



# NORTHEAST SERVICE AREA (NESA) WWTP YARD PIPING AND VALVE IMPROVEMENTS

Supplemental Technical Specifications – 100% DESIGN

PREPARED BY





**COLLIER COUNTY SUPPLEMENTAL TECHNICAL SPECIFICATIONS  
TABLE OF CONTENTS**

**SUPPLEMENTAL TECHNICAL SPECIFICATIONS**

**Note: The following technical specifications shall be incorporated into the Contract Documents for the Northeast Service Area (NESA) WWTP Yard Piping and Valves Improvements project. In addition to these supplemental technical specifications, the Collier County Utility Standards Manual shall apply to this project.**

**DIVISION 01 – GENERAL REQUIREMENTS**

01010 SUMMARY OF WORK  
01020 MEASUREMENT AND PAYMENT

**DIVISION 02 – SITE CONSTRUCTION**

02050 DEMOLITION AND MAINTENANCE

**DIVISION 03 – CONCRETE**

03300 CONCRETE WORK

**DIVISION 15 – PIPING AND MECHANICAL**

15060 PVC, SOLVENT WELDED  
15115 VALVES ACTUATED, ELECTRIC

## SECTION 01010

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Description of Work
- B. CONTRACTOR's Use of Site
- C. Work Sequence
- D. COUNTY Occupancy

##### 1.2 DESCRIPTION OF WORK

General: The Work to be done under this Contract is shown on the drawings and specified in Contract Documents. Collier County has recently acquired the Orange Tree Wastewater Treatment Plant (Plant) and has found a need to perform maintenance and make improvements to various areas of the Plant. All work associated with this Contract shall be completed within 180 calendar days.

##### **Bid Package A:**

1. Replacing three 10-inch plug valves located at the head works structure. Two of the plug valves will be replaced with new valves and hand wheel actuators, the other valve will be replaced with a new valve and chain wheel actuator.
2. Removing and replacing the existing 18-inch gate valves prior to the aeration basins to ground level with plug valves and motorized operated valves. The proposed plug valves and actuators will be 16-inch with Rotork MOVs.
3. Installation of an overflow drain on the existing conditioning tank. The contractor will core a hole in the tank and install the drain line to tie into the existing gravity line.
4. Installation of a 6-inch Lift Station flow meter assembly (piping only, no meter).

5. Installation of a concrete curbed pad in front of the sludge tanks to capture potential spills. This item will also include installing an extension of existing waterline to the proposed concrete pad and installing a hose bib.
6. Installation of a 10-inch influent meter assembly near the headworks structure (piping only, no meter).
7. Installation of DIP exterior coating system on the 18-inch above ground discharge pipes at the aeration basins.

B. The Work includes:

1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.
2. Sole responsibility for adequacy of plant and equipment.
3. Maintaining the Work area and site in a clean and acceptable manner.
4. Maintaining existing facilities in service at all times.
5. Protection of finished and unfinished Work.
6. Repair and restoration of Work or existing facilities damaged during construction.
7. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.
8. Furnishing, installing, and protecting all necessary guides, track rails, bearing plates, anchor and attachment bolts, and all other appurtenances needed for the installation of the devices included in the equipment specified. Make anchor bolts of appropriate size, strength and material for the purpose intended. Furnish substantial templates and shop drawings for installation.

- C. Implied and Normally Required Work: It is the intent of these Specifications to provide the COUNTY with complete operable systems, subsystems and other items of Work. Any part or item of Work, which is reasonably implied or normally required to make each installation satisfactorily and completely operable, is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these

Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.

- D. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

### 1.3 CONTRACTOR'S USE OF SITE

- A. Limit use of site and premises for work and storage to allow for the following:
  - 1. Coordination of the Work under this CONTRACT with the work of the other contractors where Work under this CONTRACT encroaches on the Work of other contractors.
  - 2. COUNTY occupancy and access to operate existing facilities.
  - 3. Coordination of site use with ENGINEER.
  - 4. Responsibility for protection and safekeeping of products under this CONTRACT.
  - 5. Providing additional off site storage at no additional cost to the COUNTY as needed.

### 1.4 WORK SEQUENCE

- A. Construct Work in stages to accommodate the COUNTY's use of premises during construction period and in accordance with the limitations on the sequence of construction specified. Coordinate construction schedules and operations with ENGINEER.
- B. Coordinate Work of all subcontractors.

### 1.5 COUNTY OCCUPANCY

- A. The COUNTY will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with the COUNTY's Manager or designee in all construction operations to minimize conflict, and to facilitate COUNTY usage.
- B. Conduct operations with the least inconvenience to the general public.

## 1.6 PROTECTION OF EXISTING UTILITIES

- A. In case of damage to existing utilities caused by construction activities, contact the owner of the utility or appropriate COUNTY department (Water or Wastewater) immediately. Repair any damage to existing utilities caused by construction activities in coordination with or as directed by the owner of the utility.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

- A. Starting Work: Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

## SECTION 01200

### MEASUREMENT AND PAYMENT

#### PART 1- GENERAL

##### 1.01 DESCRIPTION

- A. This section describes the method used to determine quantities of Work performed or materials supplied for which a price is given in the Bid. It establishes the basis upon which payment will be made for Payment Items.
- B. Subject to the provisions in General Conditions, all Work and payment for the Work is represented by Payment Items and associated unit prices.

