisfactorily completed by the personnel, listed by name and responsibility.
- 4. Provide special training as specified in the coating detail sheets.
- 5. Visit the Site at the following intervals:
 - a. On the first day of application of any coating system.
 - b. As necessary during surface preparation and application to ensure installations are made in accordance with the manufacturer's recommendations.
 - c. As required to resolve field problems attributed to or associated with the manufacturer's products.
- 6. Routinely inspect and verify in writing that application personnel have successfully performed surface preparation, filler/surfacer application, coating system application, and quality control inspection in accordance with this Section and to warrantable quality.
 - a. Be on site to periodically observe and oversee:
 - 1) Coating application.
 - 2) End of surface preparation.
 - 3) During coating application.
 - 4) Post-cure inspection.
- 7. Conduct final review of completed coating system installation and submit detailed report to the Owner.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Coating materials shall be formulated for environments encountered in water and wastewater treatment processes.
- B. Coating materials that encounter water distributed as potable water shall be certified in accordance with NSF 61.

2.02 MATERIALS

- A. General:
 - 1. As specified in Section 01_60_00 - Product Requirements.

2.03 COATING SYSTEMS IDENTIFICATION

- A. Naming conventions: Coating systems identifications contain the elements defined in Table 1.

Table 1. Coating System Identification Elements					
First Element	-	Second Element	-	Third Element	- Fourth Element (optional)
3 or 4 alpha characters		1-3 alpha characters		1 number	3 or 4 alpha characters
Coating Type		Substrate		System Number	Additional Substrate or Special Condition
Example: EPX	-	C	-	6	- BSC

1. First element identifies the coating type using the following abbreviations:
 - a. ACR: Acrylic.
 - b. CTE: Coal tar epoxy.
 - c. ELA: Elastomeric acrylic.
 - d. EPU: Epoxy-polyurethane.
 - e. EPX: Epoxy.
 - f. POL: Polyurethane.
 - g. SIL: Silicone.
 - h. SILX: Siloxane or silane.
 - i. VE: Vinyl ester.
2. Second element identifies the substrate using the following abbreviations:
 - a. C: Concrete or masonry.
 - b. F: Concrete flooring.
 - c. FRP: Fiber-reinforced plastic.
 - d. GM: Galvanized metal.
 - e. M: Metal.
 - f. PVC: Polyvinyl chloride, chlorinated polyvinyl chloride.
3. Third element identifies the sequential system number.
 - a. For example, EPX-C-2 is the second standard epoxy coating system for concrete substrates.
4. Fourth element is optional and identifies the additional substrate or special condition with the following abbreviations:
 - a. BG: Below grade or buried.
 - b. BSC: Biogenic sulfide corrosion-resistant applications in wastewater.
 - c. OZ: Organic zinc primer, epoxy polyurethane system.
 - d. PWS: Potable water service applications (NSF-61 approved).
 - e. SC: Secondary containment.

2.04 PRODUCTS FOR COATING SYSTEMS

- A. Products: As specified in Attachment B - Coating Detail Sheets.
- B. Cleaning solvents:
1. Requirements for solvent wash, solvent wipe, or cleaner used, including, but not limited to, those used for surface preparation in accordance with SSPC-SP 1.
 2. Use clean white cloths and clean fluids in solvent cleaning.

PART 3 EXECUTION

3.01 GENERAL PROTECTION REQUIREMENTS

- A. Protect adjacent surfaces from coatings and damage associated with coating work and repair any damage that occurs.
- B. Place coating waste, cloths, and material that may pose a fire hazard in closed metal containers and remove daily from the Site.
- C. Remove electrical plates, surface hardware, fittings, and fasteners before coating application.
 - 1. Carefully store, clean, and replace items after completing coating in each area.
 - 2. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finishes.
- D. Erect and maintain protective enclosures in accordance with SSPC-Guide 6.
- E. Protect the following surfaces from abrasive blasting by masking or by other means:
 - 1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
 - 2. Machined surfaces for sliding contact.
 - 3. Surfaces to be assembled against gaskets.
 - 4. Surfaces of shafting where sprockets will be fit.
 - 5. Surfaces of shafting where bearings will be fit.
 - 6. Machined bronze surfaces, including slide gates.
 - 7. Cadmium-plated items, except cadmium-plated, zinc-plated, or sherardized fasteners used to assemble equipment requiring abrasive blasting.
 - 8. Galvanized items, unless scheduled to be coated.

3.02 GENERAL SURFACE PREPARATION REQUIREMENTS

- A. Prepare surfaces in accordance with coating detail sheets in Attachment B - Coating Detail Sheets.
 - 1. Include coating and surface preparation requirements.
 - 2. CSM's instructions will also have surface preparation requirements but follow the more stringent if information conflicts.
- B. Where required by the Owner's representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before applying a coating.
 - 1. Applicator shall coordinate coating inspections.
 - a. Identify coating inspection Hold Points during the pre-installation conference.
 - b. Provide at least 2 days' notice before inspection.
 - 2. Correct surface defects identified by the inspector at no additional cost to the Owner.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

- A. Remove grilles, covers, and access panels for mechanical and electrical system and coat separately.
- B. Prepare and finish coat equipment primed by the manufacturer using specified intermediate and topcoats, as applicable, and color selected by the Owner.
- C. Prepare, prime, and coat both insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with material not requiring coating, or with a prefinished coating.
- D. Replace identification markings on mechanical or electrical equipment when coated over or spattered.
- E. Prepare and coat interior surfaces of air ducts and convector and baseboard heating cabinets visible through grilles and louvers with 1 coat of flat black paint to limit of sight line.
- F. Prepare and coat dampers exposed immediately behind louvers, grilles, and convector and baseboard heating cabinets to match face panels.
- G. Prepare and coat exposed conduit and appurtenances occurring in finished areas with color and texture to match adjacent surfaces.
- H. Prepare and coat sides, front, back, and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- I. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming, and numbering, in accordance with the Contract Documents.

3.04 CLEANING OF NEW AND PREVIOUSLY COATED OR NEW SURFACES

- A. Utilize cleaning agent to remove soluble salts, such as chlorides, from concrete and metal surfaces:
 - 1. Cleaning agent: Biodegradable non-flammable and containing no VOC.
 - 2. Manufacturers: The following or equal:
 - a. CHLOR*RID International, Inc.
 - 1) Complete soluble salt removal with steam or warm water cleaning.
 - 3. Clean surfaces with decontamination agent in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing, as approved by the CTR and the Engineer.
 - 4. Test cleaned surfaces to ensure removal of soluble salts. Carry out additional cleaning as needed.
 - 5. Complete final surface preparation before applying the new coating system in accordance with the manufacturers printed instructions.

