

# FARMERS MUTUAL DIVERSION TECHNICAL SPECIFICATIONS

100% NOT FOR CONSTRUCTIONS

September 17, 2023

Prepared by AECOM Technical Services



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- NOTE TO BIDDER: Use clearly legible BLACK INK for completing this bid form

**SECTION 00300  
BID FORM**

To: Farmers Mutual Irrigation Company  
Address: XXX  
Project: Farmers Mutual Diversion  
Contract No: xxxx

**BIDDER'S DECLARATION AND UNDERSTANDING.**

Bidder has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality where the Work is to be performed, the legal requirements (federal, state and local laws, ordinances, rules, and regulations), and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as Bidder deems necessary.

**CONTRACT EXECUTION AND BONDS.**

The undersigned Bidder proposes and agrees, if this Bid (aka Guaranteed Maximum Price) is accepted, to enter into an Agreement with the Owner in the form included in the Contract Documents to perform the Work as specified or indicated in said Contract Documents entitled "Farmers Mutual Diversion, September 2021".

Bidder accepts all of the terms and conditions of the Contract Documents, including without limitation those in the Notice Inviting Bids and Instructions to Bidders, dealing with the disposition of the Bid Security.

Bid will remain open for the period stated in "Notice Inviting Bids" unless otherwise required by law. Bidder will enter into an Agreement within the time and in the manner required in the "Notice Inviting Bids" and the "Instructions to Bidders," and will furnish the insurance certificates, Payment Bond, and Performance Bond required by the Contract Documents.

**CONTRACT TIMES, COMPLETION MILESTONES, AWARD INCENTIVES, AND LIQUIDATED DAMAGES.**

To all the foregoing, and including all Bid Forms contained in this Bid, Bidder further agrees to complete the Work required under the Contract Documents within the Contract Times and the Work milestones stipulated in the Contract Documents, and to accept in full payment therefore the Contract Price based on the Lump Sum Bid Price(s) named in the aforementioned Bid Forms.

The Bidder also agrees to complete, in all respects, the following work items by the finish dates indicated below. Work completion dates and liquidated damages for exceeding these dates are listed below.

The Liquidated Damages listed below are monies the Owner will assess against the Contractor if the listed work items are completed after the finish dates. The Bidder agrees that if he is awarded the Contract and fails to complete the listed work items by the finish dates listed, liquidated

damages shall be paid by the Contractor to the Owner at the rates listed for each day after the finish dates until the work shall have been satisfactorily completed as provided by the Contract Documents. Sundays and legal holidays shall not be excluded in determining liquidated damages.

Item No.	Work Finish Date	Work Milestone	Liquidated Damages for Exceeding Finish Date
1	Monthly	Inadequate or late Schedule of Values	\$5,000 per month
2	XXXXX	Substantial Completion of all work for a fully functional diversion	\$ 1,000/Day
3	XXXX	Final Completion of all work for the Project.	\$ 500/Day

**ADDENDA**

Bidder has examined copies of all the Contract Documents including the following addenda (receipt of all of which is hereby acknowledged):

Number: \_\_\_\_\_ Date: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Failure to acknowledge addenda shall render the bid nonresponsive and shall be cause for its rejection.

To all the foregoing, and including all Bid Forms contained in this Bid, said Bidder further agrees to complete the WORK required under the Contract Documents within the Contract Time stipulated in said Contract Documents, and to accept in full payment therefore the Contract Price based on the Total Bid Price(s) named in the aforementioned Bid Forms.

Dated: \_\_\_\_\_ Bidder: \_\_\_\_\_

By: \_\_\_\_\_  
 (Signature)

Title: \_\_\_\_\_

## **SALES AND USE TAXES.**

The Bidder agrees to pay all Federal, State, and local sales and use taxes for the Work contemplated herein.

## **SUBCONTRACTOR WORK.**

The Prime CONTRACTOR shall perform at least 70 percent of the total project Work with his own forces. Failure to comply with this requirement will render the Bid nonresponsive and may cause its rejection.

**WELDING SUBCONTRACTORS.** As the project requires a significant amount of field butt-welding, as part of the bid, Contractors (or their subcontractors) must demonstrate in Bid Form pages 7 to 12 they meet the experience requirements set forth therein.

The Bidder shall list below the name and the location of the place of business of each Subcontractor who will perform Work or labor, or render service to the Prime Contractor in or about the construction of the Work or improvement, in an amount in excess of one-half of 1 percent of the Prime Contractor's total Bid. The Bidder shall also list below the portion of the Work which will be done by each Subcontractor under this Contract. The Prime Contractor shall list only one Subcontractor for each portion as is defined by the Prime Contractor in its Bid. Failure to comply with this requirement will render the Bid nonresponsive and may cause its rejection. The Bidder shall list below the name and location of the place of business of each supplier to be used to complete the work which is listed in the Table below. Use of the listed supplier will be contingent on an approved submittal. Rejected equipment or supplies can be provided by an alternate vendor assuming an approved submittal is produced. Failure to comply with this requirement may render the Bid nonresponsive and may cause its rejection.

LIST OF SUBCONTRACTORS AND SUPPLIERS

Work To Be Performed	Subcontract or License Number	Percent of Total Bid	Subcontractor Name & Address
Flume Gate Subcontractor			
Radial Gate Subcontractor			

Materials	Manufacturer	Supplier
Concrete		
Radial Gate		
Flume Gate		
Miscellaneous mettal		

**Bid Schedule**

Schedule of lump sum bid items for construction of the Project in accordance with Contract Documents and the Guaranteed Maximum Price (GMP) cost detail with pricing and categories document incorporated herein, as shown in Exhibit A.

<b>Item</b>	<b>Description</b>	<b>Lump Sum Bid Items (in numbers)</b>
1	General Conditions (Mobilization, Insurance, and Administrative Items):	\$
2	Excavation and installation of temporary coffer dam, dewatering	\$
3	Demolition and removal of existing concrete structure	\$
4	Concrete and placement of unformed concrete	\$
5	Concrete and placement of formed concrete	\$
6	Flume gate and installation	\$
7	Radial Gate and installation	\$
8	Excavation and backfill of structure	\$
9	Removal of temporary coffer dam, disposal of material	\$
1		\$
		\$
<b>5. TOTAL LUMP SUM BID FOR ITEMS 1 THROUGH 9 OF BID SCHEDULE LISTED ABOVE</b>		\$
<b>6. LUMP SUM ADD (OR DEDUCT):</b>		\$
<b>7. TOTAL BID OF SCHEDULE WITH ADD (OR DEDUCT)</b>		\$

**TOTAL BID for SCHEDULE A1** (in words) \_\_\_\_\_

\_\_\_\_\_ dollars and \_\_\_\_\_ cents



**BID CERTIFICATE**

**(if Corporation)**

STATE OF )  
 ) SS:  
COUNTY OF )

I HEREBY CERTIFY that a meeting of the Board of Directors of the

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

a corporation existing under the laws of the State of \_\_\_\_\_, held on \_\_\_\_\_, 20\_\_\_\_, the following resolution was duly passed and adopted:

"RESOLVED, that \_\_\_\_\_, as \_\_\_\_\_ President of this Corporation, be and is hereby authorized to execute the Bid dated \_\_\_\_\_, 2022, to the **Farmers Mutual Irrigation Company** by this Corporation and that his/her execution thereof, attested by the Secretary of this Corporation, and with the Corporate Seal affixed, shall be the official act and deed of this Corporation."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the corporation this \_\_\_\_\_, day of \_\_\_\_\_, 2022.

\_\_\_\_\_  
Secretary

(SEAL)

**END OF SECTION**

**SECTION 01010  
SUMMARY OF WORK**

**PART 1 GENERAL**

**1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work under this Contract consists of furnishing all facilities, tools, equipment, materials, supplies, manufactured articles, management, planning, drawings, submittals, transportation, services, fuel, power, water, communications, coordination, permits and permit compliance, and performing all Work, or other operations required for the fulfillment of the Contract in accordance with the Contract Documents.

The Work shall be complete, and all Work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete, safe and proper construction and startup of the Work in good faith shall be provided by the Contractor within the contract time and for the bid amounts.

- B. The completed work will provide the Owner with a diversions structure with control gates.
- C. Major components of this work include the following:
1. Mobilization, meetings, and all coordination with all project stakeholders affected by the project and the work including, but not limited to:
    - a. County/Cities.
    - b. Federal/State Agencies: Owner to obtain 404 permit from U.S Army of Corps of Engineers
    - c. Land Owners: Access provided by Owner
    - d. Utilities: not applicable
    - e. Other contractors and the general public.
  2. Construction temporary coffer dam, dewatering of the site, demolition of existing structure, construction of new structure with installation of control gates.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01025  
MEASUREMENT AND PAYMENT**

**PART 1 GENERAL**

**1.1 SUBMITTALS**

- A. Informational Submittals:
  - 1. Schedule of Estimated Progress Payments:
    - a. Submit adjustments thereto with Application for Payment.
  - 2. Application for Payment.
  - 3. Final Application for Payment.

**1.2 SCHEDULE OF VALUES.**

- A. Upon request of Construction Manager, provide documentation to support the accuracy of the Schedule of Values.
- B. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form, if applicable.
- C. Lump Sum Work:
  - 1. Reflect specified contingency allowances and alternates, as applicable.
  - 2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.

**1.3 APPLICATION FOR PAYMENT**

- A. Transmittal Summary Form: Attach one accepted Schedule of Values with each detailed Application for Payment and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
- B. Provide separate form for each application for payment as applicable.
- C. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Construction Manager.
- D. Preparation:
  - 1. Round values to nearest dollar.

2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form, a listing of materials on hand, and such supporting data as may be requested by Construction Manager.

1.4 MEASUREMENT—GENERAL

- A. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

<u>Item</u>	<u>Method of Measurement</u>
AC	Acre—Field Measure by Construction Manager
CY	Cubic Yard—Field Measure by Construction Manager within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by Construction Manager
GAL	Gallon—Field Measure by Construction Manager
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Construction Manager
LS	Lump sum
MFBM	Thousand Foot Board Measure—Delivery Invoice
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.5 PAYMENT

- A. Payment for all work will be Lump Sum Work shown or specified in Contract Documents as included in the Contract Price. Payment will be based on a percentage complete basis for each line item as approved by Owner.

1.6 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
  1. Loading, hauling, and disposing of rejected material.
  2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
  3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.

4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.7 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to Construction Manager.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

END OF SECTION

## **SECTION 01300 SUBMITTALS**

### **PART 1 GENERAL**

#### **1.1 DESCRIPTION**

- A. This section describes requirements for preparing and submitting submittals. Submittals include shop drawings, samples, progress schedules, cost schedules, daily reports, surveys, reports, plans, record drawings, spare parts list, O&M manuals, copies of permits, warranties, and other items as required by the Contract Documents.
- B. The primary means of project information submission and management shall be in the form of electronic exchange.

#### **1.2 GENERAL REQUIREMENTS**

- A. Within 10 days after Notice to Proceed, submit a complete list of anticipated submittals, including Specification and Drawing references for each.
- B. Construction Manager will return each submittal (or resubmittal) to the Contractor, with review comments noted thereon, within 5 calendar days after their receipt by the Construction Manager.
- C. In ample time for each to serve its proper purpose and function, submit to the Construction Manager such schedules, reports, drawings, work plans, lists, literature samples, instructions, certificates, test data, directions, and warranties as are specified or reasonably required for construction, operation, and maintenance of the facilities to be built and/or furnished under this Contract.
- D. Shop drawings and data shall be submitted to the Construction Manager in electronic format. Each submittal shall clearly indicate the specific section of the Contract Documents for which the submittal is made. The Construction Manager's notations of the action which he has taken will be noted on the electronic copy.
- E. The submittals, shop drawings, lists, prints, samples, and other data shall become a part of the Contract and a copy of the same shall be kept with the jobsite Contract Documents, and the fabrications furnished shall be in conformance with the same. The Work covered by a submittal may be commenced only after the Construction Manager has reviewed the pertinent submittals and returned copies to the Contractor marked "NO EXCEPTIONS TAKEN", or "MAKE CORRECTIONS NOTED".
- F. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents. However, the Construction Manager's review of the above drawings, lists, prints, specifications, samples, or

other data shall in no way release the Contractor from his responsibility for the proper fulfillment of the requirements of this Contract nor for fulfilling the purpose of the installation nor from his liability to replace the same, should it prove defective or fail to meet the specified requirements.

- G. Shop Drawings, Schedules, and Samples. Submit shop drawings, layout diagrams, catalog data, test reports, and information in sufficient detail to show complete compliance with all specified requirements. All electrical and instrumentation submittal drawings developed specifically for this project shall be drafted in AutoCAD 2017 (or newer version), unless the Construction Manager requests a different format. Electronic files shall be submitted with all AutoCAD drawings.
- H. Make any such changes in the required shop drawings as may be necessary to conform to the Contract Documents. After completion of such checking, verification, and revising, stamp and sign the drawings indicating approval and submit the shop drawings and pertinent data to the Construction Manager for review. Prior to the Construction Manager's approval of such drawings, any work which the Contractor may do on the fabrications covered by the same shall be at his own risk, as the Owner will not be responsible for any expense or delays incurred by the Contractor for changes to make the same conform to the Contract Documents.
- I. Verify and make submittals complete in all respects, including accuracy and coordination with other submittals. The Contractor shall not delegate this duty to any Subcontractor. Submittals may be prepared by the Contractor, Subcontractor, or Supplier, but the Contractor shall verify that each submittal meets the requirements of the Project and the Contract Documents. The Contractor shall ensure coordination of submittals of related crafts and Subcontractors.
- J. By submitting the submittals, the Contractor represents that the material, equipment, and other Work shown thereon conforms to the Contract Documents, except for the deviations set forth in the letter of transmittal.
- K. Responsibility and liability of Contractor for submittals. Equipment, systems, or materials submitted for use in the work under this Contract shall be in accord with the intent of these Contract Documents.
  - 1. The intent of these Contract Documents is that manufacturers or suppliers of equipment, systems, or material that are named in the text for the item specified and as altered, adjusted, or revised by the manufacturer or supplier to conform to the specific requirements of the Contract Documents will require a certain amount of review to determine compliance. The foregoing shall not be interpreted to exclude the equipment, systems, or materials of manufacturers or suppliers who are not named but have a product that is equal to the item as specified. It shall be the responsibility of the Contractor to ascertain that the unnamed product is equal to the item specified. The Contractor shall include with

his submittal all information as required by these Contract Documents for the Substitution of Material or Equipment.

2. Should the Contractor submit equipment, systems, or material from any manufacturer or supplier, named or unnamed in the Contract Documents, that deviates from the intent or is nonresponsive to the specific requirements of these Contract Documents, then he shall have deducted from periodic payments by Owner the costs of evaluating the equipment, system, or material as to its acceptability, and the Contractor shall be liable for said cost whether the items submitted are acceptable or not. Any delay, cost to the Contractor, or rescheduling caused by the evaluation of this equipment, system or material shall be at the Contractor's expense and will not be a reason for an extension of time for Contract completion.
3. Deviations from the intent or non-responsiveness to the specific requirements of the Contract Documents shall include, but not be limited to; equipment, systems, or material that are new on the market, or that have little or no operational experience; equipment, systems, or materials that are untried in the application for which they are intended to be used; equipment, systems, or materials that will require a process change, or that would cause a process to change; equipment, systems, or materials that will require changes or alterations to operational, structural, architectural, mechanical, electrical, or instrumental features.

### 1.3 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. Prior to the Preconstruction Conference, submit the following items for review:
  1. A preliminary Schedule of a proposed substitute (“or-equal”) submittals.
  2. A list of all permits and licenses that the Contractor shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
  3. A 60-day plan of operation.
  4. The names and qualifications of designated safety representative and designated competent persons.

### 1.4 PROGRESS REPORTS

- A. Submit a progress report to Construction Manager with each application for payment or at a minimum weekly. If the Work falls behind schedule, submit additional progress reports at such intervals as Construction Manager may request. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Construction Manager, must be substantiated with satisfactory evidence. Each progress report shall include a list of the activities completed with



their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.

## 1.5 SHOP DRAWINGS

- A. The term “shop drawings” as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of a professional engineer registered in the appropriate discipline in the State of New Mexico, unless otherwise directed.
- B. All submittals shall be accompanied by a transmittal form acceptable to the Construction Manager. Submittals not accompanied by such a form with all applicable items on form completed, will be returned for resubmittal.
- C. Organization:
  - 1. Use a single shop drawing submittal transmittal form for each Technical Specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary Specification references other sections for components.
  - 2. On the Transmittal Form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to Specification paragraph and subparagraph, drawing number, detail number, schedule title, or room number or building name, as applicable.
  - 3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match the Contract Documents.
- D. Format:
  - 1. Use an 8.5 x 11 inch min and 11 x 17 inch max sheet sizes. Number every page of a submittal sequentially.
  - 2. Clearly mark on manufacturer data sheets the model proposed. Show all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Present sufficient detail to allow assessment of compliance with the Contract Documents.
  - 3. Number submittals sequentially (i.e., 1, 2, 3, etc.) in order of submittal date. Clearly show submittal number on each transmittal. Resubmittals shall have the same number as the original submittal followed by an alpha-numeric suffix. Thus, if submittal 25 requires a resubmittal, the first resubmittal will be “25-A”, the second “25-B”, and so on.