##### 1.02 PAYMENT

- A. Subject to all other contract requirements, the Contractor shall be paid for "as-built" quantities of Work for which a price is given in the bid.
- B. Quantities on the Bid Form are for comparison in competitive bidding only and do not constitute the basis for payment or measurement of quantities.
- C. Quantities on the Bid Form are estimated and may be increased or decreased without limit.
- D. No separate payment will be made for one Payment Item as Work incidentally required to complete the Work of another.
- E. Payment for Work performed shall be made in accordance with the unit prices in the Bid. Retainage shall apply to all Contractor payments prior to final acceptance.

##### 1.03 MEASUREMENT FOR PAYMENT

- A. Methods of Measurement:
  - 1. Measurements of lengths, widths, slope angles, and depths or elevations shall be made to determine "as-built" quantities of lengths, areas and volumes pertinent to Payment Items.
    - a. Unless otherwise specified, all lengths shall be horizontal distances.
    - b. Slope angles and elevations shall be measured using land surveying equipment.



2. Graphic representations of measured quantities shall be drafted to scale using the Drawings where convenient and appropriate. Additional drawings shall be drafted if required.
    - a. Irregular shapes representing areas and volumes shall be measured using a compensating polar planimeter or a computer digitizer.
    - b. Regular shapes shall be scaled.
  3. Use of Drawings:
    - a. Unless otherwise agreed upon between the Contractor and Owner, the Drawings shall be used as the basis to establish existing grades and other existing topographic features.
- B. Payment limits where Payment Lines are not shown on the Drawings:
1. Pipe Length: Measurement of pipe shall be made along the top of pipe, excluding fittings, valves and manholes, in place, taken as the laying length.
  2. Except as specified otherwise, measurements of Payment Item quantities of weights, lengths, areas and volumes shall be made:
    - a. On "as-built" and in-place completed Work, during construction or at the time of Substantial Completion.
    - b. If no other feasible and practical methods of measurements are available, by delivery slips delivered to the Engineer.
  3. Adjustments shall be made to eliminate overlaps in area and volume measurements.

#### 1.04 PAYMENT ITEMS

- A. Separate payment will be made for the Unit Price and Lump Sum items listed on the Bid Form. Related work not specifically listed or identified below in 1.04 B and C, but evidently necessary for satisfactory completion of the Item shall be considered to be included.
- B. No separate payment will be made for the following Work, and its cost shall be included in the Bid Price of the Payment Item to which it is associated:
  1. Trench excavation, sheeting, shoring and bracing.

2. De-watering, erosion and sedimentation control, and turbidity screening.
3. Removal, replacement and restoration of culverts and storm sewer pipe crossings of driveways and roads.
4. Cleanup.
5. Testing, including all materials and equipment.
6. Maintenance of utility service.
7. Appurtenant work.
8. Record Drawings.
9. Field Office.
10. Saw cutting.
11. Coordination with other contractors.
12. Layout of the work.
13. Notifications to property owners of construction schedule and service interruptions.
14. Coordination of activities and work hours with Airport Operations.
15. Restoration and Sodding

C. Measurement and Payment Items as listed in the Bid Schedule, broken down by contract:

**Contract A:**

**1. General Requirements (Bid Item No. 1)**

- a. Measurement for various items covered under General Conditions will not be made for payment, and all items shall be included in the lump sum price.
- b. Payment for General Conditions shall include the costs of all permits, taxes, fees, all Insurance requirements costs, the costs of all bonds, and all administrative costs associated with acquiring and maintaining the necessary coverage as described in the Contract Documents. This item will be paid upon each payment request made by the Contractor. The Contractor shall attach with the payment request invoices to substantiate that appropriate insurance and bonds have been obtained by the Contractor. General Requirements shall be limited to 10% of the total bid.

**2. Mobilization / Demobilization (Bid Item No. 2)**

- a. Measurement for various items covered under Mobilization / Demobilization will not be made for payment, and all items shall be included in the lump sum price.
- b. Payment for Mobilization / Demobilization shall include the cost for preparatory work and operations in mobilizing for beginning work on the Project and demobilizing for ending work on the Project. The establishment of field offices, buildings, safety equipment, first aid supplies, sanitary and other facilities, as required by these Specifications, State and local laws and any other preconstruction expense necessary for the state of the Work; the cost of field engineering, construction schedules, pre-construction video and photographs, project signs, shop drawings, temporary facilities, lay down storage area, temporary access, construction aids, erosion control, including silt fencing, restoration following project, including landscape and/or sodding as necessary, work associated with Contractor support during Owner/Engineer testing, reviews and inspection, re-inspection and any rework resulting from same, cleaning, project records documents, operating and maintenance data. Mobilization / Demobilization shall be limited to 5% of the total bid.

**3. 16" Plug Valves w/MOV's (Bid Item No. 3)**

- a. Measurement for 16" Plug Valves w/MOV's will be based on the quantity of each valve with MOV actually placed in the field and actually accepted.
- b. Payment for 16" Plug Valves w/MOV's will be made at the Contract unit price per each valve and MOV installed together, which price and payment shall be full compensation for removing and disposing of the old 18" gate valves, furnishing and installing 18" DIP, fittings, 16" plug valve, MOV w/ actuator, and all necessary appurtenances and other work required to complete the installation as specified, excluding the electrical components which are not part of this contract.

**4. Conditioning Tank Overflow Line (Bid Item No. 4)**

- a. No measurement will be made for this item, and all items shall be included in the lump sum price.
- b. Payment for Conditioning Tank Overflow Line will be made at the Contract lump sum price which price and payment shall be full compensation for furnishing and installing the 4" overflow line including SDR 26 pipe, glue, fittings, fernco coupling,

cleanouts, painting, coring, link seals and all other appurtenances and work required to complete the installation as specified.