3.05 BLAST CLEANING

- A. Surface preparation requirements:
 - 1. Do not reuse spent blast abrasive.
 - 2. Ensure that filter compressed air used for blast cleaning is free of condensed water and oil.
 - a. Clean moisture traps at least once every 4 hours or more frequently, as required, to prevent moisture from entering the abrasive blasting equipment air supply.
 - b. Check blast air for moisture and oil after each cleaning in accordance with ASTM D4285.
 - 3. Install oil separators just downstream of compressor discharge valves and at the discharge point of blast pot discharges. Check separators on the same frequency as the moisture traps.
 - 4. Keep regulators, gauges, filters, and separators on compressor air lines connected always when blasting nozzles operational.
 - 5. Install an air dryer or desiccant filter drying unit to dry the compressed air before blast pot connections. Use and maintain the dryer throughout surface preparation work.
 - 6. Use a venturi-type, or other high velocity-type, abrasive blast nozzles supplied with at least 100 pounds per square inch gauge air pressure at the nozzle and enough volume to obtain appropriate blast cleaning production rates and surface cleanliness.
 - 7. Provide airborne particulate evacuation and filtering that meets OSHA safety standards. Maintain optimal visibility both to clean and provide the specified surface profile and to allow inspection of the substrate during surface preparation work.
 - 8. Surfaces blasted and prepared and not coated/painted the same day shall be re-prepared prior to coating/painting. Any rust-back occurring before coating shall be removed.
 - 9. Prepared blasted surfaces may be open longer if dehumidification (DH) is used to reduce moisture vapor and eliminate the potential for rust-back.

3.06 PREPARATION REQUIREMENTS FOR CONCRETE SURFACES

- A. Cure for at least 28 days before coating.
- B. Remove degraded concrete using abrasive blast cleaning or high or ultra-high-pressure water jetting, chipping, or other abrading tools until achieving a sound, clean substrate. Remove bruised or cracked concrete.
- C. Prepare substrate cracks and areas requiring resurfacing; perform detailed treatment, including, but not limited to, terminating edges in accordance with the CSM's recommendations, and as indicated on the Drawings.
 - 1. Prepare concrete surfaces in accordance with SSPC-SP 13.
- D. Prepare concrete surfaces in accordance with SSPC-SP 13.
 - 1. Inspect concrete surfaces to select appropriate surface preparation method to provide a suitable substrate for the specified coating system.

2. Use blast cleaning or other means to expose the complete perimeter of air voids or bug holes. Do not leave shelled over, hidden air voids beneath the exposed concrete surface.
 3. Repair concrete defects and physical damage.
 4. Clean concrete surfaces of dust, mortar, formwork, fins, loose concrete particles, form release materials, oil, and grease.
 5. Fill voids to provide surface as specified in Section 03_35_29 - Concrete Finishes.
- E. Provide clean substrate visually free of calcium sulfate, loose, coarse, or fine aggregate, laitance, loose hydrated cement paste, and otherwise harmful substances.
1. Confirm concrete surface minimum pH of 9.0 with surface pH testing.
 2. If after surface preparation the surface pH remains below 9.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
- F. Prepare concrete surface for coating in accordance with SSPC-SP 13.
1. Provide ICRI 310.2 minimum No. 3 concrete surface profile (CSP) or as specified on the coating detail sheets.
 2. Evaluate profile of the prepared concrete using ICRI 310.2 surface profile replicas.
- G. Blast clean cementitious repair mortars or grouts to the same profile and degree of cleanliness requirements required for concrete substrates.
- H. Blast clean polymer-based surfacers or waterborne modified cementitious surfaces only if they have exceeded the CSM's recommended recoat time.
- I. Vacuum or blow down concrete surfaces before coating application, leaving a dust free, sound concrete substrate.
1. Thoroughly clean concrete surfaces to be coated to remove loose dirt and spent abrasive.
 2. Remove debris produced by blast cleaning from the structures to be coated, and legally dispose of it off site.
- J. Test moisture content of concrete to be coated:
1. Conduct ASTM D4263 plastic sheet test at least once for every 500 square feet of surface area to be coated.
 - a. Any moisture on plastic sheet after test period constitutes a non-acceptable test, and the concrete must be dried further.
 2. Conduct ASTM F1869 test at least once for every 1,000 square feet of concrete floor surface area to be coated.
 3. Conduct ASTM F2170 one relative humidity moisture test at least once for each 500 square feet of non-floor concrete surface area where the opposite side is exposed to soil or water.
 - a. Waterproof surfaces exposed to soil or water where specified in Section 07_11_00 - Dampproofing.
 4. Comply with specified minimum moisture content and the CSM's written recommendations for moisture vapor transmission rates or relative humidity values.

- K. Masonry surfaces:
1. Cure for at least 28 days before coating.
 2. Prepare masonry surfaces to remove chalk, laitance, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
 3. Wash and scrub masonry surfaces with clear water. Do not use muriatic acid.
 4. Seal or fill masonry surfaces with a sealer or block filler compatible with the specified primer after cleaning.
 5. Confirm that masonry surfaces are dry before coating application.
 - a. When using pressure washing or low-pressure water blast cleaning for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or until the minimum ambient temperature is 70 degrees Fahrenheit before coating.

3.07 GENERAL PREPARATION REQUIREMENTS FOR METALLIC SURFACES

- A. Remove rust, scale, and welding slag and spatter.
1. Remove and grind smooth excessive weld material and weld spatter on metal surfaces before blast cleaning in accordance with NACE SP0178.
 2. Grind sharp edges on metal substrate to approximately 1/16-inch radius before abrasive blast cleaning.
- B. Prepare metallic surfaces in accordance with applicable portions of surface preparation specifications of the SSPC specified for each coating system.
1. Remove grease and oil in accordance with SSPC-SP 1.
 2. Measure profile depth of the surface to be coated in accordance with Method C of ASTM D4417. Select blast particle size and gradation to produce the specified surface profile.
 3. Constantly monitor and maintain ambient environmental conditions to ensure cleanliness and that no "rust back" occurs before coating material application.
 4. Surfaces not coated the same day they are prepared shall be re-prepared prior to coating unless approved moisture control equipment is used and approved by the Owners representative.
- C. Prepare metallic surfaces by blast cleaning in accordance with SSPC-VIS 1 (ASTM D2200). Prepare abrasive blast representative areas for the Owner's representative to inspect on the first day of cleaning.
- D. Unless otherwise specified, the requirements for blast cleaning steel, ductile iron, and stainless-steel substrates are as follows:
1. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC-SP 10 unless blasting may damage adjacent surfaces, is prohibited, or is specified otherwise. Where abrasive blasting is not possible, clean surfaces to bare metal with power tools in accordance with SSPC-SP 11.
 2. Ferrous metal surfaces to be submerged: Abrasive blast in accordance with SSPC-SP 5, unless specified otherwise, to clean and provide roughened surface profile with a depth between 2 and 4 mils.
 3. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products, or embedded abrasive from substrate before coating application.
 4. When abrasive blasted surfaces rust or discolor before coating, abrasive blast clean surfaces again.

- E. Field preparation of shop-primed surfaces:
 - 1. Smooth welds and prominences with power tools before applying field-applied coatings.
 - 2. Clean and dry shop-primed ferrous metal surfaces and fabricated assemblies before applying field coats.
 - 3. Prepare shop epoxy primed surfaces with light abrasive blasting or abrading and then vacuum before applying finish coats.
 - a. Follow CSM instructions for surface preparation when the primer recoat limit has been exceeded.
 - 4. Non-immersion service: Clean in accordance with SSPC-SP 2 or SSPC-SP 3 and uniformly roughen.
 - 5. Immersion, BSC, and SC service: Remove shop primer in accordance with SSPC-SP 5.
- F. Damaged shop primer or rust bleeding:
 - 1. Ferrous metals: Clean in accordance with SSPC-SP 1 and spot blast in accordance with SSPC-SP 10 to achieve a uniform surface profile between 2.0 and 2.5 mils before recoating.
 - 2. Reject galvanized steel with rust bleeding.
- G. Damaged coating: Repair by abrasive blast cleaning surfaces as specified for the coating system; feather to a smooth transition before touching up.