- E. Disorganized submittals which do not meet the requirements above may be returned without review.
- F. Incomplete submittals will be returned without review. A complete submittal shall contain sufficient data to demonstrate that the items contained therein comply with the Contract Documents, meet the minimum requirements for submittals, and include all corrections noted from previous submittals.
- G. Except as otherwise noted, the Construction Manager will return one electronic copy of each submittal, or resubmittal, to the Contractor, with review comments noted thereon, within 7-calendar days after their receipt by the Construction Manager. It is deemed reasonable that the Contractor shall make a complete and acceptable submittal to the Construction Manager by the second submission of a submittal. The Owner reserves the right to withhold monies due to the Contractor to cover the costs of any reviews beyond the second submittal.
- H. Clearly identify and flag any changes on a resubmittal except those requested by the Engineer or Construction Manager.
- I. Do not commence any portion of the Work requiring a submittal until the Construction Manager has reviewed all pertinent submittals and has returned it to the Contractor as approved. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the Contract requirements.
- J. An authorized Contractor representative shall carefully review all submittals before they are submitted. Each submittal shall be dated and signed with the following: "I have verified field measurements, construction criteria, dimensions, materials, equipment, catalog numbers, and other Work related to this submittal and certify that this submittal meets the requirements of the Contract Documents, except as specifically noted otherwise on the transmittal letter." Submittals without this certification will not be reviewed.
- K. The Construction Manager's and/or Engineer's review of shop drawing submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions and for compliance with the Contract Documents. The Contractor is responsible for compliance with the Contract Documents, the proper fitting, detailing, and construction of the Work; the accuracy and completeness of the submittals; selecting fabrications processes and techniques of construction; and performing the Work in a safe and orderly manner.
- L. No changes in the Contract Time will be considered for schedule delays resulting from noncompliant submittals.

## 1.6 SAMPLES – NOT USED

## 1.7 OPERATION AND MAINTENANCE MANUAL SUBMITTALS REQUIRED

- A. Operations and maintenance manual for radial gate
- B. Operations and maintenance manual for flume gate

## 1.8 RECORD DRAWING REDLINES

- A. The Contractor shall prepare and maintain one set of record drawing redlines at the Project site. On these mark, in red ink, all Project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utilities or other features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried project features and utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawing redlines shall be supplemented by any detailed sketches, as necessary, or directed to indicate fully the Work as actually constructed. These master record drawing redlines of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the Work.
- B. Copies of the record drawing redlines shall be audited regularly by the Construction Manager after the month in which the Notice to Proceed is given, as well as on completion of Work. Failure to properly maintain record drawing redlines in an up-to-date condition may result in the withholding of payments due the Contractor at the sole discretion of the Owner.
- C. In the case of those drawing redlines which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawing redlines shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the Change Orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- D. Record drawing redlines shall be accessible to the Construction Manager at all times during the construction period.
- E. Final payment will not be acted upon until the record drawing redlines have been prepared and delivered to the Construction Manager. Said up-to-date record drawing redlines shall be in the form of a set of prints with carefully plotted information overlaid in red.
- F. Upon substantial completion of the Work, finalize and deliver a complete set of record drawing redlines to the Construction Manager for transmittal to the Owner, conforming to the construction records of the Contractor. This set of drawings

shall consist of corrected drawings showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer into the record drawings will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and for any errors or omissions which may appear on record drawings as a result.

**1.9 SURVEYOR QUALIFICATIONS**

Provide qualifications for onsite staking (Crew Chief). Minimum of 5 years in responsible charge of construction surveys.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01640  
MANUFACTURERS' SERVICES**

**PART 1 GENERAL**

1.1 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular Contractor working hours for startup and training.

1.2 SUBMITTALS

- A. Informational Submittals:
  - 1. Training Schedule: Submit not less than 10 days prior to start of equipment installation and revise as necessary for acceptance.
  - 2. Lesson Plan: Submit proposed lesson plan not less than 10 days prior to scheduled training and revise as necessary for acceptance.

1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified elsewhere.
- B. Representative subject to acceptance by Owner and Construction Manager. No substitute representatives will be allowed unless prior written approval by such has been given.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

3.1 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' training for flume gate and all other manufacturers' services for radial gate and flume gate.
- B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.
- C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

- D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by Construction Manager will be credited to fulfill the specified minimum services.
- F. When specified in individual specification sections, manufacturer's onsite services shall include:
  - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
  - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
  - 3. Providing, on a daily basis, copies of all manufacturers' representatives field notes and data to Construction Manager.
  - 4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Construction Manager.
  - 5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
  - 6. Assistance during functional and performance testing, and facility startup and evaluation.
  - 7. Training of Owner's personnel in the operation and maintenance of respective product as required.
  - 8. Additional requirements may be specified elsewhere.

### 3.2 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by the entity supplying the product, material, or service, and submitted prior to shipment of product or material or the execution of the services.
- B. Construction Manager may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. The certificate may reflect recent or previous test results on material or product, if acceptable to Construction Manager.

### 3.3 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. For both the radial gate and flume gate, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.
- B. Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

### 3.4 TRAINING

- A. General:
  - 1. Furnish manufacturers' representatives for detailed hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, or component) for the flume gate.
  - 2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner and familiar with operation and maintenance manual information.
  - 3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
  - 4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.
- B. Training Schedule:
  - 1. List specified equipment and systems that require training services and show:
    - a. Respective manufacturer.
    - b. Estimated dates for installation completion.
    - c. Estimated training dates.
  - 2. Allow for multiple sessions when several shifts are involved.
  - 3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
- C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare for each required course, containing the following minimum information:
  - 1. Title and objectives.
  - 2. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).

3. Course description and outline of course content.
  4. Format (e.g., lecture, self-study, demonstration, hands-on).
  5. Instruction materials and equipment requirements.
  6. Resumes of instructors providing the training.
- D. Pre-startup Training:
1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals.
  2. Complete at least 10 days prior to beginning of facility startup.
- E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

### 3.5 SUPPLEMENTS

- A. The supplements listed below are part of this Specification.
1. Form: Manufacturer's Certificate of Compliance.
  2. Form: Manufacturer's Certificate of Proper Installation.



**MANUFACTURER'S CERTIFICATE OF COMPLIANCE**

OWNER:

PRODUCT, MATERIAL, OR SERVICE  
SUBMITTED:

PROJECT NAME:

PROJECT NO:

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I hereby certify that the above-referenced product, material, or service called for by the contract for the named project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the contract requirements and are in the quantity shown.

Date of Execution: \_\_\_\_\_, 20\_\_

Manufacturer: \_\_\_\_\_

Manufacturer's Authorized Representative (*print*): \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signature)

**MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION**

OWNER \_\_\_\_\_ EQPT SERIAL NO: \_\_\_\_\_

EQPT TAG NO: \_\_\_\_\_ EQPT/SYSTEM: \_\_\_\_\_

PROJECT NO: \_\_\_\_\_ SPEC. SECTION: \_\_\_\_\_

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical & mechanical connections meet quality & safety standards.
- All applicable safety equipment has been properly installed.
- Functional tests.
- System has been performance tested & meets or exceeds specified performance requirements. (When complete system of one mfr.)

Note: Attach any performance test documentation from manufacturer.

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 his equipment and (iii) authorized to make recommendations required to assure that the equipment 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: \_\_\_\_\_, 20\_\_

Manufacturer: \_\_\_\_\_

By Manufacturer's Authorized Representative: \_\_\_\_\_

(Authorized Signature)

END OF SECTION

**SECTION 01810  
STARTUP AND TESTING**

**PART 1 GENERAL**

**1.1 STARTUP AND TESTING REQUIREMENTS**

- A. Perform both functional and performance tests on all new components of the Farmers Mutual Diversion work in this contract.
- B. Coordinate with Farmers Mutual Irrigation Company for complete testing of the Farmers Mutual Diversion.

**1.2 DEFINITIONS**

- A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.
- B. Functional Test: A test or tests in the presence of Design Engineer and/or Construction Manager to demonstrate that the installed equipment or system meets manufacturer's installation, calibration, and adjustment requirements and other specified requirements including, but not limited to, proper function and operation, noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing. Functional testing may include both pre-operational and operational tests.
- C. Performance Test: A test or tests, conducted in the presence of the Design Engineer and/or Construction Manager and after successful completion of functional testing, to demonstrate and confirm that the equipment and/or system meets specified performance requirements.
- D. Facility Performance Demonstration:
  - 1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Construction Manager.
  - 2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

**1.3 SUBMITTALS – NOT USED**

1.4 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN – NOT USED

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

3.1 GENERAL

- A. Facility Startup Meetings: Schedule to discuss test schedule, test methods, materials, coordination with river master, and Owner involvement.
- B. Contractor's Testing and Startup Representative:
  - 1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
  - 2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.
- C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.
- D. Coordinate with Owner's operating personnel to fill the pipelines 10 days prior to startup.
- E. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.
- F. Owner will:
  - 1. Observe and participate in startup

3.2 EQUIPMENT TESTING

- A. Preparation:
  - 1. Complete installation before testing.
  - 2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
  - 3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01640, Manufacturers' Services, when required by individual Specification sections.
  - 4. Equipment Test Report Form: Not used

5. Cleaning and Checking: Prior to beginning functional testing:
  - a. Calibrate testing equipment in accordance with manufacturer's instructions.
  - b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
  - c. Lubricate equipment in accordance with manufacturer's instructions.
  - d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.
  - e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
  - f. Check power supply to electric-powered equipment for correct voltage.
  - g. Adjust clearances and torque.
  - h. Test for leaks.
6. Ready-to-test determination will be by Construction Manager based at least on the following:
  - a. Acceptable Operation and Maintenance Data.
  - b. Notification by Contractor of equipment readiness for testing.
  - c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
  - d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
  - e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
  - f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
  - g. Equipment and electrical tagging complete.
  - h. Delivery of all spare parts and special tools.

B. Functional Testing (Dry):

1. Conduct testing of equipment without water in the system (dry).
2. Notify Owner and Construction Manager in writing at least 10 days prior to scheduled date of dry testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Construction Manager's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by Construction Manager/Owner's signature as witness on Equipment Test Report.

C. Performance Testing (Wet):

1. Conduct testing of the equipment with forebay of Farmers Mutual Diversion full of water.
2. Notify Construction Manager and Owner in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Construction Manager as having satisfied functional test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Equipment Test Report summarizing test method and results.
7. When, in Construction Manager's opinion, equipment meets performance requirements specified, such equipment will be accepted as conforming to Contract requirements. Such acceptance will be evidenced by Construction Manager's signature on Equipment Test Report.

### 3.3 FACILITY PERFORMANCE DEMONSTRATION

- A. When, in the opinion of Construction Manager, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.
- B. Demonstrate proper operation of required interfaces within and between individual unit processes and equipment.

### 3.4 SUPPLEMENTS

- A. Supplements listed below, following "End of Section," are a part of this Specification:
  1. Unit Process Startup Form.
  2. Facility Performance Demonstration/Certification Form.

END OF SECTION

**UNIT PROCESS STARTUP FORM**

**OWNER:** \_\_\_\_\_ **PROJECT:** \_\_\_\_\_

**Unit Process Description: (Include description and equipment number of all equipment and devices):**

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**Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):**

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**Startup Requirements (Water, power, chemicals, etc.):** \_\_\_\_\_

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**Evaluation Comments:** \_\_\_\_\_

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**FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM**

**OWNER:** \_\_\_\_\_ **PROJECT:** \_\_\_\_\_

**Unit Processes Description (List unit processes involved in facility startup):**

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**Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):**

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**Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:**

**Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_, 20\_\_

**Construction Manager:** \_\_\_\_\_ **Date:** \_\_\_\_\_, 20\_\_  
(Authorized Signature)



**SECTION 02220**  
**EROSION AND SEDIMENT CONTROL**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. This Section includes designing, furnishing, installing, maintaining, and final removal of temporary erosion and sedimentation controls for all earthwork, excavation, trenching, clearing, grubbing and stripping operations, including those activities associated with construction of permanent spoil disposal piles, temporary stockpiles, portal sites, staging areas, access roads, and any other areas disturbed by construction activities.
- B. All erosion and sediment control measures and practices are subject to review and approval by the Construction Manager and applicable regulatory agency.

**1.2 RELATED SECTIONS**

- A. Section 01010, Summary of Work.
- B. Section 01300, Submittals.
- C. Section 02310, Backfilling, and Compacting.

**1.3 SUBMITTALS**

- A. Submit the following in accordance with Section 01330.
- B. As part of the New Mexico Pollution Discharge Elimination System (NMPDES), a Storm Water Pollution Prevention Plan (SWPPP) shall be prepared and submitted prior to commencement of construction in conformance with permit requirements and in conformance with San Juan County SWPPP permit requirements. The SWPPP shall address both stormwater and non-stormwater (e.g., construction) discharges.

- C. Prepare an erosion and sediment control plan for each area to be disturbed by the construction work including each staging area(s), portal site, spoil disposal site(s), pipeline segment, access road(s), and structure site. Determine appropriate control measures for specific site conditions and provide all necessary materials, labor, and equipment to control erosion and off-site sediment transport. Erosion control plans shall also include details for monitoring erosion and sediment control measures during construction; a maintenance program with provisions for inspection, reseeded, repairs or reconstruction; and plans addressing the removal of control measures and site restoration following construction. Drawings shall be prepared, stamped, and signed by a civil engineer registered in the State of New Mexico.
- D. Manufacturers' catalog data and samples of materials used for erosion and sedimentation control, including the physical characteristics, application and installation instructions.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Provide silt fences, staked hay or straw bales, sandbags and other materials to control erosion and sedimentation as indicated in the SWPPP and this Section.

## **PART 3 EXECUTION**

### **3.1 GENERAL REQUIREMENTS**

- A. Construct and implement erosion control measures in accordance with the SWPPP and as described herein.
- B. Implement effective erosion and sediment control anywhere that the Work disturbs existing surface vegetation or soils.
  - 1. Prevent erosion of graded areas during construction and until these areas have been regraded and revegetated.
  - 2. Prevent any sediment from leaving the work areas, including transport by water or air, material spillage from hauling, or falling from vehicles (e.g., mud from tires).
- C. Schedule and execute all work such that the amount of area disturbed is minimized.
- D. Grade disturbed surfaces to provide positive drainage and prevent ponding of water. Surface water shall be controlled to prevent water damage or deposition of sediment to all adjoining and downstream properties.
- E. Install silt fences, staked hay or straw bales, sandbags, sedimentation ponds, dikes, stabilized construction entrances and any other erosion

control measure to minimize sediment escape from the construction site and to maintain runoff quantity and quality in compliance with permits. Prevent construction sediment from entering any streams, creeks, ponds or drainage facilities.

- F. As a minimum, provide erosion and sediment control measures immediately following clearing and grubbing operations in the following locations:
1. Inside construction limits for pipelines, access roads, staging areas and spoil disposal areas immediately upstream of all natural channels.
  2. Along the toe of all permanent spoil piles and temporary stockpiles.
  3. At the lowest end of areas disturbed by construction before runoff from storms can reach natural streams.
  4. Base of slopes adjacent to road crossings.
  5. At additional locations as required to control sedimentation in accordance with SWPPP.
- G. NOT USED As a minimum, provide temporary slope breakers consisting of soil, silt fences, staked hay or straw bales, sandbags, or functional equivalent, installed at the spacings indicated below. Slope breakers shall be constructed with a 2 percent to 8 percent outslope to divert surface flow to stable, well-vegetated areas. Appropriate energy-dissipating devices shall be built at the end of the slope breaker as necessary.
1. Slopes 5 Percent to 15 Percent: 300-foot spacing.
  2. Slopes Greater than 15 Percent to 30 Percent: 200-foot spacing.
  3. Slopes Greater than 30 Percent: 100-foot spacing.
- H. Erosion and sediment control measures shall remain in place and functional until such time that the work area is restored and revegetated, or prepared for permanent drainage and erosion control measures.