**5. 10" Plug Valves at Headworks (Bid Item No. 5)**

- a. Measurement for 10" Plug Valves at Headworks will be based on the actual quantity of valves installed and accepted.
- b. Payment for 10" Plug Valves at Headworks will be made at the Contract unit price which price and payment shall be full compensation for furnishing and installing the plug valves, removing and disposing of existing plug valves, furnishing and installing Mega-Flange adaptors, handwheel and chain operators and all other work and appurtenances required to complete the installation as specified.

**6. 6" Lift Station Meter Assembly (Piping Only) (Bid Item No. 6)**

- a. No measurement will be made for this item, and all items shall be included in the lump sum price.
- b. Payment for 6" Lift Station Meter Assembly will be made at the Contract lump sum price for installing all components as shown on the Drawings and payment shall be full compensation for but not limited to, forms, reinforcement, concrete, concrete finishing, testing, 6-inch DIP and fittings, excavation, backfill, ductile iron spool spiece in place of the meter, remove existing piping, and all appurtenances required to complete the installation as specified.

**7. Concrete Curbed Pad at Sludge Tanks (Bid Item No. 7)**

- a. No measurement will be made for this item, and all items shall be included in the lump sum price.
- b. Payment for Concrete Curbed Pad at Sludge Tanks will be made at the Contract lump sum price for installing all components as shown on the Drawings and payment shall be full compensation for but not limited to, forms, rebar, concrete, concrete finishing, testing, SDR 26 PVC pipe and fittings, excavation, backfill, SCH 80 PVC Pipe and fittings, precast concrete post, and all appurtenances required to complete the installation as specified.

**8. 10" Influent Meter (Piping Only) (Bid Item No. 8)**

- a. No measurement will be made for this item, and all items shall be included in the lump sum price.
- b. Payment for 10" Influent Meter will be made at the Contract lump sum price for installing all components as shown on the Drawings and payment shall be full compensation for but not limited to, forms, reinforcement, concrete, concrete finishing, testing, 10-inch DIP and fittings, excavation, backfill, ductile iron spool piece in place of the meter, remove existing piping, and all appurtenances required to complete the installation as specified.

**9. DIP Exterior Coating System (Bid Item No. 9)**

- a. No measurement will be made for this item, and all items shall be included in the lump sum price.
- b. Payment for DIP Exterior Coating System will be made at the Contract lump sum price for installing the coating system as shown on the Drawings and payment shall be full compensation for but not limited to, prep work, primers, finish coats and all other work necessary to install the coating system as shown on the Drawings and described in the manufacturers instructions.

**10. Generator Coating System (Bid Item No. 10)**

- a. No measurement will be made for this item, and all items shall be included in the lump sum price.
- b. Payment for Generator Coating System will be made at the Contract lump sum price for installing the coating system as shown on the Drawings and payment shall be full compensation for but not limited to, prep work, primers, finish coats and all other work necessary to install the coating system as shown on the Drawings and described in the manufacturers instructions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

## SECTION 02050

### DEMOLITION AND MAINTENANCE OF SERVICE DURING CONSTRUCTION

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. Scope of Work:

1. This Section includes furnishing all labor, materials, permits, notifications, equipment and incidentals required for the demolition and disposal of all materials and equipment designed for removal. Such materials and equipment include equipment, pipe, valves, supports, and other related appurtenances.
2. These Specifications call attention to certain activities necessary to maintain and facilitate operation during and immediately following construction and do not purport to cover all of the activities necessary. The Contractor shall exercise due care to maintain continuous operation of the existing facilities and minimize operation inconvenience.
3. Demolition includes, but is not limited to:
  - a. Removal of concrete walls, concrete floor, piping, valves, electrical conduits, wiring, control panels, gravity sewer, manholes, junction boxes, handrails, fences, pavement, diesel fuel storage tanks, aerators, and other items as shown on the Drawings or necessary to complete the Project.
  - b. Disposal of nonsalvageable and excess unacceptable material as specified below.
  - c. Off-site disposal of excess and unacceptable materials.
4. The Contractor shall examine the Contract Documents, visit the project site and determine the extent of the work affected therein, and all conditions under which the work will be performed.

##### 1.02 PERMITS AND NOTICES

- A. Permits and Licenses: Contractor shall obtain all necessary permits and licenses for performing the work and shall furnish a copy of same to the Owner prior to commencing the Work. The Contractor shall comply with the requirements of the permits.

- B. Utility Services: Contractor shall notify utility companies or local authorities furnishing gas, water, electrical, telephone, cable television, or sewer service to remove any equipment owned by them in structures to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.

#### 1.03 CONDITIONS AND STRUCTURES

- A. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable, however, minor variations within the structure may occur prior to the start of demolition work.

#### 1.04 RULES AND REGULATIONS

- A. The Florida Building Code and applicable codes shall control demolition, modification, or alteration of the existing buildings or structures.
- B. No blasting shall be done on site. The Contractor shall not bring or store any explosives on site.

#### 1.05 DISPOSAL OF MATERIAL

- A. Salvageable material shall become the property of the Owner, if the Owner requests any specific item. The Contractor shall dismantle all the materials to such a size that they can be readily handled, and deliver any of the salvageable materials requested by the Owner to a designated storage area on-site, as directed by the Owner.
- B. The following examples are the types of material of which the Owner may maintain ownership:
  - 1. Valves greater than 3 inches in diameter.
- C. Any material that the Owner rejects shall become the Contractor's property and must be removed from the site, transported, and disposed of by the Contractor.
- D. Concrete, concrete block, and unsalvageable bricks shall be hauled to a waste disposal site by the Contractor.
- E. The storage of or sale of removed items on the site shall not be allowed.