3.08 PREPARATION REQUIREMENTS BY SURFACE TYPE

- A. Steel and ferrous metal surfaces that require coating:
 - 1. Degrease or solvent clean (SSPC-SP 1).
 - 2. Abrasive blast surfaces to a SSPC-SP 10 for non-immersion and a SSPC-SP 5 for immersion.
 - a. If abrasive blast cannot be performed, abrade in accordance with SSPC-SP 7.
- B. Galvanized steel and non-ferrous metal surfaces:
 - 1. Degrease or solvent clean (SSPC-SP 1) to remove oily residue.
 - 2. Abrasive blast clean in accordance with SSPC-SP 16.
 - a. If abrasive blast cannot be performed, abrade in accordance with SSPC-SP 3.
 - 3. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded, such as bolts, nuts, or preformed channels.
 - 4. Test surface for contaminants using copper sulfate solution.
- C. Stainless-steel surfaces:
 - 1. Abrasive blast clean in accordance with SSPC-SP 16 to leave a clean, uniform appearance with surface profile between 1.5 and 2.5 mils.
- D. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.
- E. Sherardized, aluminum, copper, and bronze surfaces:
 - 1. Abrasive blast clean in accordance with SSPC-SP 16.
 - 2. Prepare in accordance with the CSM's instructions.

- F. Cadmium-plated, zinc-plated, or sherardized fasteners:
 - 1. Abrasive blast in the same manner as uncoated metal when assembling equipment designated for abrasive blasting.
- G. PVC and FRP surfaces:
 - 1. Lightly sand surfaces to be coated.
 - a. Sand to remove gloss and establish uniform surface profile.
 - 2. Vacuum to remove loose dust, dirt, and other materials.
 - 3. Solvent clean with clean white rags and allow solvent to evaporate completely before applying coating materials.

3.09 APPLICATION REQUIREMENTS

- A. Apply coatings in accordance with the manufacturer's instructions.
- B. Empty aboveground piping to be coated of contents when applying coatings.
- C. Items to be coated: Commercial or manufactured items with a factory or shop-applied coating system.
 - 1. Factory or shop-applied permanent coating system:
 - a. Commercial components shall be coated with the manufacturer's standard surface preparation and applied permanent coating system:
 - 1) Pumps and valves: Shop coat with the manufacturer's highest quality coating system in accordance with the Project Specifications.
 - 2) Non-immersed equipment: Touch up shop primer, and coat in the field with specified coating system after installation.
 - 3) Immersed equipment with shop primer: Touch up shop primer and coat in the field with specified coating system after installation.
 - 2. Items subject to sunlight shall be topcoated with ultraviolet (UV) stable materials.
 - 3. Permanent coating system shall have a 10-year corrosion-free protection without significant defects stored in atmospheric exposure.
 - 4. Color and gloss: Manufacturer's standard color unless a specific color is otherwise specified in the color schedule or indicated on the Drawings.
 - 5. Unless otherwise specified, unexposed surfaces that require coatings, such as interior of cabinets, enclosures, and equipment, shall be given the manufacturer's standard permanent coated finish.
 - 6. Field repair: Repair damaged areas of coated surfaces with compatible materials to equal thickness and color match of undamaged areas.
- D. Repair damaged galvanized surfaces in accordance with ASTM A780. Repair materials containing cadmium and lead are not permitted.
- E. Stainless steel surfaces to receive uniform passivation. Clean and restore uniform passivation layer on damaged, contaminated, or depassivated stainless steel surfaces in accordance with ASTM A380.
- F. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with the manufacturer's recommended special primer.

- G. Use equipment designed to apply materials specified.
 - 1. Use compressors with moisture traps and filters that remove water and oils from the air.
 - a. Perform a paper blotter test at the Engineer's request to verify air is sufficiently free of oil and moisture. Do not allow the amount of oil and moisture to exceed the CSM-recommended amount.
 - 2. Equip spray equipment with properly sized mechanical agitators, pressure gauges, pressure regulators, and spray nozzles.
- H. Where 2 or more coats are required, tint prime coat intermediate coats as necessary to distinguish each coating and to help indicate coverage.
- I. Apply coating by brush, roller, trowel, or spray, unless a specific application method is required by the coating manufacturer's instructions or these Specifications.
 - 1. With a brush, stripe coat edges, welds, corners, nuts, bolts, and difficult-to-reach areas, as necessary, before spray application to ensure specified coating thickness along edges.
 - 2. After the prime coat dries, mark, repair, and retest pinholes and holidays before intermediate or topcoats are applied.
- J. Spray application:
 - 1. With a brush, stripe coat edges, welds, corners, nuts, bolts, and difficult-to-reach areas, as necessary, before spray application to ensure specified coating thickness along edges.
 - 2. When using spray application, apply each coat to a thickness no greater than recommended in the coating manufacturer's instructions.
 - 3. Use airless spray method unless air spray method is required by the CSM's instruction or these Specifications.
 - 4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.
- K. Shop and field coats:
 - 1. Prime coat: Shop-apply or field-apply prime coats as specified. Use shop-applied primer compatible with the specified field coating system and apply at the minimum dry film thickness recommended by the finish coat CSM.
 - a. Provide datasheets identifying the shop primer to on-site coating application personnel.
 - b. Perform adhesion tests on the shop primer.
 - c. Remove and recoat damaged, deteriorated, and poorly applied shop coatings.
 - d. If the shop primer coat meets this Section's requirements, spot prime exposed metal of shop-primed surfaces before spray applying primer over the entire surface.
 - 2. Field coats: Apply field coats with one or more prime coats and finish coats to build up coating to dry film thickness specified for the coating system.
 - a. Do not apply finish coats until other work in the area is complete and previous coats are inspected.
 - 3. Adhesion confirmation: Perform adhesion tests after proper coating cure in accordance with ASTM D3359. Demonstrate that:
 - a. Primer coat adheres to the substrate.

- b. Coatings adhere to the primer and intermediate coats.
 - 1) Coating 5 mils or more DFT: Achieve adhesion test result of 5A on immersed surfaces and 4A or better on other surfaces.
 - 2) Coating less than 5 mils DFT: Achieve adhesion test results of 5B on immersed surfaces and 4B or better on other surfaces.
- L. Brush, roll, trowel, or spray and back roll coats for concrete and masonry.
- M. Plural component coating application:
 - 1. Premix contents of component drums if required by the CSM each day.
 - 2. Before starting application:
 - a. Verify gauges are working properly.
 - b. Complete ratio checks.
 - c. Sample the mix on plastic sheeting to ensure set time is appropriate and complete.
 - d. Label and retain spray samples. Submit to the Engineer when requested.
- N. Drying and recoating:
 - 1. Provide means to prevent condensate or dew on substrate surface or between coats and during curing after applying the last coat.
 - 2. Allow each coat to cure or dry thoroughly, in accordance with, if required, the CSM's printed instructions before recoating.
 - 3. Use the CSM's printed instructions and the requirements specified in this Section to determine the minimum required drying time.
 - a. Recoat coatings within time limits recommended by CSM.
 - b. If time limits are exceeded, abrasive blast clean and de-gloss clean before applying another coat.
 - 4. Ensure primer and intermediate coats of coating are unscarred and completely integral when applying each succeeding coat.
 - 5. Touch up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
 - 6. Repair holidays in accordance with the requirements on pertinent Coating Detail Sheets or as recommended by the CSM.
 - 7. Sand and feather to a smooth transition and recoat scratched, contaminated, or otherwise damaged coating surfaces so repairs are invisible to the naked eye.
- O. Workmanship:
 - 1. Ensure that coated surfaces are free from runs, drips, ridges, waves, laps, dry spray, and brush marks. Coats shall be applied to produce a smooth, even film of uniform thickness completely coating corners and crevices.
 - 2. Evenly apply each coat of material and sharply cut to a line created with masking tape or other suitable materials.
 - 3. When coating complex steel shapes, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer before overall coating system application.
 - a. Brush apply stripe coat to ensure proper coverage.
 - b. Do not stripe coat with spray or roller.
 - 4. Ensure that the finish coat, including repairs, has a uniform color and gloss.