### 3.2 MAINTENANCE

- A. Conduct site inspections of the erosion and sedimentation control measures prior to forecasted storm events and after the actual storm to evaluate the adequacy and effectiveness of such measures. Make and implement modifications as necessary to comply with permit requirements and this Section. Submit inspection reports to the Construction Manager after each storm event. Include in the inspection reports as a minimum, the date of the inspection, the individual(s) who performed the inspection, the observations, and any modifications or repairs implemented.
- B. Maintain erosion and sediment control measures, ensuring proper operation before, during, and after all storm events.
- C. Repair all damaged erosion and sediment controls. Reinstate to finished

condition any erosion damage within the construction area for the duration for the Contract.

- D. In accordance with permit requirements, certify that the construction activity is in compliance with the requirements of the SWPPP. The certification shall be based upon the site inspections required above. The written certification shall be submitted to the Construction Manager.
- E. Immediately notify the Construction Manager in writing if it is determined that the construction activity is not or has not been in compliance with permit requirements, the SWPPP, or the requirements of this Section. The notification shall identify the type of noncompliance and include a time schedule when compliance will be achieved.
- F. Additional site inspections and/or sampling and analysis may be required at the request of the Construction Manager.

### 3.3 REMOVAL AND MAINTENANCE

- A. Remove materials used for temporary erosion and sedimentation control and dispose offsite when the Work described in this Section is completed.

END OF SECTION

**SECTION 02310  
BACKFILLING, AND COMPACTING**

**PART 1 GENERAL**

**1.1 WORK INCLUDED**

- A. For all project facilities requiring backfilling or to attain elevation for subgrade of structure, this Section includes materials, testing, and installation for backfilling and compacting.
- B. Stockpile excavated trench materials at locations designated on the plans.
- C. Cold weather (below freezing temperatures) placement and testing requirements for earthwork are identified in Section 02200, Earthwork.

**1.2 RELATED WORK**

- A. Section 02200, Earthwork
- B. Section 02330, Geotextiles
- C. Section 03300, Cast-in-Place Concrete.

**1.3 SUBMITTALS**

- A. Submit method for excavating rock. Blasting is not allowed. Submit ripping, rock sawing, hoe ramming, or other rock excavation method proposed. Rock excavation methods must be reviewed and approved by Construction Manager before this Work may proceed.
- B. Submit report from a testing laboratory verifying that material conforms to the specified gradations or characteristics for CLSM for foundation stabilization, and water.
- C. Submit mix designs for controlled low-strength material (CLSM). Comply with CLSM cold-weather placement and curing submittals as specified in Section 02200.
- D. Submit dewatering plan associated with the Temporary Cofferdam.

**1.4 TESTING FOR COMPACTION – NOT USED**

- A. Test for compaction in accordance with Section 02200.

## **PART 2 PRODUCTS**

### **2.1 CONTROLLED LOW STRENGTH MATERIAL (CLSM) FOR BACKFILL**

- A. See Section 03315, Controlled Low Strength Material (CLSM).

### **2.2 FILTER FABRIC (GEOTEXTILE)**

- A. See Section 02330. Geotextile.

### **2.3 IMPERVIOUS BARRIERS –**

- A. In impervious barrier for the Temporary Cofferdam will be at the discretion of the Contractor. Contractor responsible for dewatering sufficient to perform compaction of subgrade and placement of CLSM and structural concrete without free water in project site.

## **PART 3 EXECUTION**

### **3.1 ROCK EXCAVATION**

- A. Blasting is not allowed.

### **3.2 COMPACTION REQUIREMENTS**

- A. Unless otherwise shown on Drawings the only compaction will be for the native subgrade of the structure since all backfill for grade control and structural backfill will be CLSM.
- B. Native subgrade disturbed during demolition will be removed. No more than 4 inches of disturbed native subgrade may be left in place for compaction.
- C. Native subgrade will be compacted with 4 passes of a vibrating drum roller.

### **3.3 MATERIAL REPLACEMENT**

- A. Remove and replace any backfilling material which does not meet the Specifications, at the Contractor's expense.

### **3.4 SLOPING, SHEETING, SHORING, AND BRACING OF SLOPES**

- A. Sloped excavation shall have sloping incline, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P - Excavations, OSHA requirements.
- B. Shoring/bracing shall be designed and maintained so that soil does not migrate

from behind the structural system creating voids. Shoring/bracing systems shall be removed such that backfill is not disturbed.

- C. Prevent potentially unsafe excavation walls. Fill voids with CLSM.
- D. Prevent ground settlement and utility shearing/settlement during installation and removal of shoring.

### 3.5 DEWATERING

- A. Comply with the dewatering requirements of this section to maintain project site dewatered of free standing water.
- B. Provide and maintain means and devices to remove and dispose of all water. Maintain groundwater 1 foot below the bottom of excavations and at an adequate lateral distance away from the slopes so as to have negligible effects on stability. Locate dewatering facilities such as sumps a minimum distance 10 feet from structure footprint.
- C. Open pumping from sumps shall not result in boils, softening of the ground, or loss of fines. These provisions shall apply 24 hours a day whenever pumping is performed. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory agency requirements. Do not drain water to the Animas River. Do not allow groundwater to rise above the bottom of structures until they have attained a minimum of 80% of design strength.
- D. CLSM shall not be placed with standing water in the excavation. If water exists in the bottom of the excavation, dewatering processes shall be increased until the groundwater level is at least 1 foot below the base of the excavation prior to the placement of the CLSM.

### 3.6 LOCATION OF EXCAVATED MATERIAL

- A. During excavation, place the excavated material only within the working area authorized by Owner and only where runoff would discharge downstream of the project to the existing canal.
- B. Spoil piles shall be located at least 5 feet from the tops of the slopes. Cranes and other equipment shall not be operated on the spoil piles.

### 3.7 FOUNDATION STABILIZATION

- A. Overexcavation shall include the removal of all material that exists directly beneath the structure footprint to a width 24 inches (minimum) greater than the outside edge of structure and to the depth required.

- B. Where overexcavation and rock refill are not required in the plans, foundation stabilization work shall be executed only by change order when unacceptably soft (as determined by the Construction manager) subgrade materials are encountered in the project site. In such areas, after the required excavation has been completed, the Construction Manager will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade.

### 3.8 INSTALLING IMPERVIOUS BARRIER FOR TEMPORARY COFFER DAM

- A. Where shown on Drawings or indicated otherwise, construct impervious barriers such that the barrier will protect the coffer dam from erosion and reduce flow from the Animas River requiring dewatering.

### 3.9 BACKFILL COMPACTION – NOT USED

### 3.10 PLACEMENT OF CLSM

- A. The aggregate, cement, and water shall be proportioned either by weight or by volume. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed. Prepare CLSM in accordance with ASTM C94.
- B. Provide batching equipment to obtain the proper weights of soil, cement, water, and admixtures. All measuring devices should be sensitive to a 2 percent variation above or below the actual weights required. Volumetric batching may be used, provided the same accuracy required for weight batching is maintained. Batch tickets are required with all batch results, including cement, aggregate, air, and water weights or volumes.
- C. Design and operate the mixers used for mixing the CLSM so that the CLSM as discharged from the mixer is uniform in composition and consistency throughout each batch.
- D. Place the CLSM such that it flows easily into all areas to be backfilled. In some cases, such on a slope, a stiffer mix may be required to prevent it from flowing down the slope. In this case, use vibration to be sure that the CLSM completely fills all spaces.
- E. If the ambient temperature is 40 degrees F or less, comply with the cold weather backfill and CLSM placement and curing requirements in Section 3300, Cast-in-place Concrete.
- F. Whenever freezing temperatures are imminent, maintain the CLSM at a temperature of not less than 50 degrees F for 7 days after placement. The



temperature of the mix shall be 50 degrees F or greater at the time of placement. The temperature shall be monitored by placing a thermometer in the CLSM immediately after sampling at the placement site. When freezing weather appears imminent, make ready at the placement site materials which may be required for protection of CLSM. Placement of CLSM shall be delayed until adequate provisions for protection against weather are made. No CLSM bedding shall be placed when the subgrade or walls are frozen or contain frozen material. Backfill placed as cover over the CLSM is prohibited from containing any frozen material.

### 3.11 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess excavated in an approved landfill.

END OF SECTION

## **SECTION 02330 GEOTEXTILES**

### **PART 1 GENERAL**

#### **1.1 DEFINITIONS**

- A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
- B. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.
- C. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.
- D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.

#### **1.2 SUBMITTALS**

- A. Shop Drawings:
  - 1. Manufacturer material specifications and product literature.
  - 2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
  - 3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, adhesives (if any), and provisions for holding geotextile temporarily in place until permanently secured.
- B. Quality Control Submittals:
  - 1. Certifications from each geotextile manufacturer that furnished products have specified property values. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.
  - 2. Field seam efficiency test results for sewn seams not required for Temporary Cofferdam.

### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.
- B. Handle products in manner that maintains undamaged condition.
- C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

### 1.4 SCHEDULING AND SEQUENCING

- A. Where geotextile is to be laid directly upon ground surface, prepare subgrade to minimize ruptures or tears.
- B. Notify Construction Manager whenever geotextiles are to be placed. Do not place geotextile without Construction Manager's approval of underlying materials.

## **PART 2 PRODUCTS**

### 2.1 NONWOVEN GEOTEXTILE

- A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching or spun-bonding.
- B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.
- C. Unseamed Sheet Width: Minimum 12 feet.
- D. Nominal Weight per Square Yard: 16 ounces (ASTM D5261).

E. Physical Properties: Conform to requirements in Table No. 1.

<b>Table No. 1 Physical Property Requirements for Nonwoven Geotextile</b>		
<b>Property</b>	<b>Requirement</b>	<b>Test Method</b>
Water Permittivity	0.8 sec. <sup>-1</sup> , MinARV	ASTM D4491 (Falling Head)
Apparent Opening Size (AOS)	100 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength, Machine Direction	300 lb/in, MinARV	ASTM D4632
Grab Elongation, Machine Direction	50 percent, MaxARV	
Puncture Strength	190 lb, MinARV	ASTM D6241
Trapezoid Tear Strength	115 lb, MinARV	ASTM D4533
Ultraviolet Radiation Resistance	90 percent strength retention, MinARV after 500 hours	ASTM D4355

2.2 ADHESIVES – NOT USED

### **PART 3 EXECUTION**

3.1 LAYING GEOTEXTILE

A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.2 SHEET ORIENTATION ON SLOPES – NOT USED.

3.3 JOINTS

A. Unseamed Joints: Overlapped minimum 18 inches.

3.4 SECURING GEOTEXTILE

A. Secure geotextile during installation on horizontal surfaces as necessary with sand bags or other means approved by Construction Manager.

B. Secure geotextile during installation on vertical surfaces – not used.

### 3.5 PLACING PRODUCTS OVER GEOTEXTILE

- A. Before placing material over geotextile, notify Construction Manager. Do not cover installed geotextile until after Construction Manager provides authorization to proceed.
- B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as specified in Article Repairing Geotextile.
- C. General:
  - 1. Place fill over the geotextile with sufficient care so as to prevent damage.
  - 2. Place fill only by dumping and spreading only.
  - 3. Dump fill only on previously placed fill.
  - 4. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.
  - 5. Equipment shall not operate directly on geotextile, except to minimum extent necessary to deploy specified materials over geotextile.
- D. Spreading:
  - 1. Spreading equipment shall be lightweight, low ground pressure equipment.
  - 2. Operate spreading equipment on minimum of 8 inches of fill over the geotextile.
  - 3. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.
  - 4. Maintain proper overlap of geotextiles.

### 3.6 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.
- B. Repair Procedure:
  - 1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.
  - 2. Remove interfering material as necessary to expose damaged geotextile for repair.
  - 3. Sew patches or secure them with heat fusion tacking or as specified above in Article Securing Geotextile, or by other means approved by Construction Manager.

3.7 REPLACING CONTAMINATED GEOTEXTILE

- A. Protect geotextile from contamination that would interfere, in Construction Manager's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

**END OF SECTION**

**SECTION 03012  
CONCRETE REPAIR**

**PART 1 GENERAL**

1.1 WORK INCLUDED

- A. This Section includes requirements for the repair of concrete construction.

1.2 RELATED SECTIONS

- A. No related specifications.

1.3 SUBMITTALS

- A. Concrete Repair Materials: Manufacturer's written product literature and written instructions for application of repair methods and materials.
- B. Concrete Repair Methods: Written plan, including Drawings as applicable, specifically detailing the Contractor's plan for repairing the concrete in question.

1.4 DELIVERY AND STORAGE

- A. Acceptance at Site: Verify that delivered materials are in accordance with Specifications and manufacturer's product data sheets prior to unloading and storing onsite.
- B. Storage: Store materials in a manner to protect from oil, dirt, and sunlight, and other sources of damage.

**PART 2 PRODUCTS**

2.1 CONCRETE REPAIR MATERIALS

- A. As approved and required by the Construction Manager.

**PART 3 EXECUTION**

3.1 REPAIRING CONCRETE

- A. General:
  - 1. Complete repairs in accordance with ACI Concrete Repair Manual.
  - 2. Repair of cracks and other defects shall be repaired to the satisfaction of the Construction Manager.

3. Concrete which cannot be repaired to the satisfaction of the Construction Manager will be rejected and require removal and replacement at the expense of the Contractor.
  4. Develop repair techniques with material manufacturer on mockup panels prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from the Construction Manager.
  5. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to the Construction Manager.
  6. The Guide to Concrete Repair published by the United States Department of the Interior Bureau of Reclamation Technical Service Center will be used as a guide for repair materials and methods as directed by the Construction Manager. The repair guide is available for download from the Bureau of Reclamation website.
  7. Cracks: Cracks which leak or are wider than 1/16th of an inch shall be repaired.
- B. Major Defects: If the defects are serious or affect the structural integrity of the structure or if patching does not satisfactorily restore the quality and appearance to the surface, the Construction Manager may require the concrete to be removed and replaced, complete, in accordance with the provisions of this Section at the expense of the Contractor.
- C. Exposed Metal Objects:
1. Metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, shall be removed by chipping back concrete to depth of 1-inch and then cutting or removing metal object.
  2. Repair area of chipped-out concrete to satisfaction of Construction Manager.

END OF SECTION



**SECTION 03100**  
**CONCRETE FORMING AND ACCESSORIES**

**PART 1 GENERAL**

1.1 WORK INCLUDED

- A. This Section includes requirements for the forming and accessories for cast-in-place concrete construction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03210, Reinforcing Steel.
- B. Section 03300, Cast-in-Place Concrete.

1.3 DESIGN REQUIREMENTS

- A. Design formwork in accordance with ACI 347 and ACI 350 to provide concrete finishes specified in Section 03300, Cast-in-Place Concrete.
- B. When high range water reducer (superplasticizer) is used in concrete mix, forms shall be designed for full hydrostatic pressure per ACI 347.
- C. Make joints in forms watertight.
- D. Limit panel deflection to 1/360th of each component span to achieve tolerances specified.
- E. Form liner designer shall verify compatibility of proposed concrete mix with proposed form liner.

1.4 SUBMITTALS

- A. Action Submittals:
  - 1. Shop Drawings:
    - a. Formwork, falsework, and shoring drawings.
    - b. Form Ties-Tapered Through-Bolts: Proposed method of sealing form tie hole; coordinate with details shown.
    - c. Manufacturer's data for form release agent.
    - d. Form liner product data.
- B. Informational Submittals: Statement of qualification for formwork designer.

1.5 QUALIFICATIONS

- A. Formwork Designer: Formwork, falsework, and shoring design shall be by an engineer licensed in the State of New Mexico.
- B. Form liner designer shall have previous experience with design and installation of comparable form liners.
- C. Form liner installer shall be approved by form liner manufacturer.

## **PART 2 PRODUCTS**

### **2.1 FORM MATERIALS**

- A. Wall Forms:
  - 1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in “new and undamaged” condition, of sufficient strength and surface smoothness to produce specified finish.
  - 2. Plywood may be of lower finish grade when used in conjunction with form liners.
  - 3. Where steel forms are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.
- B. Painted Surface Forms: High-density overlay plywood for flat concrete surfaces to be painted.
- C. All Other Forms: Materials as specified for wall forms.
- D. Form Release Agent:
  - 1. Material: Release agent shall not bond with, stain, or adversely affect concrete surfaces, and shall not impair subsequent treatments of concrete surfaces when applied to forms. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations and can be used in potable water facilities.
  - 2. Manufacturers and Products:
    - a. BASF, Shakopee, MN; MBT, MasterFinish RL-211.
    - b. Cresset Chemical Company; Crete-Lease 20-VOC.
    - c. Unitex Chemicals; Farm Fresh.
    - d. Atlas Construction Supply, Inc.; Bio-Guard.
- E. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.
- F. Form Ties:
  - 1. Material: Steel.