#### 1.06 TRAFFIC AND ACCESS

- A. Conduct demolition and modification operations, and the removal of equipment and debris to ensure minimum interference with roads, streets, and sidewalks both on-site and off-site and to ensure minimum interference with occupied or used facilities.

- B. The Contractor shall at all times maintain safe and convenient access to the existing site.
- C. Do not close or obstruct streets or walks without permission from the Owner and Engineer. Provide alternate traffic routes around closed or obstructed access ways.
- D. Special attention is directed towards maintaining safe and convenient access to the existing facilities remaining in service by COUNTY personnel. Relocation of the Contractor's materials or equipment due to uncoordinated interruption will be at the Contractor's expense.

#### 1.07 DAMAGE

- A. Promptly repair damage caused to adjacent facilities by demolition operations at no cost to the Owner.

#### 1.08 UTILITIES

- A. Maintain existing utilities to remain in service and protect against damage during demolition operations.
- B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Owner and the Engineer. Provide temporary service during interruptions to existing utilities as acceptable to the Owner.
- C. The Contractor shall cooperate with the Owner to shut off utilities serving structures as required by demolition operations.
- D. The Contractor shall be solely responsible for making all necessary arrangements and for performing any necessary work involved in connection with the discontinuance or interruption of all public and private utilities or services under the jurisdiction of the utility companies.
- E. All utilities being abandoned shall be disconnected and terminated at the service mains in conformance with the requirement of the utility companies or the municipality owning or controlling them.

#### 1.09 POLLUTION CONTROL

- A. For pollution control, use water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Comply with the governing regulations.
- B. Take all necessary measures and means to provide dust, dirt, debris and paint abatement methods to prevent damage to surrounding properties, on-site structures, and private property.



- C. Clean on-site structures and improvements of all dust, dirt and debris caused by demolition operations as directed by the Engineer. Clean or repair all off-site property as shown on the Drawings and specified herein. Return areas to conditions existing prior to the start of work.

#### 1.10 QUALITY CONTROL

- A. Protect all existing materials and equipment to be salvaged or reused from damage.
- B. No above-ground pipes, junction boxes, conduits, or wires are to be left abandoned.
- C. Leave all exposed ends of all pipe and conduit or junction boxes covered and safe.

#### PART 2 – PRODUCTS (NOT USED)

#### PART 3 – EXECUTION

##### 3.01 REMOVAL OF EXISTING EQUIPMENT, PIPING, AND APPURTENANCES

- A. Subject to the constraints of maintaining the existing facility in operation, existing equipment, non-buried valving and piping, and appurtenances not necessary for the operation of the new facility shall be removed as shown or indicated on the Drawings.
- B. All equipment, piping, and appurtenances shall be cleaned, flushed, and drained. Equipment to be retained by the Owner as specified in Paragraph 1.05 above shall be dismantled sufficiently to permit thorough cleaning and draining. All valves shall be left open.

##### 3.02 BURIED PIPING

- A. Remove all demolished and abandoned buried piping encountered during excavation unless otherwise directed by Engineer.

END OF SECTION

## SECTION 03300

### CONCRETE WORK

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation, and erection of items specified in this Section as shown on Drawings or listed on Schedules.
- B. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.
- C. Products Installed but not Furnished under this Section:
  - 1. Anchor bolts.
  - 2. Miscellaneous metal embedments.

##### 1.02 DEFINITIONS

- A. Flowable Fill: Cement Stabilized Fly Ash Fill (CSFAF) consisting of cement, fly ash, and water. These Specifications classify this material as Class F mix.
- B. Mass concrete refers to slabs or walls greater than 3 feet thick.

##### 1.03 REFERENCES

- A. ASTM:
  - 1. A 185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
  - 2. A 497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
  - 3. A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 4. C 31 Test Methods of Making and Curing Concrete Test Specimens in the Field.
  - 5. C 33 Concrete Aggregates.
  - 6. C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 7. C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  - 8. C 94 Ready-Mixed Concrete.
  - 9. C 143 Test Method for Slump of Hydraulic Cement Concrete.
  - 10. C 150 Portland Cement.
  - 11. C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
  - 12. C 171 Sheet Materials for Curing Concrete.
  - 13. C 172 Practice for Sampling Freshly Mixed Concrete.

14. C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
15. C 231 Test Method for Air Content of Freshly Mixed Concrete by Pressure Method.
16. C 260 Air-Entraining Admixtures for Concrete.
17. C 309 Liquid Membrane-Forming Curing Compounds for Curing Concrete.
18. C 494 Chemical Admixtures for Concrete.
19. C 578 Preformed, Cellular Polystyrene Thermal Insulation.
20. C 595 Blended Hydraulic Cements.
21. C 618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
22. C 881 Epoxy-Resin-Base Bonding Systems for Concrete.
23. C 989 Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars.
24. C 1107 Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
25. C 1240 Silica Fume for Use as a Mineral Admixture in Hydraulic Cement Concrete.
26. D 994 Preformed Expansion Joint Filler for Concrete (Bituminous Type).
27. D 471 Test Method for Rubber Property – Effect of Liquids.
28. D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextending and Resilient Bituminous Types).
29. E 1155 Test Method for Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

B. CE:

1. CRD-C 572 PVC Waterstop.

C. ACI:

1. 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
2. 222.1 Provisional Standard Test Method for Water-Soluble Chloride Available for Corrosion of Embedded Steel in Mortar and Concrete Using the Soxhlet Extractor.
3. 301 Specification for Structural Concrete.
4. 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete.
5. 305R Hot Weather Concreting.
6. 306R Cold Weather Concreting.
7. 309R Guide for Consolidation of Concrete.
8. 318R Building Code Requirements for Structural Concrete and Commentary.
9. 347R Guide to Formwork for Concrete.
10. 350R Environmental Engineering Concrete Structures and Commentary.
11. 503R Use of Epoxy Compounds with Concrete.
12. SP-66 ACI Detailing Manual.