- P. Coating properties, mixing, and thinning:
1. If maximum recoat time is exceeded, prepare surface with solvent washing, light abrasive blasting, sanding, or other procedures in accordance with the CSM's instructions.
 2. Allow adequate drying time between coats as instructed by the CSM, adjusted as necessary for the Site conditions.
 3. Ensure that coatings, when applied, provide a satisfactory film and a smooth even surface. Lightly sand glossy undercoats to provide a surface suitable for proper application and adhesion of subsequent coats. Thoroughly stir and strain coating materials during application and maintain uniform consistency.
 4. Mix coatings with 2 or more components in accordance with the CSM's instructions.
 5. Where necessary to suit conditions of the surface, temperature, weather, and method of application, thin the coating in accordance with the CSM's recommendations.
 - a. Ensure that volatile organic content (VOC) of the thinned coating complies with prevailing air pollution control regulations.
 - b. Thin coatings to only what is necessary to obtain proper application characteristics.
 - c. Use a thinner recommended by the CSM.
- Q. Film thickness and continuity:
1. Apply coating to the specified thicknesses.
 - a. Apply additional coats when necessary to achieve specified thicknesses, especially at edges and corners.
 2. Verify WFT of the coating system first coat and after applying each subsequent coat.
 3. Do not allow the minimum thickness at any point to deviate more than 20 percent on the low end and 120 percent on the high end from the required average.
 4. Do not allow the surface area covered per gallon of coating for various types of surfaces to exceed those recommended by the CSM.
 - a. Provide coating coverage worksheets listing the maximum and minimum coverage for each unit volume of coating for concrete surfaces.
 5. Apply additional coats to achieve the specified dry film thickness if brush or roller application methods cannot achieve the specified film thickness per coat.
- R. Protecting coated surfaces:
1. Do not handle, work on, or otherwise disturb coated items until the coating is completely dry and hard.
 2. After installation, recoat shop-coated surfaces with specified coating system as necessary to match surrounding surfaces, and to coordinate with the specified color identification requirements.
- S. Special requirements:
1. Before erection, apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces inaccessible after assembly. Apply final coat after erection.
 2. Coat structural slip-critical connections and high strength bolts and nuts after erection.

3. Areas damaged during erection:
 - a. Prepare surface for spot repairs as specified for the coating system.
 - b. Recoat with prime coat before applying subsequent coats.
 - c. Touch up surfaces after installation.
 - d. Clean and dry surfaces to be coated at time of application.
4. Coat underside of equipment bases and supports not galvanized with at least 2 coats of primer specified before setting the equipment in place.
5. Coat aluminum surfaces in contact with concrete.

3.10 APPLICATION REQUIREMENTS FOR CONCRETE COATING SYSTEMS

- A. Apply filler/surfacer as recommended by CSM to fill bug holes and air voids in concrete or block texture in CMU, leaving a uniformly filled surface that does not produce blowholes or outgassing causing the coating system to pinhole.
 1. Allow filler/surfacer to cure sufficiently before applying prime coat as required by the CSM. Use the CSM-recommended drying time between coats.
- B. Apply surfacer or filler and let dry before coating application.
 1. Use the drying time between filler/surfacer and coating system specified by the CSM for the Site conditions.
 - a. Let concrete substrate dry before applying filler/surfacer or coating system materials.
 2. If the maximum recoat time is exceeded, prepare surfaces by solvent washing, light abrasive blasting, and other procedures in accordance with the CSM's instructions.
 3. Apply a complete parge coat of the specified filler/surfacer material over the entire substrate before applying the coating system.
 - a. Scrub filler/surfacer into the substrate to completely fill open air voids and bug holes.
 - b. Completely cover the substrate, unless otherwise specified, above such filled voids by 1/8 inch of thickness.
 - c. Provide relatively flat, uniformly even surface before coating application.
 4. Secondary containment: Place surfacer or filler 1/16 inch thick above concrete plane to create a monolithic surface free of pinholes.
 - a. Floor surfaces: Broadcast with aggregate to create a non-slip surface texture.
 - b. Remove excess aggregates and apply base coat to encapsulate embedded non-slip aggregate.
- C. Concrete substrate temperatures:
 1. Apply filler/surfacer and the coating system when temperatures are falling, typically late afternoon or evening.
 - a. Do not coat concrete with rising concrete substrate surface temperatures or substrates in direct sunlight, to minimize outgassing from the substrate and formation of pinholes, and/or blistering.
 2. Should bubbles, pinholes, or other discontinuities form in the applied coating system material, they shall be repaired.
 - a. Should discontinuities develop in the filler/surfacer material or in the first coat of the coating material, repair them before the next coat.
 - b. When discontinuities occur, open the air void behind or beneath the discontinuities and completely fill with specified coating material. Then,

abrade the coated area around the discontinuities repair reapply coating over that area.

- D. Perform application detail work in accordance with these Specifications, the CSM's current written recommendations, and Drawings, whichever is stricter.
- E. Concrete coating systems application requirements:
 - 1. Concrete coating minimum dry film thickness excludes parge coat, block filler, and sealer.

3.11 COATING SYSTEMS

- A. Attachment A - Schedule of Surfaces to be Coated specifies surfaces to be coated in the field with the coating systems required.

3.12 SURFACES NOT REQUIRING COATING

- A. Stainless steel piping, valves, pipe supports, instrument sunshades.
 - 1. Clean and restore uniform passivation layer on damaged, contaminated, or de-passivated stainless-steel surfaces in accordance with ASTM A380.
- B. Sliding surfaces on expansion joints, motor and pump shafts, machined surfaces at bearings and seals, grease fittings, etc.
- C. Galvanized structural steel framing, galvanized roof decking, galvanized pipe supports.
- D. Copper and brass pipe, fittings, valves, etc.
- E. Bronze valves, bearings, bushings, and fasteners.
- F. Corrosion resistant special alloys: Inconel, Alloy 20, Hastelloy, etc.
- G. Exterior concrete.
- H. Plastic surfaces, except coat PVC, CPVC, and other plastic piping system exposed to sunlight.
- I. Exception - Piping that is encased in concrete or cement mortar:
 - 1. Coat the first 6 inches of pipe to be encased.
 - 2. Caulk gaps and seams after encasement.

3.13 QUALITY CONTROL

- A. CSA to perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section. These inspections shall include the following:
 - 1. Prepare reports, after daily coating work ends, summarizing each day's test data, observations, drawings, and photographs.
 - 2. Perform the following activities to confirm conformance with the specifications:
 - a. Inspect ambient conditions during coating system installation at Hold Points for conformance with the specified requirements.