2. Spreader Inserts:
  - a. Conical or spherical type.
  - b. Design to maintain positive contact with forming material.
  - c. Furnish units that will leave no metal closer than 1-1/2 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1-1/2-inch depth and sufficient dimensions to permit patching of tie hole.
5. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:
  - a. Integral steel water stop 0.103-inch thick and 0.625-inch in diameter tightly and continuously welded to tie.
  - b. Neoprene water stop 3/16-inch minimum thickness and 3/4-inch minimum diameter whose center hole is one half diameter of tie, or molded plastic water stop of comparable size.
  - c. Orient water stop perpendicular to tie and symmetrical about center of tie.
  - d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.
6. Through-Bolts: Tapered minimum 1-inch diameter at smallest end.
7. Elastic Vinyl Plug:
  - a. For use in plugging through-bolt holes.
  - b. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming watertight seal.
  - c. Manufacturer and Product: Dayton/Richmond Co., Miamisburg, OH; A58 Sure Plug.

G. Form Liners:

1. Material: Elastomeric, FRP, ABS, or PVC.
2. Manufacturing Tolerance: Overall dimensions within 0.125 inch at time of manufacture.
3. Manufacturers:
  - a. Fitzgerald Formliners.
  - b. Greenstreak.
  - c. Symons (by Dayton Superior).
4. Form Liner Pattern Basis of Design:
  - a. Type A (Fieldstone or Cobble Rock): Symons, Hill Country Flagstone.

## **PART 3      EXECUTION**

### **3.1      FORM SURFACE PREPARATION**

- A. Thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants prior to coating surface.
- B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by the manufacturer.
- C. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.
- D. Form Liner Forms:
  - 1. Prepare forms as recommended by manufacturer.
  - 2. Provide liners in full sheets and locate seams as shown on approved Shop Drawings.
  - 3. Anchor liners to formwork as recommended by liner manufacturer.
  - 4. Clean form liner after each use and use only form release agents approved by form liner manufacturer.

### **3.2      ERECTION**

- A. General: Unless specified otherwise, follow applicable recommendations of ACI 347.
- B. Beveled Edges (Chamfer):
  - 1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
  - 2. Where beveled edges on existing adjacent structures are other than 3/4-inch, obtain Construction Manager's approval of size prior to placement of beveled edge.
- C. Wall Forms:
  - 1. Do not reuse forms with damaged surfaces.
  - 2. Locate form ties and joints in an uninterrupted uniform pattern.
  - 3. Inspect form surfaces prior to installation to assure conformance with specified tolerances.
- D. Forms for Curbs, Sidewalks, and Driveways: Not Used
  - 1. Provide standard steel or wood forms.
  - 2. Set forms to true lines and grades, and securely stake in position.
- E. Forms Supporting Form Liners:

1. Construct to structurally withstand deflection, movement, leakage, high hydraulic pressures resulting from rapid filling and heavy-high frequency vibration.
  2. Lay out form joints and ties in uniform pattern, unless otherwise shown.
- F. Form Liner Installation:
1. Protect form liners from extended exposure to sunlight and from high surface temperatures during installation.
  2. Handle, cut, and install form liners in accordance with form liner manufacturer's instructions and recommendations.
  3. Place form liners with level and square, unless otherwise noted and in accordance with specified patterns and joints.
  4. Maintain required concrete cover between form liner and reinforcing steel.
- G. Form Tolerances: Provide forms in accordance with ACI 117/117R, ACI 347, and ACI 350 and the following tolerances for finishes specified:
1. Wall Tolerances:
    - a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
    - b. Wall Type W-A:
      - 1) Plumb within 1/4-inch in 10 feet or within 1-inch from top to bottom for walls over 40 feet high.
      - 2) Depressions in Wall Surface: Maximum 5/16-inch when 10-foot straightedge is placed on high points in all directions.
    - c. Wall Type W-B:
      - 1) Plumb within 1/8-inch in 10 feet or within 1/2-inch from top to bottom for walls over 40 feet high.
      - 2) Depressions in Wall Surface: Maximum 1/8-inch when 10-foot straightedge is placed on high points in all directions.
    - d. Thickness: Maximum 1/4-inch minus or 1/2 inch plus from dimension shown.
    - e. Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/4 inch.

### 3.3 FORM REMOVAL

- A. Non-supporting forms may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
1. Concrete is sufficiently hard so as not to sustain damage by form

- removal operations.
- 2. Curing and protection operations are maintained.
- B. Supporting Forms: In accordance with ACI 350 and at such time as concrete has reached compressive strength equal to 80 percent of specified 28-day compressive strength as determined by field cured test cylinders.
- C. Forms with Form Liners: Remove formwork in accordance with form liner manufacturer's recommendations. Use consistent form liner removal timing to avoid variations in concrete color. Avoid damaging formed profiles.

### 3.4 MANUFACTURER'S SERVICES

- A. Provide form liner manufacturer's representative at Site for installation assistance and inspection.

**END OF SECTION**

**SECTION 03210  
REINFORCING STEEL**

**PART 1 GENERAL**

1.1 WORK INCLUDED

- A. This Section includes requirements for the materials and placement reinforcing steel for cast-in-place concrete construction.

1.2 RELATED WORK

- A. Section 03100, Concrete Forming and Accessories.
- B. Section 03251, Doweling for Concrete.
- C. Section 03300, Cast-in-Place Concrete.

1.3 SUBMITTALS

- A. Action Submittals:
  - 1. Shop Drawings prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66:
    - a. Bending lists.
    - b. Placing drawings.
  - 2. Welded, metallic sleeve splice, and mechanical threaded connection.
- B. Informational Submittals:
  - 1. Lab test reports for reinforcing steel showing stress-strain curves and ultimate strengths.
  - 2. Mechanical Threaded Connections: Not Used.
  - 3. Welding Qualification: not used
  - 4. Test results of field testing.

1.4 QUALITY ASSURANCE

- A. Welder Qualifications: Not used

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."

**PART 2 PRODUCTS**

## 2.1 MATERIALS

### A. Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A615/A615M, Grade 60, where welding is not required.
3. ASTM A706/A706M, Grade 60, for reinforcing to be welded.
4. ASTM A767/767M, Grade 60, for galvanized bars.

### B. Mechanical Splices and Connections:

1. Metal Sleeve Splice:
  - a. Furnish with cast filler metal, capable of developing, in tension or compression, 125 percent of minimum tensile strength of bar.
  - b. Manufacturer and Product: Erico Products, Inc., Cleveland, OH; Cadweld T-Series.
2. Mechanical Threaded Connections:
  - a. Furnish Type 2 metal coupling sleeve with internal threads engaging threaded ends of bars. Must be capable of developing tension or compression to 125 percent of yield strength of bar. Meet requirements of ACI 318.
  - b. Manufacturers and Products:
    - 1) Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
    - 2) Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.

### C. Welded Wire Fabric: Not used

## 2.2 ACCESSORIES

### A. Tie Wire: Black, soft-annealed 16-gauge wire.

### B. Bar Supports and Spacers:

1. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
2. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.
3. Plastic bar supports may be used in interior spaces protected from exposure to weather, earth, water, chloride intrusion, or corrosive



- chemicals and where approved by the Construction Manager.
4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to reinforcing steel.
  5. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
  6. Precast Concrete Supports: Total bond precast high performance concrete bar supports as supplied by Con Sys Inc., Pinawa, MB, Canada.
  7. Plastic Bar Supports: Manufactured by Aztec Concrete Accessories, Bloomington, CA.

## 2.3 FABRICATION

- A. Follow CRSI Manual of Standard Practice.
- B. Bend bars cold.

## **PART 3 EXECUTION**

### 3.1 PREPARATION

- A. Notify Construction Manager when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.
- B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.
- C. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.

### 3.2 INSTALLATION

- A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.
- B. Spacing and Positioning: Conform to ACI-350.
- C. Location Tolerances: In accordance with CRSI publication, "Placing Reinforcing Bars."
- D. Splicing:
  1. Follow ACI -350.
  2. Use lap splices, unless otherwise shown or permitted in writing by Construction Manager.

3. Welded Splices: Accomplish by full penetration groove welds and develop a minimum of 125 percent of yield strength of bar.
  4. Stagger splices in adjacent bars where indicated.
- E. Mechanical Splices and Connections:
1. Use only in areas specifically approved in writing by the Construction Manager.
  2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
  3. For metal sleeve splice, follow manufacturer's installation recommendations.
  4. Maintain minimum edge distance and concrete cover.
- F. Tying Reinforcing Bars:
1. Tie reinforcing bars sufficiently to hold bars securely in place during fabrication and concrete placement, as a minimum this shall include tying every other bar intersection.
  2. Bend tie wire away from concrete surface to provide minimum clearance of 1-inch from surface of concrete to tie wire.
- G. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.
- H. Welding Reinforcement: Not Used
1. Only ASTM A706/A706M bars may be welded.
  2. Do not perform welding until welder qualifications are approved.
- I. Straightening and Rebending: Field bending of reinforcing steel bars is not permitted.
- J. Unless permitted by the Construction Manager, do not cut reinforcing bars in field.

3.3 WELDED WIRE FABRIC INSTALLATION Not Used

3.4 TESTS AND INSPECTION – Not used

**END OF SECTION**

**SECTION 03251  
DOWELING FOR CONCRETE**

**PART 1 GENERAL**

1.1 WORK INCLUDED

- A. This Section includes requirements for the materials and placement of adhesive dowels in concrete construction.

1.2 RELATED WORK

- A. Section 03210, Reinforcing Steel.
- B. Section 03300, Cast-in-Place Concrete.

1.3 DEFINITIONS

- A. ICC-ES Reports: Published by International Code Council (ICC) for concrete anchor manufacturers.

1.4 SUBMITTALS

- A. Action Submittals:
  - 1. Product Data: Manufacturer's catalog information.
- B. Informational Submittals:
  - 1. Doweling system manufacturer's ICC-ES Reports.
  - 2. Detailed instructions for the Special Inspection procedure in accordance with ICC-ES Reports and IBC.
  - 3. Special Inspection report.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store adhesive cartridges and adhesive components on pallets or shelving in a covered storage area.
- B. Store at temperatures as indicated in the manufacturer's literature and ICC-ES Report.
- C. Dispose of when:
  - 1. Shelf life has expired.
  - 2. Stored other than per manufacturer's instructions.

- D. 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.

## **PART 2 PRODUCTS**

### **2.1 ADHESIVE**

- A. Approved by an ICC Evaluation Services Report for conformance to 2015 IBC requirements for doweling in steel reinforcing bars in cracked concrete.
- B. Disposable, self-contained cartridge system capable of dispensing both components in the proper mixing ratio and that fit into manually or pneumatically operated caulking gun.
- C. Meet requirements of ASTM C881.
- D. Two-component, insensitive to moisture, designed to be installed in adverse freeze/thaw environments.
- E. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
- F. Mixed Adhesive: Nonsag light paste consistency with ability to remain in a 1-inch diameter overhead drilled hole without runout.
- G. Manufacturers and Products:
  - 1. ITW Ramset/Red Head, Wood Dale, IL; Epcon Ceramic 6 Epoxy or A7 Adhesive Anchor System. (Use only Epcon A7 Adhesive System for hollow masonry.)
  - 2. Hilti, Inc., Tulsa, OK; HIT-RE 500 V3 Adhesive Anchors.
  - 3. Powers Rawl, New Rochelle, NY; Power Fast Epoxy Injection Gel Cartridge System.
  - 4. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Epoxy-Tie Adhesive ET22.
  - 5. Covert Operations, Inc., Long Beach, CA; CIA-Gel 7000 Epoxy Anchors.
  - 6. Unitex, Kansas City, MO; Pro-Poxy 300 and Pro-Poxy 300 Fast Epoxy Adhesive Anchors.

### **2.2 MIXING NOZZLES**

- A. Disposable, manufactured in several sizes to accommodate size of reinforcing dowels.

- B. Non-removable internal static mixer required to ensure proper blending of components.

### 2.3 REINFORCING DOWELS

- A. As specified in Section 03210, Reinforcing Steel.

## **PART 3 EXECUTION**

### 3.1 GENERAL

- A. Install in accordance with manufacturer's recommended instructions.
- B. Dispense components through specially designed static mixing nozzle that thoroughly mixes components and places mixed adhesive at base of predrilled hole.

### 3.2 DOWEL SIZING AND INSTALLATION

- A. Install per adhesive manufacturer's instructions.
- B. Drilling Equipment: Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.
- C. Hole Diameter: Use drill bit diameter meeting ICC-ES Report requirements and as recommended by the manufacturer.
- D. Obstructions in Drill Path:
  - 1. When existing reinforcing steel is encountered during drilling and when approved by the Construction Manager, enlarge hole by 1/8-inch, core through existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter; or redrill hole 1-inch from original location, beginning in same line at surface, redirecting drill to miss reinforcing steel.
  - 2. Place dowels in both the misdrilled hole and the new one.
  - 3. When using epoxy anchors, dowels may be prebent prior to installation to 15 degrees to align with other bars. Do not heat dowels to bend.
  - 4. If bars have fused epoxy coating and coating is damaged, recoat damaged area with epoxy.
  - 5. Bent Bar Dowels: Where edge distances are critical, and striking reinforcing steel is likely, drill hole at 10-degree angle or less and use prebent reinforcing bars.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide manufacturer's representative at Site as required by Construction Manager, for installation assistance, inspection, and certification of proper installation.

**END OF SECTION**

**SECTION 03300  
CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

1.1 WORK INCLUDED

- A. This Section includes requirements for the materials and placement of cast-in-place concrete.

1.2 RELATED SPECIFICATIONS

- A. Section 03210, Reinforcing Steel
- B. Section 03251, Doweling for Concrete.
- C. Section 03900; Curing Concrete

1.1 DEFINITIONS

- A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.
- B. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.
- C. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch in diameter (surface area), cracks in liquid containment structures and below grade habitable spaces that are 1/16th-inch wide and wider or that are leaking water out of or into the structure, and cracks in other structures that are 1/16<sup>th</sup>-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning. Refer to Section 03012, Concrete Repair.
- D. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- E. Hot Weather: As defined in ACI 305.1.
- F. Hydraulic Structure: Liquid containment or conveying structure. Below grade accessible space.

G. New Concrete: Less than 60 days old.

## 1.2 SUBMITTALS

### A. Action Submittals:

#### 1. Mix Designs:

- a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
- b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
- c. Manufacturer's Certificate of Compliance for the following:
  - 1) Portland cement.
  - 2) Supplementary cementitious material.
  - 3) Aggregates, including specified class designation for coarse aggregate.
  - 4) Admixtures.
  - 5) Concrete producer has verified compatibility of constituent materials in design mix.
- d. Test Reports:
  - 1) Cement: Chemical analysis report.
  - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
  - 3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
  - 4) Shrinkage Test Results: In accordance with ASTM C157/ C157M as modified herein.
- e. Aggregates:
  - 1) Gradation:
    - a) List gradings and percent passing through each sieve for coarse, fine, and combined aggregates.
    - b) Testing shall be performed within 4 months prior to submittal.
  - 2) Provide evidence not more than 120 days old showing compliance with the requirements of Article Materials, Paragraph B, including the following:
    - a) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
    - b) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
    - c) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with ASTM C227. Include documentation of test results per applicable standards.
- f. Admixtures: Manufacturer's catalog cut sheets and product data



sheets for each admixture used in proposed mix designs.

2. Product Data: Specified ancillary materials.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
  - a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
  - b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
  - c. Methods for temperature protection during placement.
  - d. Types of covering, insulation, housing, or heating to be provided.
  - e. Curing methods to be used during and following protection period.
  - f. Use of strength accelerating admixtures.
  - g. Methods for verification of in-place strength.
  - h. Procedures for measuring and recording concrete temperatures.
  - i. Procedures for preventing drying during dry, windy conditions.
4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
  - a. Procedures for measuring, and recording temperatures of reinforcement and other embedded items prior to concrete placement.
  - b. Use of retarding admixture.
  - c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
  - d. Types of shading and wind protection to be provided.
  - e. Curing methods, including use of evaporation retardant.
  - f. Procedures for measuring and recording concrete temperatures.
  - g. Procedures for preventing drying during dry, windy conditions.

B. Informational Submittals:

1. Preinstallation Conference minutes.
2. Statement of Qualification:
  - a. Batch Plant: Certification as specified herein.
  - b. Mix designer.
  - c. Installer.
  - d. Testing agency.
3. Field test reports.
4. Recorded temperature data from concrete placement where specified.

5. Concrete Delivery Tickets:
  - a. For each batch of concrete before unloading at Site.
  - b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
  - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

### 1.3 QUALITY ASSURANCE

- A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.
- B. Qualifications:
  1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
  2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
  3. Testing Agency **Provided by Contractor:** Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
    - a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
    - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Preinstallation Conference:
  1. Required Meeting Attendees:
    - a. Contractor, including pumping, placing and finishing, and curing subcontractors.
    - b. Ready-mix producer.
    - c. Admixture representative.
    - d. Testing and sampling personnel.
    - e. Construction Manager.
    - f. Engineer.
  2. Schedule and conduct prior to incorporation of respective products into Project. Notify Construction Manager of location and time.