D. CRSI:

1. Manual of Standard Practice.
2. Placing Reinforcing Bars.

## 1.04 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01040, Project Coordination, covering the items included under this Section.
    - 1. Shop Drawings of Reinforcement: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with Reinforcement Shop Drawing Checklist below.
      - a. Reinforcement Shop Drawing Checklist:
        - 1) Specify ASTM number and grade of reinforcing.
        - 2) Show bar spacings and quantities.
        - 3) Specify lap lengths using table in Tetra Tech, Inc. Structural Standard Details.
        - 4) Specify whether bars are inside and outside or near face and far face on walls.
        - 5) Specify clear coverages per Placing Reinforcement Specification in Part 3.
        - 6) Specify bar support spacings per Tetra Tech, Inc. Standard Detail for Concrete Slabs.
        - 7) Show stirrup spacing.
        - 8) Use closed stirrups and ties with 135-degree hooks.
        - 9) Submit Bar Bending Schedule on Drawings.
        - 10) Reference major Contract Drawings. Use same section cut numbers and letters when practical.
        - 11) Show details for equipment pads.
        - 12) Show numeric elevation references on sections.
        - 13) Locate expansion and control joints.
        - 14) Organize and present sheets in logical sequence.
        - 15) Submit "small" submittal packages when practical.
        - 16) Immediately contact ENGINEER if Contract Documents are unclear.
- B. Product Data: Submit data for proprietary materials and items, including admixtures, patching compounds, waterstops, joint systems, curing compounds, and other materials installed under this Section.
- C. Submit samples of materials as requested by ENGINEER, including names, sources, and descriptions.
- D. Mix Designs: Submit the following for all concrete classes:
  - 1. Water/cement ratio (total gallons of water per cubic yard).
  - 2. Brand, type, and quantity of cement.
  - 3. Type and quantity of aggregates.
  - 4. Type and quantity of admixtures.
  - 5. Type, composition, and quantity of fly ash, slag (GGBFS), or silica fume.
  - 6. Unit weight (wet density).
  - 7. Composition strength based on 28-day compression test.

- E. Submit laboratory test reports for concrete mix design, aggregates (particularly deleterious materials in coarse aggregate) and fly ash, slag (GGBFS) and silica fume (if used) 4 weeks before scheduled pouring.
  - 1. For mass concrete, submit laboratory test report on the heat of hydration for the trial mix design if requested by ENGINEER. Trial mix design shall consist of concrete block 4-foot by 4-foot by 4-foot.
- F. Quality Assurance Submittals:
  - 1. Submit written reports to ENGINEER documenting testing and inspection results.
  - 2. Submit mill test reports on reinforcement.
  - 3. Submit materials certificates in lieu of laboratory test reports on other materials. Manufacturer and CONTRACTOR shall sign material certificates certifying that each material item complies with, or exceeds, specified requirements. Submit certification from admixture manufacturers that chloride content complies with specification requirements.

#### 1.05 PROJECT CONDITIONS

- A. Protect adjacent finish materials against spatter during concrete placement.

#### 1.06 OWNER'S INSTRUCTIONS

- A. Concrete Testing Service: Engage testing laboratories acceptable to ENGINEER to do material evaluation tests and to design concrete mixes.
- B. Materials and installed Work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at CONTRACTOR's expense.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, products which may be incorporated in Work include:
1. Air-Entraining Admixture:
    - a. "AEA-92" or "Air-Mix," Euclid Chemical Co.
    - b. "Darex II AEA" or "Daravair 1000 or 1400," Grace Construction Products.
    - c. "MB AE 90" or "Micro-Air," Master Builders.
  2. Water-Reducing Admixture:
    - a. "Eucon WR-75," Euclid Chemical Co.
    - b. "Pozzolith 220-N," Master Builders.
    - c. "WRDA with Hycol" or "Daracem," Grace Construction Products.
  3. Mid-range Water-Reducing Admixture:
    - a. "Eucon MR," Euclid Chemical Co.
    - b. "Mira 70" or "Daracem 65 or 55," Grace Construction Products.
    - c. "Polyheed 997," Master Builders.
  4. High-range Water-Reducing Admixture (Superplasticizer):
    - a. "ADVA," "Daracem," Grace Construction Products.
    - b. "Eucon 37," Euclid Chemical Co.
    - c. "Rheobuild 1000 or 7161," Master Builders.
  5. Water Reducing, Nonchloride Accelerator Admixture:
    - a. "Accelguard 80 or 90," Euclid Chemical Co.
    - b. "Daraset," Grace Construction Products.
    - c. "Pozzutec 20" or "Pozzolith NC 534," Master Builders.
  6. Water Reducing, Retarding Admixture:
    - a. "Daratard," Grace Construction Products.
    - b. "Eucon Retarder 75," Euclid Chemical Co.
    - c. "Pozzolith Retarder," Master Builders.
  7. PVC Waterstops:
    - a. Greenstreak, Inc.
    - b. Vinylex Corp.
    - c. W.R. Meadows.
  8. Thermoplastic Elastomeric Rubber (TPER) Waterstops:
    - a. Westec Barrier Technologies, Inc.
  9. Bentonite Waterstops:
    - a. "Swellstop Waterstop," Greenstreak, Inc.
    - b. "Volclay Waterstop," Cetco-Colloid Environmental Technologies Co.
  10. Hydrophilic Waterstop:
    - a. "Akwastop Gasket Waterstop," Cetco-Colloid Environmental Technologies Co.
    - b. "Swellseal," De Neef Construction Chemicals, Inc.
  11. Expansion and Isolation Joint Filler:
    - a. "Sealtight Sponge Rubber," W.R. Meadows.
    - b. "1300 Series Sponge Rubber," Williams Products.
  12. Expansion and Isolation Joint Sealant:
    - a. "Dynaseal W-517 or 907," Williams Products.