- b. Inspect each coated surface type and coating system applied to verify the following:
 - 1) Inspect materials upon receipt to ensure that the CSM supplied them.
 - 2) Verify that specified storage conditions for the coating system materials, solvents, and abrasives are provided.
 - 3) Inspect and record findings for substrate cleanliness.
 - 4) Inspect and record pH of concrete and metal substrates.
 - 5) Inspect and record substrate profile (anchor pattern).
 - 6) Measure and record ambient air and substrate temperature.
 - 7) Measure and record relative humidity.
 - 8) Check for substrate moisture in concrete.
 - 9) Verify that mixing of coating system materials is in accordance with the CSM's instructions.
 - 10) Inspect, confirm, and record that the coating system materials' "pot life" is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
 - 11) Perform adhesion testing.
 - 12) Measure and record the coating system's thickness.
 - 13) Verify proper curing of the coating system in accordance with the CSM's instructions.
 - 14) Holiday or continuity testing in accordance with NACE SP0188 for coatings that will be immersed or exposed to aggressively corrosive conditions.
 - 15) Prepare and submit written reports directly to the Owner's representative at the shift's end:
 - a) Reports shall identify observations and testing relative to the quality of the surface preparation and painting/coatings work.
 - b) Reports shall address any conditions observed which have the potential to adversely impact the finished painting/coating system integrity and performance.
 - c) Any such findings shall be immediately repaired.
 - c. Verify surface profile of substrates by completing the following:
 - 1) Inspect preparation and application of coating detail treatment at terminations, transitions, metal embedment's in concrete, and joints and cracks in substrates.
 - 2) Inspect application of filler/surfacer materials for concrete and masonry substrates.
- B. Damaged factory finishes shall be repaired and, if directed by the Owner's representative, refinished the entire surfaces of the factory-finish equipment at the applicators' expense.
- C. Owner-provided inspection or inspection by others does not limit the required Contractor's or CSA's responsibilities for quality workmanship or quality control. Owners' inspection is in addition to any inspection performed by the applicator.

3.14 CORRECTIVE MEASURES

- A. Repair pinholes or holidays identified by holiday testing as follows:
- 1. Remove coating system at pinholes and holidays at least 2-inches diameter around the defect back to expose substrate.

2. Concrete voids: Chip back to expose entire cavity in all directions.
 - a. Completely fill void with approved filler/surfacer material using a putty knife or other suitable tool and strike off. Cure in accordance with the CSM's recommendations.
3. Aggressively abrade or sand the intact coating system surfaces at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system.
4. Remove dust, dirt, etc., leaving clean, sound surfaces.
5. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area.
6. Apply the coating system with enough coats to achieve the specified finish coat thickness over the defect and coating removal area. Feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline.
7. Follow curing time between coats as specified by the CSM for the Site conditions. Solvent wash and abrasive blast in accordance with the CSM's instructions if the maximum recoat time is exceeded.
8. Apply coating at specified dry film thickness.

3.15 CLEANUP

- A. Remove surplus materials, protective coverings, and accumulated rubbish after completing coating. Thoroughly clean surfaces and repair overspray or other coating-related damage.

3.16 FINAL INSPECTION

- A. Conduct final inspection of coating system work to determine whether it meets specifications requirements.
- B. Conduct subsequent final inspection with the Engineer to ensure Work is in accordance with Contract Documents requirements.
- C. Mark any rework required.
 1. Re-clean and repair, as specified, at no additional cost to the Owner.

END OF SECTION

ATTACHMENT A - SCHEDULE OF SURFACES TO BE COATED

ATTACHMENT A
Schedule of Surfaces to be Coated

- A. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Contact Engineer for clarification.

EPU-M-1	Metals, exterior, non-immersed.
EPX-M-1	0
EPX-M-2	Metals, interior, non-immersed.
EPX-M-5	Aluminum surfaces in contact with concrete or masonry. Locations where Alkali-resistant bitumastic is specified.
EPX-M-6-BG	Metals, buried pipe and valves, below grade.
Notes:	
1: Non-immersed ferrous metal surfaces include: a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing. b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports. c. Motors and motor accessory equipment. d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment. e. Valve and gate operators and stands. f. Structural steel. g. Crane and hoist rails. h. Exterior of tanks and other containment vessels. i. Mechanical equipment supports, drive units, and accessories. j. Bare electrical equipment: boxes, exposed conduit, and accessories. k. Pumps not submerged. l. Other miscellaneous metals. 2: Immersed ferrous metal surfaces include: a. Interior surfaces of ferrous metal tanks. b. Field priming of ferrous metal surfaces with defective shop-prime coat; including non-submerged service. c. Bell rings, underside of manhole covers and frames. d. Sump pumps, including underside of base plates and submerged suction and discharge piping. e. Exterior of submerged piping and valves other than stainless steel or PVC piping. f. Submerged pipe supports and hangers. g. Stem guides. h. Other submerged iron and steel metal unless specified otherwise.	

ATTACHMENT B - COATING DETAIL SHEETS

Attachment B			
Coating Detail Sheet			
Coating System	EPU-M-1		
Coating Material	Two coats epoxy with polyurethane finish coat		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carbothane 134 VOC
International Paint	Devran 224V	Devran 224V	Devthane 379
PPG	Amercoat 385	Amercoat 385	Amercoat 450H
Sherwin Williams	Macropoxy 646	Macropoxy 646	Hi Solids Polyurethane
Tnemec	Series 69	Series 69	Series 1095
Service Condition	Interior or Exterior, subject to direct sunlight. Non-immersion.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP10, Near-White Blast Cleaning. Shop primed surfaces: SSPC-SP2, Hand Tool Cleaning or SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP10, Near White Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush Blast Cleaning. Test for surface contaminants.		
Surface Profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	10 to 13 mils		
Primer	4 to 5 mils		
Intermediate Coat	4 to 5 mils		
Finish Coat	2 to 3 mils		
Application			
Special CTR Training	Not required.		

Attachment B			
Coating Detail Sheet			
Coating System	EPX-M-1		
Coating Material	Epoxy		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	None Applied	Carboguard 890
International Paint	Bar-Rust 236	None Applied	Bar-Rust 236
PPG	Amerlock 2/400 Series	None Applied	Amerlock 2/400 Series
Sherwin Williams	Macropoxy 646	None Applied	Macropoxy 646
Tnemec	Series 69	None Applied	Series 69
Service Condition	Interior, non-corrosive.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP10, Near-White Blast Cleaning. Shop primed surfaces: SSPC-SP2, Hand Tool Cleaning or SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP10, Near White Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush Blast Cleaning. Test for surface contaminants.		
Surface Profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	10 to 12 mils		
Primer	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
Special CTR Training	Not required.		

Attachment B			
Coating Detail Sheet			
Coating System	EPX-M-2		
Coating Material	Epoxy		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amerlock 2/400 Series	Amerlock 2/400 Series	Amerlock 2/400 Series
Sherwin Williams	Tank Clad HS	Tank Clad HS	Tank Clad HS
Tnemec	Series 69	Series 69	Series 69
Service Condition	Immersed, non-immersed, moderately corrosive environment.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP5, White Metal Blast Cleaning. Shop primed surfaces: SSPC-SP7, Brush-Off Blast Cleaning. Damaged primer or rust: SSPC-SP5, White Metal Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface Profile			
Ferrous Metal	2 to 4 mils		
Nonferrous Metal	1.0 to 1.5 mils		
Galvanized Metal	1.0 to 1.5 mils		
System Thickness (Dry Film)			
Total	12 to 16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
Special CTR Training	Not required.		