3. Agenda shall include:
  - a. Admixture types, dosage, performance, and redosing at site.
  - b. Mix designs, test of mixes, and Submittals.
  - c. Placement methods, techniques, equipment, consolidation, and form pressures.
  - d. Slump and placement time to maintain slump.
  - e. Finish, curing, and water retention.
  - f. Protection procedures for weather conditions.
  - g. Other specified requirements requiring coordination.
4. Conference minutes.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

#### **A. Cementitious Materials:**

1. Cement:
  - a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
  - b. Furnish from one source.
  - c. Type shall be shown in the mix design.
2. Supplementary Cementitious Materials (SCM):
  - a. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
    - 1) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
    - 2) Provide from one source.

#### **B. Aggregates: Furnish from one source for each aggregate type used in a mix design.**

1. Normal-Weight Aggregates:
  - a. In accordance with ASTM C33/C33M, except as modified herein.
    - 1) Class Designation: 4S, unless otherwise specified.
  - b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
  - c. Obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by submitted historical data or used in trial mixtures.
  - d. Alkali Silica Reactivity: See Article Concrete Mix Design.
2. Fine Aggregates:
  - a. Clean, sharp, natural sand.
  - b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:

- 1) Limit material finer than 75- $\mu\text{m}$  (No. 200) sieve to 3 percent mass of total sample.
  - 2) Limit coal and lignite to 0.5 percent.
3. Coarse Aggregate:
- a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
  - b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.
- C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.
1. Characteristics:
    - a. Compatible with other constituents in mix.
    - b. Contain at most, only trace amount chlorides in solution, or as otherwise limited by the specific mix designs included as supplements to this Specification. Trace amount cannot be greater than 0.15 percent per weight of cement.
    - c. Do not use admixtures known to be toxic after concrete is 30 days old.
    - d. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
  2. Air-Entraining Admixture:
    - a. ASTM C260/C260M.
    - b. Manufacturer and Product: Provide by same manufacturer as other admixtures unless otherwise approved by the Construction Manager.
  3. Water-Reducing Admixture:
    - a. ASTM C494/C494M, Type A or Type D.
    - b. Manufacturers and Products:
      - 1) BASF Admixtures Inc., Shakopee, MN; MasterPozzolith Series or MasterPolyHeed Series.
      - 2) Euclid Chemical Co., Cleveland, OH; Eucon Series.
      - 3) GCP Applied Technologies, Cambridge, MA; Daracem Series or Mira Series.
  4. Retarding Admixture:
    - a. ASTM C494/C494M, Type B.
    - b. Manufacturer and Product: Provide by same manufacturer as other admixtures unless otherwise approved by the Construction Manager.
  5. Accelerating Admixture: DO NOT USE
    - a. ASTM C494/C494M, Type C.
    - b. Manufacturer and Product: Provide by same manufacturer as other admixtures unless otherwise approved by the Construction

Manager.

6. High-Range, Water-Reducing Admixture:
    - a. ASTM C494/C494M, Type F or Type G.
    - b. Manufacturers and Products:
      - 1) BASF Admixtures Inc., Shakopee, MN; or MasterRheobuild 1000.
      - 2) Euclid Chemical Co., Cleveland, OH; Eucon Series or Plastol Series.
      - 3) GCP Applied Technologies, Cambridge, MA; ADVA Series, Daracem Series, or EXP 950.
  7. Do not use calcium chloride as an admixture.
  8. Crystalline Waterproofing -Not used.
- D. Water and Ice: NOT USED. Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
    - a. Chloride Content: 1,000 ppm.
    - b. Sulfate Content as SO<sub>4</sub>: 3,000 ppm.
    - c. Alkalis as (Na<sub>2</sub>O + 0.658 K<sub>2</sub>O): 600 ppm.
    - d. Total Solids by Mass: Less than 50,000 ppm.

## 2.2 ANCILLARY MATERIALS

- A. Repair Material: In accordance with requirements of Section 03012, Concrete Repair.
- B. Crack Repair: In accordance with requirements of Section 03012, Concrete Repair.

## 2.3 CONCRETE MIX DESIGN

- A. General:
  1. See Supplement at the end of this Section for mix design requirements for each class of concrete used on Project.
  2. Select and proportion ingredients using trial batches; sample, cure and test concrete mix through approved independent testing laboratory in accordance with ACI 211.1.
  3. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.

4. Unless otherwise permitted, use water-reducing admixture and high-range water reducing admixture in concrete that is part of hydraulic structures unless otherwise approved by the Construction Manager.
5. Unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture in columns, piers, pilasters, and walls.
6. Use water-reducing admixture or high-range, water-reducing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
7. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
8. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Construction Manager, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.

B. Potential Alkali-Aggregate Reactivity of Concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.
  - a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.
  - b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
  - c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.
2. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.

D. Slump Range at Site:

1. Prior to submitting mix design, consult with concrete producer and select a target slump value at point of delivery, for each application of each design mix. Unless otherwise permitted, target slump value will then be enforced for duration of Project.
2. Design mixes that include a high-range, water-reducing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
3. Slump tolerance shall meet requirements of ACI 117 and as follows:
  - a. Target Slump 2 Inches through 4 Inches: Plus or minus 1 inch.
  - b. Target Slump More than 4 Inches: Plus or minus 1-1/2 inches.

E. Combined Aggregate Gradation: Limits shown are for coarse aggregates and fine aggregates mixed together (combined). Select one of the gradations shown in the following table:

Sieve Sizes	Combined Gradation Percentage Passing		
	1-1/2" Max.	1" Max.	3/4" Max.
2"	100	-	-
1-1/2"	95 - 100	100	-
1"	65 - 85	90 - 100	100
3/4"	55 - 75	70 - 90	92 - 100
1/2"	-	-	68 - 86
3/8"	40 - 55	45 - 65	57 - 74
No. 4	30 - 45	31 - 47	38 - 57
No. 8	23 - 38	23 - 40	28 - 46
No. 16	16 - 30	17 - 35	20 - 36
No. 30	10 - 20	10 - 23	14 - 25
No. 50	4 - 10	2 - 10	5 - 14
No. 100	0 - 3	0 - 3	0 - 5
No. 200	0 - 2	0 - 2	- 2

2.4 CONCRETE MIXING

- A. General: In accordance with ACI 301, except as modified herein.

<b>Concrete Temperatures</b>
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Ambient Air Temperature	Concrete Member Size, Minimum Dimension			
	<12"	12"-36"	36"-72"	>72"
Minimum concrete temperature as mixed for indicated air temperature:				
Above 30 deg F	60 deg F	55 deg F	50 deg F	45 deg F
0 to 30 deg F	65 deg F	60 deg F	55 deg F	50 deg F
Below 0 deg F	70 deg F	65 deg F	60 deg F	55 deg F

Concrete Temperatures				
Ambient Air Temperature	Concrete Member Size, Minimum Dimension			
	<12"	12"-36"	36"-72"	>72"
Discontinuance of protection against cold temperatures shall be such that the drop in temperature of the concrete will be gradual and will not exceed 5 degrees F per hour. Maximum allowable gradual temperature drop in first 24 hours after curing period and after end of protection.				
-	50 deg F	40 deg F	30 deg F	20 deg F

B. Truck Mixers:

1. Equip with electrically actuated counters to readily verify number of revolutions of drum or blades.
2. Counter:
  - a. Resettable, recording type, mounted in driver's cab.
  - b. Actuated at time of starting mixers at mixing speeds.
3. Truck mixer operation shall furnish concrete batch as discharged that is homogeneous with respect to *consistency*, mix, and grading.
4. If slump tests taken at approximately 1/4 and 3/4 points of load during discharge give slumps differing by more than 2 inches when specified, slump is more than 4 inches, discontinue use of truck mixer unless causing condition is corrected and satisfactory performance is verified by additional slump tests.
5. Before attempting to reuse unit, check mechanical details of mixer, such as water measuring, and discharge apparatus, condition of blades, speed of rotation, general mechanical condition of unit, admixture dispensing equipment, and clearance of drum.
6. Do not use nonagitating or combination truck and trailer equipment for transporting ready-mixed concrete.
7. Concrete Volume in Truck:
  - a. Limit to 63 percent of total volume capacity in accordance with ASTM C94 when truck mixed.



- b. Limit to 80 percent of total volume capacity when central mixed.
- 8. Mix each batch of concrete in truck mixer for minimum 70 revolutions of drum or blades at rate of rotation designated by equipment manufacturer.
- 9. Perform additional mixing, if required, at speed designated by equipment manufacturer as agitating speed.
- 10. Place materials, including mixing water, in mixer drum before actuating revolution counter for determining number of mixing revolutions.
- 11. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

## 2.5 SOURCE QUALITY CONTROL

- A. Source Quality Control Inspection: Construction Manager shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and subcontractors, providing products included in this Section.

## PART 3 EXECUTION

### 3.1 PLACING CONCRETE

- A. Preparation: Meet requirements ACI 301, except as modified herein.
- B. Inspection: Notify Construction Manager at least 1 full working day in advance before starting to place concrete.
- C. Time of Discharge:
  - 1. Concrete shall be discharged and placed in its final position within 90 minutes from the time water and cement is added to the mix when ambient air temperature is below 80 degrees F, 75 minutes when ambient air temperature is between 80 and 85 degrees F, and 60 minutes when ambient air temperature is greater than 85 degrees F.
  - 2. Discharge time may be extended with the use of a retardant admixture. However, Contractor will be required to demonstrate that the use of retardant and the longer discharge time does not effect the quality of the concrete and meets all criteria in this specification. Concrete testing must be conducted and results

accepted by the Construction Manager before this method of delivery may be used for project facilities. This demonstration must be :

- a. with a full load from the supplier
- b. at the maximum anticipated future times for discharge
- c. at the maximum anticipated future ambient temperature.

If the actual times and temperatures are greater than the demonstration, the delivery will be rejected. A new demonstration must be completed at the greater time and /or temperature if future deliveries are required at these greater times and temperatures.

3. Concrete not placed within the specified time shall be rejected and wasted offsite at the Contractor's expense.

D. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Before depositing concrete, remove debris from space to be occupied by concrete.
3. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
4. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
5. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
6. Vertical Free Fall Drop to Final Placement:
  - a. Forms 8 Inches or Less Wide: 5 feet.
  - b. Forms Wider than 8 Inches: 8 feet, except as specified.
7. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
  - a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
8. Do not use aluminum conveying devices.
9. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
10. Joints in Footings and Slabs:
  - a. Be sure space beneath plastic waterstop completely fills with concrete.

- b. During concrete placement, make visual inspection of entire waterstop area.
  - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
  - d. Apply procedure to full length of waterstop.
- 11. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
- 12. Cure concrete as specified in Section 03900, Concrete Curing.
- E. Conveyor Belts and Chutes:
  - 1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
  - 2. Do not use chutes longer than 50 feet.
  - 3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
  - 4. Conveyor Belts:
    - a. Approved by Construction Manager.
    - b. Wipe clean with device that does not allow mortar to adhere to belt.
    - c. Cover conveyor belts and chutes.
- F. Retempering: Not permitted
- G. Pumping of Concrete:
  - 1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
  - 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
  - 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- H. Maximum Size of Concrete Placements:
  - 1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
  - 2. Locate expansion, control, and contraction joints where shown on Drawings.

3. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
  - a. Locate construction joints as shown on Drawings or where approved in joint location submittal.
  - b. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
  - c. When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
  - d. Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.

I. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: 7 days unless otherwise specified.
2. Construction Joint Between Top of Footing or Slab, and Column or Wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
3. Expansion or Contraction Joints: 1 day.
4. For columns and walls with a height in excess of 10 feet, wait at least 2 hours before depositing concrete in beams, girders, or slabs supported thereon.
5. For columns and walls 10 feet in height or less, wait at least 1 hour prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

J. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate all areas of concrete placement with special attention given in the vicinity of joints to obtain impervious concrete.

K. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
  - a. Maintain concrete temperature below 90 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
  - b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
2. Prevent differential temperature between reinforcing steel and concrete.
3. Concrete Curing: As specified in Section 03900, Concrete Curing.

L. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
  - a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
  - b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Construction Manager.
  - c. Do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
  - d. Provide heated enclosures when air temperatures are below 40 degrees F.
  - e. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
  - f. Maintain concrete at a temperature of not less than 50 degrees F for 72 hours after placement and maintain above freezing for an additional 96 hours.
  - g. Concrete being water cured shall be protected from freezing for the duration of the curing cycle or until the concrete has attained a compressive strength of 4,500 psi whichever is longer. Then after discontinuance of the water curing, concrete shall be maintained at a temperature of not less than 50 degrees F for 72 hours.
2. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.

3. External Heating Units:
  - a. Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
  - b. Vent heating units to atmosphere and do not locally heat or dry concrete. Where water cure is specified, maintain wet condition.
4. Maintain curing conditions as specified in Section 03900, Concrete Curing.

### 3.2 CONCRETE BONDING

- A. Construction Joints in New Concrete Members: Prepare surface of construction joint .
- B. Construction Joints at Existing Concrete:
  1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4 inch.
  2. Saturate surface with water for 24 hours prior to placing new concrete.

### 3.3 REPAIRING CONCRETE

- A. General:
  1. Inject cracks that leak with approved crack repair epoxy as specified in Section 03012, Concrete Repair.
  2. Repair horizontal concrete surfaces in accordance with Section 03012, Concrete Repair.
  3. Repair vertical and overhead concrete surfaces in accordance with Section 03012, Concrete Repair.
  4. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Construction Manager.
- B. Snap-Tie Holes: Unless otherwise specified, fill with approved repair material.
  1. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Alternate Form Ties, Through-Bolts:
  1. Mechanically roughen entire interior surface of through hole.
  2. Apply bonding agent to roughened surface and drive elastic vinyl plug to half depth.

3. Dry pack entire hole from both sides of plug with nonshrink grout.
4. Use only enough water to dry pack grout.
5. Dry pack while bonding agent is still tacky.
6. If bonding agent has dried, remove bonding agent by mechanical means and reapply new coat of bonding agent.
7. Compact grout using steel hammer and steel tool to drive grout to high density.
8. Cure grout with water.

D. Exposed Metal Objects:

1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1-inch and then cutting or removing metal object.
2. Repair area of chipped-out concrete as specified for defective areas.

E. Blockouts at Pipes or Other Penetrations: Where shown install in accordance with requirements of Drawings.

### 3.4 CONCRETE WALL FINISHES

A. Type W-1 (Ordinary Wall Finish):

1. Patch tie holes.
2. Knock off projections.
3. Repair defective areas and inject cracks in accordance with Section 03012, Concrete Repair.

B. Type W-2 (Smooth Wall Finish): NOT USED

1. Patch tie holes.
2. Grind off fins and other projections.
3. Repair defective areas to provide smooth uniform appearance and in accordance with Section 03012, Concrete Repair.
4. Inject cracks in accordance with requirements of Section 03012, Concrete Repair.

### 3.5 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.

2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03900, Concrete Curing.

B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
  - a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
  - b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
  - c. Do first steel troweling for slab S-1 finish by hand.

C. Type S-2 (Wood Float Finish): NOT USED

1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
2. Wood float finish to compact and seal surface.
3. Remove laitance and leave surface clean.
4. Coordinate with other finish procedures.