- b. "Sonolastic NP1," Sonneborn.
  - c. "Vulkem 45 or 116," Mameco International.
13. Vapor Retarder:
- a. Moisture Vapor-Sensitive Applications (Class C):
    - 1) "Sealtight Vapor-Mat (10 mil)," W.R. Meadows, Inc.
    - 2) "Stego Wrap Vapor Barrier (10 mil)," Stego Industries LLC.
    - 3) "VaporBlock 10," Raven Industries.
  - b. Critical Moisture Vapor-Sensitive Applications (Class B):
    - 1) "Sealtight Vapor-Mat (15 mil)," W.R. Meadows, Inc.
    - 2) "Stego Wrap Vapor Barrier (15 mil)," Stego Industries LLC.
    - 3) "VaporBlock 15," Raven Industries.
14. Perimeter and Slab Insulation:
- a. "Styrofoam High Load 40," Dow Chemical Co.
15. Cement-Polymer Patching Mortar:
- a. "EUCO Poly-Patch," Euclid Chem. Co.
  - b. "Masterpatch 220" or "EMACO S88," Chemrex, Inc.
  - c. "Sikatop," Sika Chem. Corp.
  - d. "Thin Coat Concrete Coat," Euclid Chem. Co.
16. Nonshrink Grout:
- a. "Crystex," L&M Construction Chemicals, Inc.
  - b. "Five Star Grout," U.S. Grout Corp.
  - c. "Master Flow," Chemrex, Inc.
  - d. "Multi-Purpose," Symons.
  - e. "NS Grout," Euclid Chemical Co.
  - f. "Sure-Grip Grout," Dayton-Superior.
17. Chemical Hardener:
- a. "Day-Chem Hardener," Dayton-Superior.
  - b. "Lapidolith," Sonneborn.
  - c. "Mastertop CST," Chemrex, Inc.
  - d. "Surfhard," Euclid Chemical Co.
18. Transparent Membrane Forming Curing Compound:
- a. "Kurez DR," Euclid Chemical Co.
  - b. "L&M Cure R," L&M Construction Chemicals, Inc.
  - c. "Sealtight 1100-Clear," W.R. Meadows.
19. Crystalline Concrete Waterproofing:
- a. Vandex International.
  - b. Xypex Chemical Corp.
20. Epoxy Bonding Compound:
- a. "Concresive Liquid LPL," Chemrex, Inc.
  - b. "Duralbond," Tamms Industries.
  - c. "Euco #452 or #620 Epoxy," Euclid Chemical Co.
  - d. "Rescon R606, R616, R631, R649," Symons Corp.
  - e. "Sikadur 32 Hi-Mod," Sika Chemical Corp.
  - f. "Thiopoxy," Grace Construction Products.
21. Fastening Systems:
- a. Medium-duty Expansion Anchors (Wedge Anchors):
    - 1) "Kwik-Bolt II" Hilti, Inc.
    - 2) "Power-Stud," Powers Fasteners, Inc.
    - 3) "Trubolt," ITW Ramset/Red Head.

- 4) "Wedge-All," Simpson Strong-Tie Co., Inc.
  - b. Heavy-duty Expansion Anchors (Sleeve Anchors):
    - 1) "HSL Heavy Duty Sleeve Anchor," Hilti, Inc.
    - 2) "Power-Bolt," Powers Fasteners, Inc.
    - 3) "Redi-Bolt," ITW Ramset/Red Head.
    - 4) "Sleeve-All," Simpson Strong-Tie Co., Inc.
  - c. Heavy-duty Screw Anchors:
    - 1) "Large Diameter Tapcon (LDT)," ITW Ramset/Red Head.
    - 2) "Titen HD," Simpson Strong-Tie Co., Inc.
    - 3) "Wedge-Bolt," Powers Fasteners, Inc.
  - d. Adhesive Anchors:
    - 1) "AC100/AC5.5" or "Power-Fast," Powers Fasteners, Inc.
    - 2) "Epcon," ITW Ramset/Red Head.
    - 3) "Epoxy-Tie," Simpson Strong-Tie Co., Inc.
    - 4) "HIT HY150/HIT-ICE," Hilti, Inc.
22. Bearing Pads:
- a. Fluorocarbon Co.
  - b. Williams Products, Inc.

## 2.02 FORM MATERIALS

- A. Forms for Smooth Form Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel materials, to achieve continuous, straight, smooth, exposed surfaces. Furnish largest practicable sizes to minimize joints and to conform to joint system shown on Drawings.
- B. Forms for Rough Form Finish Concrete: Plywood, lumber, metal, or other acceptable material. Use lumber dressed on two edges and one side for tight fit.
- C. Forms for Textured Finish Concrete: Use units with face design, size, arrangement, and configuration to match ENGINEER's control sample. Provide solid backing and form supports to stabilize textured form liners.
- D. Form Coatings: Commercial formulation form-coating compounds with no more than 350 mg/ltr volatile organic compounds (VOCs) that do not bond with, stain, or adversely affect concrete surfaces, or prevent good bonding with later concrete surface treatments.
- E. Forms Ties: Factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which shall leave no metal closer than 1-1/2 inches to surface.
  - 1. Provide ties which, when removed, leave holes no larger than 7/8-inch or less than 1/2-inch in diameter in concrete surface.