Attachment B			
Coating Detail Sheet			
Coating System	EPX-M-5		
Coating Material	Epoxy mastic		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	CSM recommended	None applied	Carbomastic 15
International Paint	CSM recommended	Bar-Rust 231	Bar-Rust 231
PPG	CSM recommended	None applied	Amerlock 2 AL
Sherwin Williams	CSM recommended	None applied	Epoxy Mastic Aluminum II
Tnemec	CSM recommended	Series 135	Series 135
Service Condition	Interior, corrosive environment, confined enclosures, where minimal surface preparation is possible.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP11, Power to Cleaning to Bare Metal. Shop primed surfaces: SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP11, Power to Cleaning to Bare Metal.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface Profile			
Ferrous Metal	2.0 to 2.5 mils		
Nonferrous Metal	1.0 to 1.5 mils		
System Thickness (Dry Film)			
Total	15 to 19 mils		
Primer	2 to 4 mils		
Finish Coat	15 mils		
Application			
Special CTR Training	Not required.		

Attachment B			
Coating Detail Sheet			
Coating System	EPX-M-6-BG		
Coating Material	Epoxy		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amerlock 2/400 Series	Amerlock 2/400 Series	Amerlock 2/400 Series
Sherwin Williams	Tank Clad HS	Tank Clad HS	Tank Clad HS
Tnemec	Series 69	Series 69	Series 69
Service Condition	Below grade in contact with soil.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	SSPC-SP10, Near White Metal Blast Cleaning.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface Profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
General	Fill all bugholes with a filler/surfacer compatible with the coating.		
Special CTR Training	Not required.		

SECTION 10_14_00

SIGNAGE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Plastic and metal signs for building and Site use.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Z535.1 - Safety Colors.
 - 2. Z535.2 - Environmental and Facility Safety Signs.
- B. National Fire Protection Association (NFPA):
 - 1. 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response.

1.03 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Manufacturer's data indicating sign type, style, and color.
- C. Shop Drawings:
 - 1. Include lists of sign types, sizes, text, colors, and locations.
- D. Samples: Include actual materials.
- E. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Regulatory requirements: Provide signage in accordance with Americans with Disabilities Act as published in the Federal Register, Volume 56, No. 144, Friday, July 26, 1991.

PART 2 PRODUCTS

2.01 ROOM AND AREA SIGNS

- A. Manufacturers:
 - 1. One of the following or equal:
 - a. Andco Industries Corp., equivalent product.
 - b. Best Manufacturing Sign Systems, System 900013.

- c. Vomar Products, Inc., equivalent product.
- B. Attachment:
 - 1. Vinyl tape, self-adhering.
- C. Lettering:
 - 1. Helvetica medium, 3/4 inch high.
- D. Materials:
 - 1. Interior use:
 - a. Plastic 1/8-inch thick raised letters.
 - 2. Exterior use:
 - a. Fiberglass 1/4 inch thick with high gloss finish, raised letters, blasted from single piece of fiberglass for integral letter and background.
 - b. No adhesive as mechanical fastening of letters shall be allowed.
- E. Colors:
 - 1. As selected by the Engineer from the manufacturer's standard colors.
- F. See Attachment A - Room and Area Signage Schedule for specific sign size, location, text, pictogram, and quantity.

2.02 SAFETY SIGNS

- A. General:
 - 1. Colors: In accordance with ANSI Z535.1.
 - 2. Design: In accordance with ANSI Z535.2.
 - 3. 40-mil thick aluminum with baked enamel finish.
 - 4. Fasteners: Round head stainless steel bolts or screws.
- B. Manufacturers: One of the following or equal:
 - 1. Emedco.
 - 2. Seton Name Plate Co., Special Wording.
- C. Danger signs:
 - 1. Background: White.
 - 2. Heading: White lettering on red oval with white border in black rectangular panel.
 - 3. Message: Black lettering on white.
 - 4. Size: As scheduled.
- D. Caution signs:
 - 1. Background: Yellow.
 - 2. Heading: Yellow lettering on black rectangular panel.
 - 3. Message: Black lettering on yellow.
 - 4. Size: As scheduled.
- E. Safety instruction signs:
 - 1. Background: White.
 - 2. Heading: White lettering on green rectangular panel.
 - 3. Message: Black lettering.

4. Size: As scheduled.
- F. Warning signs:
1. Background: Orange.
 2. Heading: Black lettering on orange diamond in black rectangular panel.
 3. Message: Black lettering on orange.
 4. Size: As scheduled.
- G. Notice information signs:
1. Background: White.
 2. Heading: White lettering on blue rectangular panel.
 3. Message: Black lettering.
 4. Size: As scheduled.
- H. See Attachment B - Safety Signage Schedule for specific sign size, location, text, and quantity.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect adjacent surfaces which may be damaged by installation of signs.
- B. Prepare substrates in accordance with the sign manufacturer's instructions.
- C. Remove scale, dirt, grease, and other contaminants from substrates.

3.02 INSTALLATION

- A. Install signs in accordance with the sign manufacturer's instructions.
- B. Fasten signs securely in level, plumb, and true to plane positions.
- C. Install signs where indicated on the Drawings.

END OF SECTION

ATTACHMENT A - ROOM AND AREA SIGNAGE SCHEDULE

ROOM AND AREA SCHEDULE

A. Room Names:

1. Location: On wall outside room adjacent to latch side of doors or when not enough space on latch side, on nearest adjacent wall.
2. Height: 60 inches above floor to center of sign.
3. Size: 6 inches square.
4. Colors: As selected by the Engineer.
5. Text:
ELECTRICAL ROOM (2 required)
PUMP ROOM (2 required)

ATTACHMENT B - SAFETY SIGNAGE SCHEDULE

SAFETY SIGNAGE SCHEDULE

A. EMERGENCY EXIT:

1. Location: Bottom of ladder to deck hatch located in the Pump Room
2. Height: 5-ft above finish floor
3. Size: 20 inches wide by 14 inches high.
4. Heading: EMERGENCY EXIT
5. Wording: USE IN CASE OF EMERGENCY

B. REMOTELY CONTROLLED AUTOMATIC EQUIPMENT:

1. Location: On front and back of equipment that starts automatically by remote control.
2. Height: 5-FT above finish floor
3. Size: 20 inches wide by 14 inches high
4. Heading: DANGER
5. Wording: THIS EQUIPMENT STARTS AUTOMATICALLY
BY REMOTE CONTROL

SECTION 10_44_00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Fire extinguishers.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. E814-11a - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- B. National Fire Protection Association (NFPA):
1. 10 - Standard for Portable Fire Extinguishers.
- C. Underwriters Laboratories, Inc. (UL):
1. 711 - Rating and Fire Testing of Fire Extinguishers.

1.03 SUBMITTALS

- A. Product data.
1. Extinguishers: Materials description for fire extinguishers; include ratings and classifications.
 2. Installation instructions for each product specified.
- B. Shop drawings:
1. Small-scale plans showing locations of individual fire extinguishers.
 2. Schedule showing each type of extinguisher to ensure proper fit and function.
 3. Indicate installation procedures and accessories required for a complete installation.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Minimum 5 years with satisfactory performance record.

1.05 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The following or equal:
 - 1. Activar Construction Products Group - JL Industries.