D. Type S-3 (Underside Elevated Slab Finish): NOT USED

When forming is removed, grind off projections on underside of slab and repair defective areas, including small shallow air pockets where schedule of concrete finishes requires:



1. Prepare surfaces to match Type W-2 (Smooth Wall Finish).
- E. Type S-5 (Broomed Finish):
1. Finish as specified for Type S-1 floor finish, except use only a light- steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
  2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.
- F. Type S-6 (Sidewalk Finish): Not Used
- G. Concrete Curbs: Not Used

### 3.6 CONCRETE SLAB TOLERANCES

- A. Slab Tolerances:
1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
  2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
  3. Slab Type S-A: Steel gauge block 5/16 inch thick.
  4. Slab Type S-B: Steel gauge block 1/8 inch thick.
  5. Slab Type S-A and S-B: Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
  6. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2 inch plus.
- B. Slab Elevation and Thickness:
1. Finish Slab Elevation: Slope slabs to floor drains and gutter. Slabs shall adequately drain regardless of tolerances.
  2. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

### 3.7 FINISHES

- A. Beam and Column Finishes
  - 1. Type B-1: Match wall Type W-1.
  - 2. Type B-2: Match wall Type W-2.
- B. Form Tolerances: As specified in Section 03100, Concrete Forming and Accessories.
- C. Schedule of Concrete Finishes:

Area	Type of Finish	Required Form Tolerances
<b>Exterior Wall Surfaces</b>		
Abovegrade/exposed (above point 6" below finish grade)	W-2	W-B
Abovegrade/covered with brick veneer or other finish material	W-1	W-A
Backfilled (below point 6" below finish grade)	W-1	W-A
<b>Interior Wall Surfaces</b>		
Covered water-holding tanks and basins/not painted or coated	W-1	W-A
Buildings, vaults, pipe galleries, and other dry areas/not painted or coated	W-2	W-A
<b>Exterior Slabs</b>		
Roof slab/exposed	S-5	S-B
Roof slab/covered with roofing material	S-1	S-A
Water-holding tanks and basins/top of wall	S-5	S-B
Top of footing	S-2	S-A
Stairs and landings	S-5	S-B
Sidewalks	S-6	S-B
Other exterior slabs	S-5	S-A
<b>Interior Slabs</b>		
Buildings, vaults, pipe galleries, and other dry areas	S-1	S-B
Hydraulic channels and basins	S-1	S-A
Underside of elevated slabs	S-3	S-A
<b>Beams and Columns</b>		
Beams/not coated	B-2	B-A

Columns/not coated	C-2	C-A
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### 3.8 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.
- B. Refer to Drawings for additional requirements.
- C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

### 3.9 FIELD QUALITY CONTROL

- A. General:
  - 1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
  - 2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
  - 3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
    - a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours or 75 cubic yards, whichever results in the greatest number of tests from the point of delivery.
  - 4. Evaluation will be in accordance with ACI 301 and Specifications.
  - 5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
  - 6. Frequency of Testing
    - a. Frequency of testing shall be a minimum of 3 samples at each placement.
    - b. Frequency of testing may be changed at the discretion of the Construction Manager.
  - 7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M, and shrinkage specimens (ASTM C157/C157M) at placement (discharge) end of line.
  - 8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample

from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified in Section 03900, Concrete Curing, by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Construction Manager.

C. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test:

1. Segregation Test Objective: Concrete shall stay together when slump tested or placed in forms.
2. Reject concrete if mortar or moisture separates and flows out of mix.

D. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
  - a. Minimum three specimens for each placement of concrete.
2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal or for prestressing.

E. Tolerances:

1. Walls: Measure and inspect walls for compliance with tolerances specified in Section 03100, Concrete Forming and Accessories.
2. Slab Finish Tolerances and Slope Tolerances:
  - a. Slab Flatness and Levelness: Make measurements within 72 hours of concrete placement.
    - 1) Flatness measurements are not applicable to unshored form surfaces or shored form surfaces after removal of shores.
    - 2) Levelness measurements are not applicable to cambered or sloped surfaces.
  - b. Slab flatness and levelness shall be determined in accordance with ASTM E1155.

### 3.10 MANUFACTURER'S SERVICES – NOT USED

- A. Provide representative at site for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.
  1. Concrete Producer Representative:
    - a. Observe how concrete mixes are performing.
    - b. Be present during first placement of each type of concrete mix.
    - c. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
    - d. Establish control limits on concrete mix designs.
    - e. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.
  2. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.
  3. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

### 3.11 PROTECTION OF INSTALLED WORK

- A. After curing as specified in Section 03900, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.
- B. Repair areas damaged by construction, using approved repair materials and approved repair methods.

### 3.12 SUPPLEMENTS

- A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification, and supplement requirements of Part 1 through Part 3 of this Section:
1. Concrete Mix Design, Class: Structural.
  2. Concrete Mix Design, Class: Concrete Fill (Not Used).
  3. Concrete Mix Design, Class: Civil (Not Used).

**END OF SECTION**

**CONCRETE MIX DESIGN, CLASS: STRUCTURAL**

- A. Mix Locations: Typical, unless otherwise specified.
- B. Exposure Categories and Classifications: F3S1P2C2.
- C. Mix Properties:
  - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
  - 2. Minimum concrete compressive strength (f'c) shall be 4,500 psi at 28 days.
  - 3. Mix design shall produce a plastic and workable mix.
  - 4. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
    - a. Slabs to receive hard-troweled finish.
  - 5. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	Air Content (%)*
3/4	6.0
1	6.0
1-1/2	5.5
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is +/- 1-1/2 percent.	

- 6. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:
  - a. Fly Ash: 15 percent minimum, 25 percent maximum.
- 7. Provide cementitious materials in accordance with one of the following:
  - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
  - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
    - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
    - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.

8. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
    - a. 500 pounds minimum cement (not including other cementitious materials).
    - b. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
    - c. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
    - d. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
    - e. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.
    - f. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
    - g. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.
  9. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
    - a. Limits are stated in terms of chloride ions in percent by weight of cement.
    - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
  10. Include crystalline waterproofing in concrete in accordance with Section 09820, Crystalline Waterproofing.
- D. Refer to Part 1 through Part 3 of this Section for additional requirements.



**CONCRETE MIX DESIGN, CLASS: CONCRETE FILL – (Not Used)**

- A. Mix Locations: Where Concrete Fill is specified in Contract Documents.
- B. Exposure Categories and Classifications: F1S1P0C1.
- C. Mix Properties:
  1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.50.
  2. Minimum concrete compressive strength (f'c) shall be 3,500 psi at 28 days.
  3. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
3/4	5.0
1	4.5
1-1/2	4.5
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is +/- 1-1/2 percent.	

4. Provide cementitious materials in accordance with one of the following:
  - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
  - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
    - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
    - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
  - a. Limits are stated in terms of chloride ions in percent by weight of cement.
  - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this Section for additional requirements.

**CONCRETE MIX DESIGN, CLASS: CIVIL (Not Used)**

- A. Mix Locations: Concrete curbs and sidewalks.
- B. Exposure Categories and Classifications: F3S1P1C2.
- C. Mix Properties:
  - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.
  - 2. Minimum concrete compressive strength (f'c) shall be 4,500 psi at 28 days.
  - 3. Mix design shall produce a plastic and workable mix.
  - 4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
1	6.0
1-1/2	5.5
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is +/- 1-1/2 percent.	

- 5. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in a mix design, as follows:
  - a. Fly Ash and other Pozzolans: 15 percent minimum, 25 percent maximum.
- 6. Provide cementitious materials in accordance with one of the following:
  - a. ASTM C150/C150M Type II.
  - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
    - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
    - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
- 7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent, unless otherwise specified.
  - a. Limits are stated in terms of chloride ions in percent by weight of cement.
  - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this Section for additional requirements.

**SECTION 03315**  
**CONTROLLED LOW STRENGTH MATERIAL (CLSM)**

**PART 1 GENERAL**

1.1 DESCRIPTION

- A. Provide and install controlled low strength material as indicated and specified.

1.2 RELATED SPECIFICATIONS

- A. Section 02310, Backfilling, and Compaction.

1.3 SUBMITTALS

- A. Submit the following shop drawings in accordance with Section 01330.
1. CLSM mix design and results of strength tests from trial mixes by the Contractor's testing laboratory firm. Minimum strength required: 50 psi.
  2. Submit manufacturer's Stable-Air Generator Admixture product data, installation instructions and recommendations for material use.
  3. Test and Performance - Submit the following data:
    - a. Any required deviations from prescribed tests and special handling instructions for test specimens.
    - b. Controlled Low Strength Material shall have a maximum strength of 200 psi according to ASTM C39 at 56 days after placement.
    - c. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a final bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4-inch per foot of depth) as measured in Section 10 of ASTM C940.
    - d. Controlled Low Strength Material shall have a unit weight of 90 - 110 lbs./ft<sup>3</sup> measured at the point of placement.

1.4 QUALITY ASSURANCE

- A. Do not place CLSM until design mix, material tests and trial batch mix compression test results are approved by the Engineer. Approvals are required at least 30 days before placing any production CLSM.
- B. Employ an independent testing laboratory, acceptable to the Construction Manager, to test conformity of materials to specifications and to design CLSM mixes.
- C. Furnish, pay for and deliver representative samples of sufficient quantity of cement, aggregates and admixtures required for trial batch mixes to the testing

laboratory. Obtain materials from the batching plant that will be supplying production CLSM in conformance with ASTM D75.

- D. Measure all materials for CLSM, including water, with equipment and facilities suitable for accurate measurement and capable of being adjusted in conformance with ASTM C94. Use scales certified by local Sealer of Weights and Measures within one year of use and accurate when static load tested to plus or minus 0.4 percent of total capacity of scale. Batch all materials by weight except admixtures that may be batched by volume. Provide certification the cylinder break machine is calibrated for breaks strengths between 50 and 200 psi.
- E. The testing laboratory shall take control test specimens and conduct slump tests and temperature measurements in the field.
- F. Methods of Sampling and Testing:
  - 1. Fresh Concrete Sampling: ASTM C172.
  - 2. Specimen Preparation: ASTM C31.
  - 3. Compressive Strength: ASTM C39.
  - 4. Slump: ASTM C143.
  - 5. Temperature: ASTM C1064.
  - 6. Unit Weight: ASTM C138.

#### 1.5 DELIVERY STORAGE AND HANDLING

- A. Order CLSM from batching plant so that trucks arrive at discharge locations when material is required.
- B. Deliver CLSM to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, temperature and homogeneity.
- C. Reject CLSM not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket

#### 1.6 PROJECT/SITE CONDITIONS

- A. Do not place CLSM until conditions and facilities for making and curing control test specimens are in compliance with ASTM C31 and as specified herein.

## **PART 2      PRODUCTS**

### **2.1      MATERIALS**

- A.      CLSM shall consist of a mixture of Portland cement, aggregate, fly ash, water, and admixtures conforming to the following:
1.      Portland Cement
    - a.      Furnish Portland cement conforming to ASTM C150, Type II (or Type II/V) unless otherwise specified, maximum of 50 lb/cy.
    - b.      Use one approved brand from one mill throughout the contract term unless otherwise approved by the Engineer.
  2.      Proportion the CLSM to be a flowable, non-segregating, self-consolidating non-shrink slurry. The water content shall not exceed that required to provide a mix that will flow, can be pumped, and will maintain the soil in suspension without segregation of the aggregate while being placed. Proportion the aggregate, cement, and water either by weight or by volume. Use as little cement for each cubic yard of material produced as necessary to make the CLSM flowable. Flowability shall be verified by visual inspection during placement that there are no voids in the CLSM.
  3.      Bedding Zone CLSM: Flowability shall be a minimum of 8 inches per ASTM D6103.
  4.      Water
    - a.      Use water that is clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances, and conforms to the requirements for water in ASTM C94, and as specified herein.
    - b.      The maximum water-soluble chloride ion in the water shall not exceed 0.060 percent by weight of cement.
    - c.      The water-cement ratio shall not exceed .28
  5.      Aggregates
    - a.      Use aggregates for CLSM conforming to ASTM C33 and to the following requirements:
    - b.      The aggregate must conform to the following gradation:

Sieve Size	Percentage Passing
<b>1 1/2 inches</b>	<b>100</b>
<b>1 inch</b>	<b>80 to 100</b>
<b>3/4 inch</b>	<b>60 to 100</b>
<b>3/8 inch</b>	<b>50 to 100</b>
<b>No. 4</b>	<b>40 to 80</b>
<b>No. 100</b>	<b>10 to 40</b>

6. Admixtures
  - a. General Requirements: ASTM C494.
  - b. Red dye for all electrical and communication conduit in CLSM separate from pipe trench.
7. Fly Ash: Provide fly ash conforming to the following requirements
  - a. Class F fly ash conforming to ASTM C618 for chemical and physical properties.
  - b. Supplemental requirements in percent:
 

(1) Maximum carbon content	3 percent
(2) Maximum sulfur trioxide (SO <sub>3</sub> ) content	4 percent
(3) Maximum loss on ignition	3 percent
(4) Maximum water requirement (as a percent of control)	100 percent
(5) Fineness, maximum retained on No. 325 sieve	25 percent

## 2.2 MIXES

- A. Mix design shall produce a consistency that will result in a flowable product at the time of placement that does not require manual means to move it into place.
- B. Provide mix with compressive strength of maximum 200 psi when measured 56 days after placement
- C. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a Final Bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4-inch per foot of depth) as measured in Section 10 of ASTM C940 “Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory”.
- D. The fresh unit weight shall be 90 - 110 lbs./ft<sup>3</sup>, except where specified, and in the absence of strength data the cementitious content shall be a maximum of 150 lbs./cy.



## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Refer to Section 02310 for placement of CLSM.

### **3.2 TRANSPORTING AND MIXING**

- A. Conform to concreting procedures set forth in ACI 304R and as specified herein.
- B. Transport CLSM to discharge locations without altering the specified properties of water-cement ratio, slump, temperature and homogeneity.
- C. On-site batching is permitted.

### **3.3 FIELD TESTING**

- A. General
  - 1. The testing laboratory shall use CLSM samples taken at the point of agitator or mixer truck discharge to perform slump, and temperature tests and for field control test specimens.
- B. Notification of Delivery
  - 1. Notify the Engineer of CLSM deliveries a minimum of 48 hours in advance of the scheduled placement. Include within this notification, the mix design and quantity of CLSM, method and location of placement, frequency of trucks, ordered slump and time of initial delivery.
  - 2. Furnish delivery batch ticket to the representative from the owner's testing laboratory or to the Engineer representative in the field with each batch delivered to the discharge locations in conformance with ASTM C94.
- C. Test Measurements at Discharge
  - 1. The testing laboratory firm shall take measurement of CLSM slump, and temperature for each 50 linear yards along pipe of each mix design but not less than once a day. After consistent demonstration of meeting requirements, the Construction Manager may relax testing requirements. The laboratory shall conduct the slump, air content and temperature test measurements in conformance with ASTM C143, ASTM C231, and ASTM C1064, respectively.
  - 2. The testing laboratory shall submit test reports of field measurements specified above to the Contractor and to the Engineer.
- D. Control Test Specimens
  - 1. The testing laboratory shall cast a minimum of one set of three field control test specimens in conformance with ASTM C31 for each 50 linear

yards along pipe of each mix design of CLSM but not less than once a day. Construction Manager may relax requirement after specifications have been consistently met.

2. Laboratory personnel shall record truck and load number from the delivery batch ticket, the CLSM placement location of each specimen, the date, CLSM strength, slump, temperature and truck driver's name.
3. Furnish tightly constructed nonabsorbent test cylinder molds. Use molds of same type and manufacture for all test specimens. Leave molds on cylinders until received in testing laboratory.
4. Furnish boxes for initial curing of test cylinders in conformance with ASTM C31 from time of casting until they are transported to the testing laboratory.
5. The testing laboratory shall compression test one of each set of three specimens at seven days. Immediately notify the Contractor and the Engineer if the seven-day strength is deficient (too high or too low). Test the two remaining cylinders at 28 days for CLSM strength acceptance. The acceptance test result is the average of the strengths of the two specimens tested at 28 days. The laboratory firm shall submit compression test results of the control test specimens to both the Contractor and the Engineer. Evaluation and acceptance of CLSM shall conform to ACI 301 and ACI 318.
6. The unconfined compressive strength at seven days shall be minimum of 50 psi and a maximum of 150 psi per ASTM D4832.

### 3.4 CURING AND PROTECTION

- A. Protect CLSM from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain CLSM with minimal moisture loss at relatively constant temperature.
- B. Perform cold weather concreting in conformance with ACI 306.1, when the ambient atmospheric temperature is 40 degrees F or below.
- C. Protect Controlled Low Strength Material from traffic until sufficient strength has been achieved for further construction operations.

**END OF SECTION**

**SECTION 03900  
CONCRETE CURING**

**PART 1 GENERAL**

1.1 WORK INCLUDED

- A. This Section includes requirements for the curing of cast-in-place concrete construction.

1.2 RELATED WORK

- A. Section 02001, References.
- B. Section 03012, Concrete Repair.
- C. Section 03300, Cast-in-Place Concrete.
- D. Section 03600, Grout.

1.3 SUBMITTALS

- A. Action Submittals:
  - 1. Manufacturer's data indicating compliance with the requirements specified herein for the following products:
    - a. Evaporation retardant.
    - b. Curing compound.
  - 2. Curing methods proposed for each type of element such as slab, walls, beams, and columns in each facility.
- B. Informational Submittals:
  - 1. Manufacturer's Certificate of Compliance for the following:
    - a. Curing compound showing moisture retention requirements.

**PART 2 PRODUCTS**

2.1 MATERIALS

- A. Curing Compound:
  - 1. Water-based, high-solids content, non-yellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
  - 2. Manufacturers and Products:
    - a. BASF Construction Chemicals, Shakopee, MN; Kure 1315.

- b. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
- c. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
- d. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
- e. Dayton Superior; Safe Cure and Seal 1315 EF.