## 2.03 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.



- B. Welded Wire Fabric: ASTM A 185.
- C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar supports complying with CRSI specifications. The use of bricks is not permitted.
  - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material does not support chair legs.
  - 2. For exposed-to-view concrete surfaces, where support legs are in contact with forms, use supports with legs that are plastic-protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

#### 2.04 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except use Type III where applications require high-early-strength or Type II where required by ENGINEER for corrosive environments.
- B. Use one brand of cement throughout Project, unless otherwise acceptable to ENGINEER.
- C. Fly Ash: ASTM C 618, Type C or Type F (corrosive environments) with loss on ignition not more than 6 percent.
- D. Ground Granulated Blast-Furnace Slag: ASTM C 989.
- E. Silica Fume: ASTM C 1240.
- F. Aggregates: ASTM C 33. Use aggregates from single source for exposed concrete.
- G. Water: Potable.
- H. Air-Entraining Admixture: ASTM C 260, and certified by manufacturer to be compatible with other admixtures.
- I. Water-Reducing Admixture: ASTM C 494, Type A.
- J. High-range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G.
- K. Water Reducing, Nonchloride Accelerator Admixture: ASTM C 494, Type E.
- L. Water Reducing, Retarding Admixture: ASTM C 494, Type D.

- M. Prohibited Admixtures: Calcium chloride thycyanates or admixtures containing more than 0.1 percent chloride ions.
- N. Potable Water Structures: For surfaces in contact with potable water, use only materials approved by Department of Public Health of the state that has jurisdiction.

## 2.05 ACCESSORIES

- A. PVC Waterstops: PVC conforming to CRD-C 572. Size and type as shown on Drawings.
  - 1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for field fabrication.
  - 2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop between first and second ribs from end.
- B. Bentonite Waterstops: Flexible strip of bentonite-butyl expanding rubber. Use for cast-in-place concrete structures.
- C. Hydrophilic Waterstop: Flexible strip of hydrophilic expanding vinylester. Used for precast concrete structures where shown on Drawings.
- D. Bituminous Joint Filler: ASTM D 1751.
- E. Expansion and Isolation Joint Filler: Sponge rubber conforming to ASTM D 1752, Type I. Concrete shall be gray color with density not less than 30 pounds per cubic foot and compression deflection not more than 25 percent of thickness at 20 psi apply pressure.
- F. Expansion and Isolation Joint Sealant: One part polyurethane. Concrete shall be gray color unless otherwise required by ENGINEER. Before applying, wipe surface clean with solvent supplied by manufacturer.
- G. Granular Base: Evenly graded fine aggregate to provide smooth and even surface below slabs on grade. Minimum 6-inch thickness or as noted on Drawings.
- H. Vapor Retarder: Polyethylene sheet, meeting or exceeding the requirements of ASTM E 1745, Class C or Class B, as indicated on Drawings.
- I. Perimeter and Slab Insulation: Rigid thermal plastic foam board with 40 psi minimum compressive strength, maximum water absorption of 0.1 percent by volume, and maximum water permeability of 0.8 perm-inch meeting ASTM C 578, Type VI; 2 inches thick with adhesives as recommended by insulation manufacturer.

- J. Nonshrink Grout: ASTM C 1107, factory pre-mixed, cementitious natural aggregate grout.
- K. Chemical Hardener: Colorless aqueous solution containing magnesium fluosilicate and zinc fluosilicate combined with wetting agent, containing not less than 2 pounds of fluosilicates per gallon.
- L. Moisture-Retaining Cover: Waterproof paper, polyethylene film, or polyethylene-coated burlap complying with ASTM C 171.
- M. Transparent Membrane-Forming Curing Compound: Liquid membrane-forming curing compound complying with ASTM C 309, Type 1, Class B. Formed membrane shall be suitable for later application of cementitious coating or topping.
- N. White Pigmented Membrane-Forming Curing Compound: Liquid membrane-forming curing compound complying with ASTM C 309, Type 2, Class B. Tests for moisture retention, reflectance, and drying time shall be based on a curing compound applied at 200 square feet per gallon.
- O. Crystalline Concrete Waterproofing: Cementitious crystalline concrete waterproofing material that permanently fixes nonsoluble crystalline growth throughout capillary voids.
- P. Epoxy Bonding Agent: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material Type, Grade, and Class to suit Project requirements.
- Q. Bearing Pads: Vulcanized chloroprene elastomeric compound cut from molded sheet with 50 SHORE A durometer surface hardness. Elastomeric bearing pads shall conform to requirements for 100 percent virgin polychloroprene (Neoprene) bearing pads as specified by AASHTO Standard Specifications for Highway Bridges. Install in forms under poured-in-place concrete as shown on design details.
- R. Mechanical Anchors: Manufactured using corrosion-resistant materials.
- S. Adhesive Anchoring System: ASTM C 881, Type IV, Grade 3. Provide material Class to suit Project requirements.

## 2.06 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each concrete class and strength by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use independent testing facilities acceptable to ENGINEER for preparing and reporting proposed mix designs. Testing facility shall not be identical to that used for field quality control testing.