2.02 FIRE EXTINGUISHERS

- A. Multi-purpose chemical type:
 - 1. Extinguisher unit containing a fluidized and siliconized mono ammonium phosphate powder; nonconductive and nontoxic.
 - 2. Construction: Heavy duty steel cylinder with metal valve and siphon tube, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin and upright squeeze grip.
 - 3. Finish: Factory powder-coated: Red.
 - 4. UL Effectiveness Rating in accordance with UL 711: Class A, B, and C fires.
 - 5. UL Rating in accordance with UL 711: 4A-80BC.
 - 6. Drawing will use the symbol FE for "Fire Extinguisher".
- B. Regular dry chemical type:
 - 1. Extinguisher unit containing Halotron™.
 - 2. Size minimum: 11 pounds.
 - 3. Construction: Heavy duty steel cylinder with metal valve and siphon tube, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin, and upright squeeze grip.
 - 4. Finish: Factory powder-coated; Red.
 - 5. UL Effectiveness Rating in accordance with UL 711: Class B and C fires.
 - 6. UL Rating in accordance with UL 711: 2A-10BC.
 - 7. Drawing will use the symbol EFE for "Electrical Fire Extinguisher".

2.03 WALL BRACKETS

- A. Type: Standard as manufactured by fire extinguisher manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance NFPA 10, Standard for Portable Fire Extinguishers.

3.02 LOCATIONS

- A. Install fire extinguisher type, FE and EFE, where indicated on the Drawings.

END OF SECTION

SECTION 22_42_01

PLUMBING SYSTEMS

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PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for materials and installation of plumbing systems.

1.02 REFERENCES

- A. Abbreviations:
 - 1. gpf - gallons per flush.
 - 2. gph - gallons per hour.
 - 3. gpm - gallons per minute.
 - 4. psig - pounds per square inch, gauge.
- B. Standards:
 - 1. American Gas Association (AGA).
 - 2. American Society of Mechanical Engineers (ASME).
 - a. B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
 - b. B16.12 - Cast Iron Threaded Drainage Fittings.
 - 3. American Society of Sanitary Engineering (ASSE):
 - a. 1070 - Performance Requirements for Water Temperature Limiting Devices.
 - 4. American Water Works Association (AWWA):
 - a. C511 - Reduced-Pressure Principle Backflow Prevention.
 - b. C700 - Standard for Cold-Water Meters—Displacement Type, Bronze Main Case.
 - c. C702 - Standard for Cold-Water Meters—Compound Type.
 - 5. Americans with Disabilities Act (ADA).
 - 6. ASTM International (ASTM):
 - a. A48 - Standard Specification for Gray Iron Castings.
 - b. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 - d. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - e. A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - f. B32 - Standard Specification for Solder Metal.
 - g. B88 - Standard Specification for Seamless Copper Water Tube.
 - h. B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
 - i. B828 - Standard Specification for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - j. C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - k. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - l. C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 - m. C552 - Standard Specification for Cellular Glass Thermal Insulation.

- n. C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- o. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- p. D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- q. D297 - Standard Test Methods for Rubber Products—Chemical Analysis.
- r. D395 - Standard Test Methods for Rubber Property—Compression Set.
- s. D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
- t. D638 - Standard Test Method for Tensile Properties of Plastics.
- u. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- v. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- w. D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- x. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- y. D2240 - Standard Test Method for Rubber Property—Durometer Hardness.
- z. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- aa. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- bb. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- cc. D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- dd. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- ee. E96 - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- ff. F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- gg. F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- hh. F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- ii. F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- jj. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- kk. F594 - Standard Specification for Stainless Steel Nuts.
- ll. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water- Pressure Piping Systems.
- 7. Cast Iron Soil Pipe Institute (CISPI).
- 8. International Association of Plumbing and Mechanical Officials (IAPMO):
 - a. IS 03 - Copper plumbing Tube Pipe and Fittings.
- 9. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

10. Plumbing and Drainage Institute (PDI):
 - a. WH-201 - Water Hammer Arresters Standard.
11. Underwriters Laboratories, Inc. (UL):
 - a. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
12. United States Environment Protection Agency (EPA): Water Sense.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 1. Buried: Piping that is installed below buildings, foundations, or finish grade, either in soil or encased in concrete in soil.
 2. Exterior: Piping that is installed outside a building or within a pipe trench or tunnel.
 3. Flame spread and smoke density: Burning characteristics determined in accordance with ASTM E84.
 4. Interior: Piping that is installed inside a building.
 5. K factor: Thermal conductivity determined in accordance with ASTM C177 or ASTM C518.
 6. Mineral fiber: Fibers manufactured of glass, rock, or slag processed from a molten state, with or without a binder.
 7. Water vapor permeance: Water vapor transmission determined in accordance with ASTM E96 and expressed in units of perm-inch.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Manufacturer's instructions.
- C. Shop Drawings:
 1. System layout, mechanical, electrical power, and control diagrams.
 2. Nameplate information.
 3. Materials.
 4. Coatings and linings.
 5. Rough-in drawings.
 6. Supports, vibration isolators, and details.
 7. Primary and ancillary equipment.
 8. Proposed cutting and patching.
 9. Maximum recommended equipment vibration levels and field-testing method.
 10. Copy of factory test results.
- D. Certificates: As specified in Section 01_60_00 - Product Requirements:
 1. American Backflow Prevention Association for backflow prevention assembly.
 2. National Science Foundation for products when specified.
- E. Field testing documentation.
- F. Warranties.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Roof coordination:
 - 1. Provide plumbing equipment roof penetrations information required in the preparation of roofing drawings, including, but not limited to:
 - a. Location.
 - b. Diameter.
 - c. Configuration of penetration and the surround.
 - 2. Provide roof mounted plumbing equipment information required in the preparation of roofing drawings, including, but not limited to:
 - a. Location.
 - b. Size.
 - c. Weight.
 - d. Anchoring and support details.

1.06 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 PLUMBING AND DRAINAGE PRODUCTS

- A. Water hammer arrestors:
 - 1. Manufacturers: One of the following or equal:
 - a. Jay R. Smith.
 - b. Josam.
 - c. Zurn, Shoktrol.
 - 2. Determine manufacturer model:
 - a. Based on Table 1 in accordance with PDI WH-201.
 - b. Working pressure: 125 psig.
 - c. Static pressure: 250 psig.
 - 3. Temperature: 300 degrees Fahrenheit.
 - 4. Provide water hammer arrestors on each fixture supply line branch.
 - 5. Casing and bellows.
 - a. Material: Type 316 stainless steel.
 - b. Welded bellows.
 - 6. Hermetically sealed air cushion.
- B. Type WH-1: Wall hydrants:
 - 1. Manufacturers: One of the following or equal:
 - a. Watts.
 - b. Zurn, Z1350.
 - 2. Encased, narrow wall hydrant:
 - a. Case:
 - 1) Type 316 stainless steel.
 - 2) Gasketed, hinged cover with cylinder lock:
 - a) "WATER" stamped on the cover.
 - b. 3-5/8-inch face to back dimension.