B. Evaporation Retardant:

- 1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
- 2. Manufacturers and Products:
  - a. Master Builders Co., Cleveland, OH; Confilm.
  - b. Euclid Chemical Co., Cleveland, OH; Eucobar.
  - c. Dayton Superior; Aquafil J74

C. Water: Clean and potable, containing less than 500 ppm of chlorides.

### **PART 3 EXECUTION**

#### **3.1 CONCRETE CURING**

A. General:

- 1. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures. Refer to Interior Finish Schedule for surfaces to receive coatings.
- 2. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by the Construction Manager prior to placing concrete.
- 3. As required in Section 03300, Cast-in-Place Concrete, if result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified below, by 7 additional days.

B. Use one of the following methods as approved by the Construction Manager:

- 1. Walls:
  - a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
  - b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 7 days starting immediately after removal of forms.
  - c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.
- 2. Slabs and Curbs:

- a. Method 1: Protect surface by water ponding for 7 days.
- b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.
- c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for 7 days.
- d. Method 4: Continuously sprinkle exposed surface for 7 days.
- e. Method 5: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

### 3.2 CURING COMPOUND APPLICATION

- A. Apply in accordance with manufacturer's instructions.
- B. Apply two coats, with the second coat applied perpendicular to the first. Each coat shall have sufficient thickness to satisfy water retention for a single coat.
- C. Reapply as needed and as directed by the Construction Manager.

### 3.3 EVAPORATION RETARDANT APPLICATION

- A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface. Do not use evaporation retardant on potable water structures, unless product is NSF 61 approved.
- B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.
- C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

### 3.4 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site as required by the Construction Manager for installation assistance, inspection, and certification of proper installation for products specified.
- B. Provide curing compound manufacturer's representative to demonstrate proper application of curing compound.

END OF SECTION

**SECTION 05530  
METAL GRATING - CATWALK**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Provide metal grating indicated and in compliance with Contract Documents.
- B. This section includes:
  - 1. Aluminum Bar Grating.
- C. Furnish all labor, materials, equipment and incidentals necessary to install the products specified.

**1.2 RELATED SPECIFICATIONS**

**1.3 DESIGN CRITERIA**

- A. Grating
  - 1. Provide grating meeting the design live load of adjacent floor area but not less than a uniform live load of 100 psf or a concentrated load of 300 pounds over a 12 inch area at the center or span, whichever produces the greatest stresses.

**1.4 SUBMITTALS**

- A. Submit the following shop drawings.
  - 1. Detail shop drawings indicating:
    - a. Dimensions.
    - b. Sectional assembly.
    - c. Location and identification mark.
    - d. Connections and fastening methods.
    - e. Size and location of supporting frames required.
    - f. Materials of construction.
    - g. Installation instructions.
  - 2. Catalog data and design tables showing limits for span length and deflection under load.

**1.5 QUALITY ASSURANCE**

- A. Comply with the requirements from manufacturer. Do not allow contact with mild steel features of the project.
- B. Obtain field measurements prior to preparation of shop drawings and fabrication.

- C. Aluminum:
  - 1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as accepted and in accordance with recommendations of AWS D1.2.

## 1.6 DELIVERY STORAGE AND HANDLING

- A. Store to avoid damage.
- B. Remove material that has become damaged as to be unfit for use.
- C. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

## 1.7 FIELD MEASUREMENTS

- A. Verify dimensions and make any field measurements necessary and be fully responsible for accuracy and layout of the work.
- B. Review the Contract Drawings and report any discrepancies to the CM for clarification prior to starting fabrication.

## **PART 2 PRODUCTS**

### 2.1 ALUMINUM BAR GRATING

- A. Manufacturers:
  - 1. IKG Borden Metal Products Co.; Type B.
  - 2. Ohio Gratings, Inc.; Type SG Series.
  - 3. McNichols Co.; GAL Series.
- B. Provide aluminum alloy 6063-T6 grating material.
- C. Provide 3/16-inch thick bearing bars spaced 1-3/16-inch center to center with cross bars pressure locked on 4 inch centers.
- D. Fabricate in standard size sections where possible with a maximum panel weight of no more than 80 pounds.
- E. Apply bearing bar banding at ends of grating sections and at fixture or pipe openings where two or more bearing bars are cut.
- F. Anchor grating to support members using stainless steel removable fasteners.
- G. Provide serrated top surface with mill finish.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Upon receipt of material at job site, inspect all materials for shipping damage. Damaged items shall be replaced at no cost to Owner.
- B. Examine supports for size, layout, and alignment. Surface shall be free of debris.
- C. Correct defects considered detrimental to proper installation.

### **3.2 PROTECTION**

- A. Protect aluminum from contact with dissimilar metals, concrete, masonry, or mortar. Paint aluminum in contact with concrete. Under no circumstances shall aluminum contact concrete or dissimilar metal.
- B. Apply one coat of bituminous paint coating.
- C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot water and dry thoroughly.

### **3.3 INSTALLATION**

- A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.
- B. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.
- C. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

**END OF SECTION**



## SECTION 11296

### AUTOMATIC FLUME CONTROL GATES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section includes:

- 1 Requirements for designing, furnishing, installing, testing and training on the operation and maintenance of the Automatic Flume Control Gate. Automatic Flume Control Gate consists of the motorized Flume gate, level sensors, batteries, automatic controller and an operator interface all within a suitable control enclosure, and *radio/solar mast*.
- 2 The Control Enclosure shall be rated for outdoor service and protect against vandalism and environment typical of irrigation systems. It shall house the batteries, charging subsystem, internal control circuitry, the interface to the ultrasonic level sensors, a pre-programmed logic processor (RTU), *cellular modem, and data logger*, and the operator interface. The enclosure shall include louvered vents and filters as necessary to withstand high ambient temperatures and wind borne dust.
- 3 Flume gates shall be furnished complete with external (primary) frame, water tight seals, aluminum composite laminate gate panel assembly, wire rope and drum drive system with positive drive in both directions, self-locking worm reduction gearbox, 12-volt DC actuator with 256 count encoder and all required accessories for a complete field installation.
- 4 Manufacturer's representative shall provide on-site supervision during installation of the exterior frame and gate. Manufacturer's representative shall provide inspection, calibration, startup, functional testing, and training in the operation and maintenance of the Automatic Flume Control Gate.

###### B. Related sections include but are not necessarily limited to

- 1 0300 Bid Form.
- 2 01010 Summary of Work.
- 3 01025 Measurement and Payment
- 4 01300 Submittals
- 5 03300 Cast-in-place Concrete.

##### 1.02 MEASUREMENT AND PAYMENT

###### A. Measurement

1 Measurement of Automatic Flume Control Gates will be made by the each.

B. Payment

- 1 Payment for the accepted quantities will be made at the Contract unit price shown in the bid schedule and shall be full compensation for work prescribed in this Section and include training of Owner's personnel and functional testing.
- 2 Payment will be made under

***Item 6 Flume Gate 6'-4" Wide by 7'-0" High***

1.03 QUALITY ASSURANCE

A. Referenced Standards

- 1 American Bearing Manufacturer Association (ABMA).
- 2 American Gear Manufacturer Association (AGMA).
- 3 American Institute of Steel Construction (AISC).
- 4 American Society for Testing and Materials (ASTM)
  - a. A36, Standard Specification for Carbon Structural Steel.
  - b. A48, Standard Specification for Gray Iron Castings.
  - c. A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
  - d. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - f. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - g. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - h. A240, Standard Specification for Heating-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
  - i. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
  - j. A663, Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
  - k. B21, Standard Specification for Naval Brass Rod, Bar, and Shapes.
  - l. B98, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
  - m. B418, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
  - n. D395, Standard Test Methods for Rubber Property-Compression Set.
  - o. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
  - p. D471, Standard Test Method for Rubber Property-Effect of Liquids.
  - q. D572, Standard Test Method for Rubber-Deterioration by Heat and Oxygen.
  - r. D2000, Standard Classification System for Rubber Products in Automotive Applications.
  - s. D2240, Standard Test Method for Rubber Property-Durometer Hardness.

- t. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- u. F594, Standard Specification for Stainless Steel Nuts.

5 American Welding Society (AWS).

6 National Electrical Manufacturers= Association (NEMA).

B. Manufacturer's Qualifications

- 1 Provide proof of similar project installations that have operated successfully for a period of not less than 10 years. Provide project photos, Owner references, and project descriptions for at least 5 similar projects. Manufacturer's not able to provide acceptable quality assurance will not be allowed.
- 2 Manufacture of the Automatic Flume Control Gate shall be carried out in accordance with an ISO 9001:2000 accredited Quality System.

1.04 SUBMITTALS

A. See Sections *[reference appropriate Division 0 sections; example: 01340 and 11005]*.

- 1. Submit all items listed for Engineer's approval at least 21 days prior to gate fabrication.

B. Shop Drawings

- 1. Submit 2 sets of drawings that do not exceed 11"x 17" in size that clearly show at a minimum all connection details, gate dimensions, materials, elevations, and fasteners required for complete construction.

C. Design Calculations

- 1. Submit 2 sets of complete structural calculations on 8-1/2 " x 11" sheets. Calculations for gate and operators shall include at a minimum design loads and load diagrams, stress analysis, structural member sizing and all referenced standards.

D. Operation and Maintenance Manuals

- 1. Submit 2 sets of O&M Manuals.

E. Installation Guidelines

- 1. Submit 2 sets of manufacturer's complete installation guidelines.

F. Written Warrantee

- 1. Provide a written warrantee to the Owner, signed by both the manufacturer and the Contractor. The warrantee shall state that the Automatic Flume Control Gates shall be free of all

manufacturers' defects for a time period of not less than 12 months from the date of gate calibration. All manufacturers' defects occurring during this time period shall be repaired at no additional cost to the Owner. Submit the warrantee to the Owner 21 days prior to substantial completion.

G. Submit product data sheets and applicable test data for all materials.

## PART 2 - PRODUCTS

### 2.01 DESIGN PARAMETERS

- A. The Flume gate leaf, hinge system, and drive system shall be designed to withstand a water surface level with the top of the gate with the gate in the closed position. The manufacturer shall identify the intermediate position of the gate resulting in the greatest loading on the gate and base the design on this loading.
- B. The Flume gates shall be designed to withstand an upstream water depth equal to the vertical height of the gate when the gate is in the fully closed position and a zero downstream water depth. Maximum deflection of the gate leaf and side panels shall be no greater than the requirements of AWWA C513-97.
- C. All gate panels shall be subjected to Finite Element Analysis using the ANSYS FEA system and the design life of the panels shall be 30 years. Design loads placed on the gate panel assembly shall not induce stresses in excess of those specified in AS1664 specification for structural aluminum. Wire ropes, rope drums, hinge pins and drive shafts shall all be designed to withstand design maximum loads with factors of safety conforming to applicable USA Standards

### 2.02 MATERIALS

- A. The Flume gate shall be manufactured in accordance with manufacturing drawings. Key component materials shall be as follows: -

External (Primary) Frame:	Aluminum extrusion, grade 6351 T5
Gate Panels:	Skin Plates to be aluminum sheet, grade 5083 H321 or 5052. Extrusion to be Aluminum grade 6351 T5 and 6060 T581 (rope guides only).
Control Enclosure and Mast:	Aluminum extrusion, grade 6351 T5 or 6061 T6.
Wire ropes:	Stainless steel, grade 304, 7 x 19.
Worm gearbox output shaft:	Stainless steel, grade 431 or grade 316.
Gate Hinge Pins:	Stainless steel, grade SAF 2205.
Wire rope drums:	Acetyl co-polymer.

Seals:	EPDM, Duro Hardness 50.
Fasteners:	Stainless steel, grade 316.
Primary Frame Anchors:	Stainless steel, grade 316, Ultimate Tensile Strength 700 MPa, Yield Strength 450 MPa

### 2.03 GATE PANEL ASSEMBLY

- A. Gates shall be fully closed when gate leaf is at approx 60 degrees from horizontal.
- B. The gate panel assembly shall consist of a gate leaf panel and two side (quadrant) panels, interlocked together to form one composite panel assembly. The panels shall comprise two outer aluminum skin plates adhesively bonded to an internal core material. The structural perimeter members of the panels shall be extruded aluminum sections, adhesively bonded to both the internal core material and the outer skin plates. The thickness of the skin plates, the material type and thickness of the core, the size of the perimeter members and the type and thickness of the adhesive bond shall all be determined as a result of the design analysis carried out as described in 3.1 above.
- C. The gate panel assembly shall be housed in a extruded aluminum Internal Frame, featuring inherent stilling chambers designed to accommodate upstream and downstream water level instrumentation. The gate panel assembly shall be supported in the Internal Frame by grade SAF 2205 stainless steel hinge pins and acetyl bushes.

### 2.04 SEALS

- A. The seals shall be extruded from EPDM, with rated hardness 50 Duro. The Seals shall be continuous and fitted to the internal frame of the Flume gate, extending along the full perimeter of the outer and underside of the gate panel assembly. The seals shall be water tight per the requirements of AWWA C513-97.

### 2.05 EXTERNAL (PRIMARY) FRAME

- A. An extruded aluminum primary frame shall be anchored to the concrete structure of each regulating bay. The frame shall be anchored in accordance with manufacturer's installation instructions. The primary frame shall be the receptacle for the Flume gate, which shall slide into the frame and lock into position in the frame. The primary frame shall be installed prior to filling the canal.

### 2.06 FASTENERS

- A. All anchor bolts, assembly bolts, screws, nuts, etc., shall be of ample size to safely withstand the forces created by operation of the gate under the specified head. Quantity, type, and size of fasteners shall be as recommended by the manufacturer. Anchor bolts shall be provided with two nuts each to facilitate installation. Fasteners shall be stainless steel, unless otherwise shown on the Drawings.

## 2.07 DRIVE

- A. The drive system shall be comprised of two 7 x 19, grade 304 stainless steel Wire ropes and acetyl rope drums. The rope through each rope drum shall be continuous and be fixed to the gate side panel at the gate lip end of the rope guide and at the front (upstream end) of the rope guide. Each rope shall be pre-tensioned during gate manufacture to ensure minimal stretching in field. The wire rope and drum mechanism shall be actuated by a 12 volt DC electric motor, self-locking worm reduction gearbox and stainless steel drive shaft. The drive shaft shall be supported at both ends by a bearing block that is housed in the machined aluminum plates

## 2.08 GATE ACTUATION

- A. The gate motor, planetary gearbox, brake and encoder shall be coupled in a modular system and provided by a single manufacturer. The motor shall be a permanent magnet (electronically commutated) DC type.
- B. The 256 count digital incremental encoder shall be utilized to generate circuit pulses by which motor shaft rotation(s) can be detected and counted. Combined with the positive drive mechanism that moves the gate Flume leaf both up and down, the encoder shall measure position of the gate to within  $\pm 1.0$  mm.

## 2.09 Power Supply

- A. The Automatic Flume Control Gate with all components shall derive all power from the included sealed lead-acid batteries. Charging source shall be either solar or third party line power.
- B. Solar Option: The Automatic Flume Control Gate shall be designed such that the power requirements of the actuator, communication device and all electronic components can be met with an 85 -140 watt solar panel (dependent on motor design). The solar panel shall carry warranties on power output as follows: 25-year warranty of 80% power output, 10-year warranty of 90% power output, and a 5-year limited warranty of materials and workmanship. The solar panel shall be mounted on a 15 feet mast that is fitted into and alongside the Control Enclosure. The mast shall be securely fastened to the Control Enclosure with hinge pins that when removed will allow the mast to pivot down for maintenance.

## 2.10 CONTROL ENCLOSURE

- A. The Control Enclosure shall be designed to mount directly on the gate or optionally on a concrete maintenance pad within 15 feet of the gate. The Control Enclosure shall include a lower “pedestal” to contain and protect the batteries, and an upper accessible controller housing. Access to the operator interface shall be via a lockable hinged cover plate. Both cover plate and controller housing shall be gasket sealed to the pedestal to prevent exposure to the weather. The pedestal portion of the Control Enclosure shall include a louvered vent with filter to allow heat dissipation and protection against wind borne dust. The electronics in the controller housing provides power and control of the gate and shall include the following components:

1. Pre-programmed Remote Telemetry Unit (RTU): RTU shall be pre-programmed to provide the functionality described in paragraph 2.10 CONTROLS. The RTU shall support at

minimum three interface ports. Port 1 to be used to maintain an internal communications network with the level sensors, regulator board and motor encoder. Internal network to be Modbus RS-485. Port 2 is to be used for programming functions and shall support serial RS 232 connections with data speeds up to 57.6 kbps. Optionally, Port 2 shall be configurable to support connection to a data logger. Port 3 shall provide bi-directional communications to an internal or external data radio. Port Real-time data available over Port 2 and Port 3 include is listed in Attachment A.

2. Batteries: Batteries shall have capacity to provide for normal automatic gate operations and communications for up to 5 days. In cyclic application the batteries shall be guaranteed to perform 400 x 100% charge and discharge cycles, at the end of which 60% of the batteries rated capacity is left. Note that the requirements of the Power Management functionality as noted below shall generally keep the battery within its float voltage range during the spring to autumn months of the irrigation season, and that the power management system shall feature a low-power hibernate mode for the winter months, such that the batteries will rarely be subjected to deep discharge. Batteries (2 or 3 as required per communications option selected) shall be Panasonic 12-volt, 28 amp-hour batteries or equivalent.
3. Power Management Subsystem: The gate shall be provided with a comprehensive power management subsystem. The technology of this subsystem shall provide solar regulation algorithms that have been developed in conjunction with the battery manufacturer's specifications. The battery charger feature shall utilize a temperature sensor to be fitted to the battery terminals to factor the battery temperature into the charging regime. The technology shall provide extensive solar regulation parameter monitoring, such that the health of the battery and solar panel can be accurately monitored over time. The Power Management subsystem shall also provide managed and alarmed load-shedding functionality to reduce the power consumption of the gate during periods of supply power outage. As the battery voltage drops below configurable thresholds, the motor drive circuitry shall be first disabled, followed by the radio/communications device, then the sensors to minimize power consumption. When power is restored, then the circuits are re-activated – sensors first, then radio/communications device, then motor. All of the system shut-down and turn-on voltage parameters shall be user configurable, with default values pre-selected based on manufacturer's system performance testing. The Power Management functionality shall be provided by the SolarDrive™ board developed by Rubicon.
4. Motor Control and Protection Subsystem: The gate shall be provided with motor controller functionality to ensure reliable gate movement and long motor life. The motor controller shall use MOSFET based solid state switching and not rely on electro-mechanical relays. The motor controller shall provide soft starting, real-time continuous current monitoring and over-current protection, and pulse-width-modulation frequency adjustment for torque monitoring and control. Motor control and protection functionality shall be provided by the SolarDrive™ board developed by Rubicon.
5. Operator Interface: Data shall be displayed and controls entered locally using a four line by twenty character LCD display and six-button tactile keypad which shall be integral to the controller housing and is protected by a lockable cover. All cabling and electrical connections for this display shall be integral to the controller housing with no field wiring or termination

required. The display shall provide at minimum the following basic information. Additional system level, calibration and configuration data shall be available when performing maintenance:

Site Name	Communications Network ID
Instantaneous Flow Rate	Volume delivered since last reset
Upstream & Downstream Measured Level	Local/Remote Status & Selection
Control Mode Selection	Level & Flow Setpoints
Local Manual Control (gate position)	Irrigation Emergency Stop
Full System Self-Test and Diagnostic Information	

6. ***[Optional - Radio, Cellular Modem, or Data Logger: include hardware specification and functional description if included with gate. Name manufacturer, model number] :***

## 2.11 CONTROLS

- A. Local Controls: The pre-programmed RTU shall provide both controls to both manually position the gate and automatically move it to achieve a desired (entered set point) upstream level or through flow. When place in LOCAL MANUAL control mode, the gate will move to a position entered by the operator. When placed in LOCAL AUTO control mode, the operator can select either Upstream Level Control or Flow Control and enter the desired set point. When set in REMOTE control Mode, if a SCADA system is connected to the gate, the operator shall have all the same capabilities to control the gate from a remote location.
- B. Network Controls: Network Control is only available when used with other Rubicon gates and with the Rubicon NeuroFlo™ network control software. There are two automatic control modes available:
  - 1. DEMAND Mode: The gate will automatically adjust to provide a through flow to match the actual demand in the network below the gate while maintaining a stable downstream water level.
  - 2. SUPPLY Mode: The gate will automatically adjust to provide a through flow to match the flow provided by the network above (upstream) of the gate while maintaining a stable upstream water level.

## 2.12 SENSORS

- A. Level Sensors: The ultrasonic level sensors shall be housed in the gate internal frame which will act as stilling wells and protect sensor performance from debris, foam, silt and other contaminants.



The sensors shall be easily accessible for removal and cleaning. The sensors will self-calibrate on every reading to eliminate drift in speed of sound variations due to changes in temperature or humidity. The gate and internal frame shall accommodate optional redundant sensors.

### 2.13 FLOW CALCULATION

- A. The Automatic Flume Control Gate shall be supplied with flow measurement software that calculates instantaneous discharge and accumulated volumetric discharge. The accuracy of the gate as a flow measurement device shall be supported by evidence of flow testing against certified flow meters and by expert independent assessment (accuracy of  $\pm 2.5\%$  in the lab, and 5% in the field).

### 2.14 SHOP ASSEMBLY

- A. Except for the seals, the Flume gates shall be completely assembled in the shop to ensure that all parts fit and that the required dimensions and tolerances have been obtained. Assemble the gates in the normal position as shown on the Drawings.

### 2.15 SPARE PARTS

- A. Provide the following spare parts for each size gate:
  - 1 One set of ultrasonic level sensors.
  - 2 One solar drive board.

### 2.02 MANUFACTURERS

- A. Rubicon Systems America
- B. No other systems will be acceptable.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install Flume gate, hoists, and accessories in accordance with Section *[edit as necessary, example: 11005 and 15050]* and with manufacturers' guidelines and in accordance with the Drawings.
- B. Installation shall adhere to applicable requirements in *[edit as necessary, example: 15050]*, unless otherwise required in this Section.
- C. After installation, the actuator and drive components be cleaned, lubricated and serviced in accordance with the manufacturer's instructions.
- D. Installation of both the external (primary) frame and the Flume gate shall be carried out in a professional and workmanlike manner and in strict accordance with the installation procedures supplied by the manufacturer. Personnel engaged in the installation shall receive instruction by the manufacturer or its nominated representative, in the interpretation of the installation procedures

prior to performing the installation.

- E. In addition to other times required in this and other Sections, a manufacturer's representative shall be on site at all times during installation of the Flume gate and all its component parts including anchorages and frames.

### 3.02 FIELD TESTING

- A. Field testing shall be performed in the presence of the Engineer. Notify the Engineer of the proposed tests to be performed a minimum of 7 days before the tests are scheduled to begin.
- B. The gate manufacturer shall provide a representative for the field testing and inspection of the gates.
- C. Alignment Test
  - 1 Check gates and hoist alignment by operating gate from fully open to fully closed position. The gate should travel with no apparent racking and/or binding.
  - 2 Gate position shall be verified to be accurate to within  $\pm 1$ mm.
  - 3 Water Level sensors shall be verified by bringing the gate position to the measured water elevation and visually inspected. Flume
- D. Manufacturer shall submit written documentation verifying all testing and that the Flume gates are acceptable for complete operation.

### 3.03 TRAINING

- A. Training shall adhere to requirements in *[example: Section 01630]*.

## PART 4 - ACCEPTANCE

- 4.01 Acceptance of materials and products will be based on Certificate of Compliance and proper installation in accordance with *[example: Section 01630]*.
- 4.02 Acceptance of Work will be based on Visual Inspection and Measured or Tested Conformance.

END OF SECTION

**SECTION 11298**  
**TYPICAL SPECIFICATIONS FOR RADIAL GATES**

**PART 1 GENERAL**

**1.01 SCOPE OF WORK**

- A. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the engineer.

Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete and properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of radial gates.

- B. Unit Responsibility: To insure compatibility of all components directly related to the radial gates, unit responsibility for the radial gates and accessories as described in this section shall be the responsibility of the radial gate manufacturer unless specified otherwise.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with Sections 01300, and as specified herein. Submittals shall include as a minimum:
1. Submittal Drawings.
  2. Manufacturer's operation and maintenance manuals and information.
  3. Manufacturer's installation certificate.
  4. Manufacturer's equipment warranty.
  5. Design calculations demonstrating lift loads and deflection in conformance to the application requirements. Design calculations shall be approved by a licensed engineer (PE) and shall be available upon request.

**1.03 QUALITY ASSURANCE**

- A. Qualifications
1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years of experience designing and

manufacturing fabricated radial gates. The manufacturer shall have manufactured radial gates of the type described herein for a minimum of 20 similar projects.

2. The project design is based on the Waterman Radial Gate as manufactured by Waterman Valve of Exeter, California. Proposed alternates must be pre-approved, per addendum, at least 14-days prior to close of bid. Requests for alternates must be supplemented with detailed drawings, specifications, and references. Any/all additional costs for engineering structure modifications or other changes associated with utilizing a brand other than Waterman are to be borne by the contractor.
3. To insure quality and consistency, the radial gates listed in this section shall be manufactured and assembled in a facility owned and operated by the radial gate manufacturer. Machining and performance verification of the gates shall be in a U.S. facility. The client may verify/view the manufacturing process at the facility. Third-party manufacturers contracted for fabrication and assembly of the radial gates will not be permitted.

## PART 2 EQUIPMENT

### 2.01 GENERAL

- A. The radial gates and appurtenances shall be in accordance with the requirements of this specification.
- B. Applicable specifications listed below are for the alloy, grade, type or class of material and the condition and finish appropriate to the structural and operational requirements.

C. Materials:

COMPONENTS/MATERIALS	ALLOY/GRADE/TYPE/CLASS
Cast Iron	A48 – Class 30 ASTM A126 Class B
Structural Steel Shapes, Plates and Bars	ASTM A36
Carbon Steel Bars	A108, A575 or A311
Stainless Steel	A276 A240 Type 304, 304L, 316, 316L
Bronze Bar, Rods and Shapes	ASTM B98 or B21, PermalubeBronze
Steel Assembly Hardware	A307
Stainless Steel Assembly Hardware	ASTM F-593, F-594
Galvanizing	A123 or A153

2.02 GATE FACE ASSEMBLY

- A. The face assembly shall consist of horizontal structural members, vertical stiffeners and a curved face plate. Horizontal structural members shall be of adequate size and so located to transmit the thrust from the face of the gate to the radial arms. Design loads placed on the structural reinforcing channels shall not induce stresses in excess of those specified in Section 1.51.4 of AIS Specification for Structural Steel Builders. Minimum ¼ in thick, curved face plate shall be attached to the structural by welding. Sufficient holes shall be located around the perimeter of the assembly for attaching the seals.
- B. Each gate shall be fitted with rubber seals retained by stainless steel bars, along the side and bottom edges of the gate face. The seals shall be of the belt type or “J” type, as specified, and shall be designed to bear on the walls and bottom of the structure or on rubbing plates and sills to insure a water-tight fit when the gate is close. On breastwall gates, a rubber seal shall also be provided at the top edge of the gate.

### 2.03 RADIAL ARMS

- A. The radial arm assemblies shall consist of structural members welded to a pin plate and drilled to match gusset plates welded to the structural members of the face assembly. The slenderness ratio of the radial arms shall not exceed 150. Bolts for field assembly shall be provided.
- B. A steel pin plate shall transmit the load from the radial arms to the pivot pin collar which shall be welded to the pin plate to distribute the bearing load on the pin. The collar shall be matched drilled with the pivot pin.

### 2.04 PINS AND PIN BEARINGS

- A. The stainless steel pivot pins shall be sized to transmit the load to the pin bearings. They shall be bolted to the pin plate collar for field assembly.
- B. Permanently lubricated (grease lubricated) bronze bearings encased in cast iron / steel housings shall extend into the concrete and have sufficient surface area to properly distribute the full load to the structure. The bearings shall be bored full length for a running fit with the pivot pin.

### 2.05 SIDE SEAL RUBBING PLATES

- A. A stainless steel rubbing plate shall provide a smooth contact surface for the side seals throughout the full range of movement of the gate. The rubbing plates shall be adjustable on the anchor bolts to permit vertical alignment of the contact surfaces. Plates shall extend to top of wall or minimum on gate height above the gate top in the closed position. Rubbing plates shall be ¼ inch by 6 inch minimum size.

### 2.06 BOTTOM SILL PLATE

- A. A stainless steel bottom sill plate shall provide a smooth, level contact surface for the full width of the invert of the gate. The sill plate shall be adjustable on anchor bolts to permit leveling, and alignment with side rubbing plates. Size of bottom sill plates shall be the same as the side rubbing plates.

### 2.07 WELDING

- A. Manual welding operators performing welding operations on these gates and accessories shall be qualified under the “Standard Qualification Procedure” of the American Welding Society. All welds shall have complete fusion with the base metal and shall be free from cracks, oxides, slag inclusions and gas pockets.

## 2.08 RADIAL GATE HOISTS

- A. The hoists shall consist of a hoist base, hoist operator, cable drums, drum shafts, cables, and bearing bracket to operate the radial gates. The operators shall be adequate for opening radial gates to double the gate height for operating head specified.

## 2.09 MANUAL HOIST

- A. The manual hoist operator shall consist of worm and worm gear with, reduction spur gears as required, totally enclosed in cast iron housing. A suitable size handwheel located 36 inches above the operating surface, shall be provided to produce necessary output torque to raise the gate when maximum 40 pound pull is exerted on handwheel rim. The direction of rotation to open gate shall be marked on the handwheel.

## 2.10 ELECTRIC MOTOR OPERATED HOIST -NOT USED

- A. The electric hoist actuator shall include the motor, operator unit, gearing limit switch, limit switches, torque switches, controls as specified, declutch lever or knob, space heater, gear housings, and auxiliary handwheel as a self-contained unit.
- B. The motor shall be specifically designed for radial gate service and shall be for high torque, totally enclosed, non-ventilated construction, with motor lead brought into the limit switch compartment. Motor insulation shall be NEMA Class B with a maximum continuous temperature rating of 120 Celsius.
- C. The motor shall be of sufficient size to open or close the valve against the maximum expected differential pressure when voltage to the motor terminals is 10 percent above or below minimal 230/460V-3Ph-60Hz voltage. The motor duty rating shall be sufficient for one complete open to close (or reverse) cycle without exceeding its temperature rating. The motor shall be pre-lubricated and all bearings shall be of the anti-friction type.
- D. The actuator power gearing shall consist of generated spur or helical gears of heat treated steel, and worm gearing. The worm shall be of hardened alloy steel and the worm gear shall be of alloy bronze accurately cut with a hobbing machine. All power gearing shall be grease-lubricated. Ball or roller bearings shall be used throughout.
- E. Limit switches and associated gearing shall be an integral part of the actuator. Limit switches shall be of adjustable type capable of being set to trip at any point of gate travel between fully open and fully closed and not be subject to breakage or slippage due to over-travel.
- F. Each actuator shall be equipped with a double torque switch that is responsive to loads encountered in either the opening or closing direction.
- G. The torque switch shall operate during the complete gate cycle without the use of auxiliary relays, linkages, latches, or other devices. The torque switch shall be wired

to shut off the actuator motor in the event of excessive torque load applied in either direction of drum rotation or gate travel.

- H. A handwheel shall be provided for manual operation. The handwheel shall not rotate during motor operation nor shall a fused motor prevent manual operation. When in the manual operating position, the unit will remain in this position until the motor is energized at which time the motor operator will automatically return to electric operation and shall remain in the motor powered position/condition until handwheel operation is desired. This movement from motor operation to handwheel operation shall be accomplished by a declutching knob or lever which will disengage the motor and motor gearing mechanically but not electrically. Hand operation must require no more than 40 pounds of rim effort at a maximum required torque. It shall not be possible for the unit to be simultaneously in manual and motor operation. The direction of open for the gate shall be marked on the handwheel.

## 2.11 FASTENERS

- A. All anchor bolt, assembly bolts, screws, nuts, etc. shall be of ample section to safely withstand the forces created by operation of the gate under the specified pressures and loads. Quantity and size of fasteners shall be a recommended by the manufacturer. Sill anchor / leveling bolts shall be provided with two nuts to facilitate installation.

## 2.12 FINISH

- A. All structural and other exposed carbon steel surfaces shall be painted or finished as specified. The hoist shall be finished suitable for outdoor exposure.

## 2.13 SHOP TESTING

- A. All gates and equipment shall be inspected and approved by a qualified shop inspector prior to shipment.

# PART 3 EXECUTION

## 3.01 INSTALLATION

- A. Installation of the gates shall be performed in accordance with standard industry practices. It shall be the responsibility of the CONTRACTOR to handle, store, and install the equipment specified in this Section in strict accordance with the Manufacturer's recommendations.
- B. The CONTRACTOR shall review the installation drawings and installation instructions prior to installing the gates.



- C. The gates shall be installed in a true vertical plane, square and plumb, with no twist, convergence, or divergence in the radial arms or gate face.
- D. The CONTRACTOR shall fill any voids with non-shrink grout as shown on the installation drawing and in accordance with the grout manufacturer's recommendations.

### 3.02 FIELD TESTING

- A. After installation, all gates will be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate assembly shall be tested by the CONTRACTOR at the discretion of the ENGINEER and OWNER, to confirm there is no excessive leakage.

END OF SECTION