- c. Hydrant:
 - 1) Anti-siphon.
 - 2) Bronze body and interior parts.
 - 3) Replaceable seat washer.
 - 4) Key operated control valve.
 - 5) Screwdriver operated stop valve.
 - 6) 3/4-inch hose connection.
 - 7) Not more than 1.8 gpm.
- C. Type HB-1: Hose bib stations:
 - 1. Manufacturers: One of the following or equal:
 - a. Flexon Pro Series.
 - b. Gilmore Group.
 - 2. Hose bib: Size and mounting requirements as indicated on the Drawings.
 - 3. Hose rack: Type and installation as indicated on the Drawings.
 - 4. Hose:
 - a. Length: 50 feet.
 - b. Size: 3/4 inch.
 - c. Commercial/industrial grade rubber hose.
 - 5. Hose nozzle:
 - a. Spray: 7-pattern select-a-spray with vinyl grip.
 - b. Hold-open clip for continuous spraying.
 - c. Material: Rust resistant stainless steel spring.
 - d. Lifetime leak proof seal.
- D. Cleanouts:
 - 1. Wall cleanouts:
 - a. Type WCO-1:
 - 1) Manufacturers: One of the following or equal:
 - a) Josam.
 - b) Zurn, Z1446.
 - 2) Coated cast-iron tee.
 - 3) Gas and watertight plug:
 - a) Bronze with tapered thread.
 - b) Stainless steel cover with screw.
 - 2. Cleanouts:
 - a. Cast-iron ferrule, countersunk plug, gastight and watertight seal.
 - b. Adjustable cleanout head extension.
 - c. Nickel-bronze top and securing screw.
 - d. Type FCO-1: Floor cleanouts, finished floors:
 - 1) Manufacturers: One of the following or equal:
 - a) Josam Co.
 - b) Zurn Ind., Inc., ZN1400.
 - 2) For finished floors.
 - 3) Traffic: Heavy wheel/vehicular traffic.
 - e. Type FCO-2: Floor cleanouts, unfinished floors:
 - 1) Manufacturers: One of the following or equal:
 - a) Josam Co., 55000.
 - b) Zurn Ind., Inc.
 - 2) For unfinished floors.

- f. Type FCO-3: Floor cleanout, exterior, in asphalt or ground areas:
 - 1) Manufacturers: One of the following or equal:
 - a) Josam Co., 55000.
 - b) Zurn Ind., Inc.
 - 2) Rated for outdoor use.
- E. Drains:
 - 1. Type, shape, and size as indicated on the Drawings with connections suitable for the piping system.
 - a. Provide drains of one type from the same manufacturer.
 - 2. Type FD-1: Floor drain, finished floors, pedestrian traffic:
 - a. Manufacturers: One of the following or equal:
 - 1) Josam, 30000-A.
 - 2) Zurn.
 - b. Round, adjustable strainer head, floor level grate.
 - c. Body material: Coated cast iron.
 - d. Strainer:
 - 1) Material: Nickel bronze.
 - 2) Size:
 - a) 6 inch diameter for 3-inch drain.
 - b) 8 inch diameter for 4-inch drain.
 - 3. Type FD-2: Floor drain, finished floors, heavy wheel traffic:
 - a. Manufacturers: One of the following or equal:
 - 1) Josam.
 - 2) Zurn Z521.
 - b. Adjustable extension frame with heavy-duty tractor grate.
 - 1) Size: 12 inch diameter.
 - c. Material: Resin-coated cast iron top.
 - d. No-hub outlet.
 - e. Seepage pan with membrane flashing clamp.
 - 4. Type FS-1: Floor sink drain, light duty, indirect wastes:
 - a. Manufacturers: One of the following or equal:
 - 1) Josam.
 - 2) Zurn Z1900.
 - b. Material: Cast iron body with acid resisting porcelain enamel interior and exterior.
 - c. Size: 12 inches square by 6 inches deep.
 - d. Grating configuration as indicated on the Drawings.

2.02 PLUMBING PIPING SYSTEMS

- A. As indicated on the Drawings in Pipe Schedule or specified in Section 40_05_00.01 - Common Work Results for General Piping.
- B. Cast iron soil pipe piping system:
 - 1. In accordance with ASTM A74.
 - 2. Bell-and-spigot, service weight.
 - a. Above ground: Hubless in accordance with CISPI 310.
 - 3. Joints underground: Positive double seal compression type gaskets in accordance with ASTM C564.

4. Joints aboveground:
 - a. American standard taper screw threads, cut clean and made up with Teflon™ tape or an acceptable paste thread compound applied to the male threads only.
 - b. Slip joints permitted only in trap seals or on the inlet side of the traps.
 - 1) Do not use long screws or bushings.
 5. Cast iron drainage pattern fittings.
 6. Couplings for "No Hub": Stainless steel corrugated shield and clamp assembly over a molded 1-piece neoprene sealing sleeve, in accordance with ASTM A888.
 7. Line pipe and fittings inside and coat outside with bituminous coating, except as follows:
 8. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- C. Black steel pipe piping system:
1. Pipe:
 - a. In accordance with ASTM A53.
 - b. Type E - electric-resistance welded or Type S - seamless.
 - c. Grade A or B.
 - d. Schedule 40, unless otherwise specified.
 2. Fittings:
 - a. Screwed fittings:
 - 1) Malleable iron:
 - a) In accordance with ASME B16.3, Class 150 or Class 300 as specified.
 - b) Galvanized in accordance with ASTM A153 when used with galvanized pipe.
- D. PVC piping system:
1. Pipe: Designation PVC 1120 in accordance with ASTM D1785:
 - a. Pipe and fittings: Extruded from Type I, Grade 1, Class 12454 B material in accordance with ASTM D1784.
 - b. PVC pipe: Schedule 40, unless otherwise specified.
 2. Fittings:
 - a. Supplied by pipe manufacturer.
 - b. Pressure fittings: In accordance with ASTM D2466 or ASTM D2467.
 - c. DWV fittings: In accordance with ASTM D2665.
 3. Solvent cement: In accordance with ASTM D2564:
 - a. Chemical service: For PVC pipe in chemical service, provide the following primer and cement, or equal:
 - 1) Primer: IPS Corp Type P-70™.
 - 2) Cement: IPS Corp Type 724™ cement or cement certified by the manufacturer for chemical service.

2.03 ANTI-SEIZE LUBRICANT

- A. Manufacturers: One of the following or equal:
 - 1. Bostik, Never Seez.
 - 2. Oil Research Center.
- B. Use with assembly of stainless steel nuts and bolts.

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish and install vents required in drainage piping as part of the plumbing system, in accordance with Laws and Regulations.
- B. Use anti-seize lubricant for stainless steel threads on fittings and fasteners.

3.02 INSTALLATION

- A. Plumbing piping systems:
 - 1. Cast iron soil pipe:
 - a. Where not specified otherwise, install horizontal piping with a grade of 1/4 inch per foot.
 - b. Provide vents, roof drains, and pipes flashed and made watertight at the roof with lead sheet flashings.
 - 1) Minimum 4-pound lead sheet.
 - c. Extend flashing not less than 6 inches up the pipes and counter flash with standard cast iron or malleable iron recessed roof couplings.
 - d. Extend flashing for vents up to the top of the vent and turn down into the pipe.
 - e. Extend flashing shields not less than 8 inches from vent and pipe in all directions.
 - 2. Black steel:
 - a. Install in accordance with applicable codes and regulations.
- B. Anti-seize lubricant:
 - 1. Use with assembly of stainless steel nuts and bolts.

3.03 FIELD QUALITY CONTROL

- A. Test water piping in accordance with the plumbing code as specified in Section 01_41_00 - Regulatory Requirements.
- B. Test drain, waste, and vent lines as specified and in accordance with the plumbing code as specified in Section 01_41_00 - Regulatory Requirements.

3.04 CLEANING

- A. Upon completion of installation, clean piping interior of foreign matter and debris.
- B. Flush and disinfect potable water piping as specified in Section 01_75_18 - Disinfection.

3.05 SCHEDULES

- A. As indicated on the Drawings.

END OF SECTION