- B. Fly ash shall be used to partially supplant cement content in Class A and Class S concrete, unless noted otherwise, and is optional in other classes. Replacement quantity of cement content by weight shall be not less than 15 percent for Class A and Class S concrete or more than 25 percent for all classes except Class F.
- C. For concrete Class A and Class S, concrete mix design with fly ash and silica fume shall be maximum 30 percent of cement content by weight, and shall constitute no more than 20 and 10 percent, respectively, of the total weight of cementitious materials.
- D. For concrete, Class S, use Portland cement Type II with fly ash, Type F.
- E. Ground granulated blast furnace slag (GGBFS) shall only be permitted for mass concrete placement and as approved by ENGINEER. Replacement quantity of cement content weight shall not be less than 35 percent or more than 50 percent.
- F. Design mixes to provide normal weight concrete for following classes and properties:
  - 1. Locations for concrete classes are as follows:
    - a. Class A Structural concrete (slabs, walls, columns, beams, equipment bases, and slab toppings 2 inches or greater in thickness).
    - b. Class S Sulfate resistant structural concrete (slabs, walls, columns, and beams) where indicated on Drawings.
    - c. Class G Grout fill for use in sweeping in final surfaces in sanitary structures and slab toppings less than 2 inches in thickness.
    - d. Class P Exterior pavements (unless otherwise indicated on Drawings).
    - e. Class B Sidewalks and manhole bases (unless otherwise indicated on Drawings).
    - f. Class C Fill within manholes, mud mats, fill under structures, encasement for piping below or adjacent to structures and encasement for floor drains, sewer inlets and similar items.
    - g. Class F Flowable fill for filling spaces as permitted and directed by ENGINEER.

2. Properties for concrete classes are as follows:

Concrete Class		A	S	G	P	B	C	F
28-Day* Compressive Strength (f'c), psi		4,000	5,000	4,000	3,500	3,000	2,000	50-100
Cement Content per cubic yard of concrete, sacks minimum **		6	7	6	5.5	5	4	0.4-3.0
Water/Cement Ratio by weight, maximum		0.44	0.40	0.44	0.44	0.58	0.75	0.40-0.75
Air Content, percent by volume		5±1	<4	5±1	6.5±1.5	6.5±1.5	NA	NA
Slump at point of placement, inches.	WR***	2-4	2-4	2-4	2-4	3-5	3-6	NA
	MRWR	4-6	4-6	4-6	4-6	NA	NA	NA
	HRWR	6-8	6-8	6-8	6-8	NA	NA	NA
Monofilament Polypropylene, Type F1		Yes	Yes	Yes	NA	NA	NA	NA

- \* 7-day compressive strength for high-early-strength concrete.  
56-day compressive strength for mass concrete with ground granulated blast furnace slag.
- \*\* For concrete with fly ash, values are total of cement plus fly ash (except Class F concrete).
- \*\*\* Slump prior to the addition of mid-range or high-range water reducers.

3. Adjustment of Concrete Mixes: Mix designs may be adjusted when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, when approved by ENGINEER, at no additional cost to OWNER. Submit laboratory test data for revised mix design and strength results to ENGINEER before using in work.
4. Admixtures:
- Use water-reducing admixture or high range water-reducing admixture (superplasticizer) in concrete for placement and workability.
  - Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F (10 degrees C).
  - Add air-entraining admixture at manufacturer's prescribed rate to result in placed concrete having total air content specified.

## 2.07 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with ASTM C 94 requirements and as specified in this Section.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Coordinate installation of joint materials, perimeter insulation, and vapor retarders with placement of forms and reinforcing steel.

### 3.02 FORMS

- A. Design, build, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads applied to formwork until concrete structure can support applied loads. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position. Deflection of form-facing material between supports, and deflection of form supports shall not exceed 1/4 inch per 10 feet of span.
- B. Design formwork to be removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades level and plumb for work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features in Work. Use selected materials to obtain specified finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, and recesses to prevent swelling and for easy removal.
- E. Provide temporary openings at base of wall and column forms and other interior areas of formwork where it is inaccessible for cleanout, for observation before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges, 3/4 inch minimum, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

- G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing these items. Accurately place and securely support items built into forms.
- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing after concrete placement to eliminate mortar leaks and to maintain proper alignment.

### 3.03 VAPOR RETARDER INSTALLATION

- A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting where shown directly under concrete slab, unless otherwise indicated on Drawings, with longest dimension parallel with direction of pour.
- B. Lap joints 6 inches minimum and seal with appropriate tape as recommended by manufacturer.
- C. Seal around all duct, pipe, or wire penetrations using appropriate tape and/or prefabricated boots.
- D. Damaged areas shall be repaired by placing a piece of vapor retarder material over the damaged area with a 6-inch minimum lap on each side. The perimeter of the repair shall be sealed using an appropriate tape.

### 3.04 PERIMETER AND SLAB INSULATION

- A. Place perimeter and floor slab insulation at locations shown on Drawings.

### 3.05 PLACING REINFORCEMENT

- A. Comply with CRSI recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as specified in this Section.
  - 1. Avoid cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers.

- D. Place reinforcement to obtain clear cover space for concrete protection:
  - 1. Footings and slabs cast over mud mats, supported slabs, beams, girders, columns, and walls, both interior and exterior unless noted otherwise: 2 inches.
  - 2. Footings and slabs cast against and permanently exposed to earth: 3 inches.
- E. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Direct wire tie ends into concrete, not toward exposed concrete surfaces.
- F. Field bending of reinforcement:
  - 1. Field bending of plain reinforcement shall be performed using an approved and appropriate sized portable hydraulic device that makes ACI-approved radius bends. No other field bending method shall be permitted.
  - 2. No field bending shall be permitted for epoxy coated reinforcement.
- G. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces one full mesh and lace splices with wire.

### 3.06 MASS CONCRETE PLACEMENT

- A. The maximum temperature differential (MTD) between the interior and exterior concrete surfaces should not exceed 35 degrees F.
- B. To control the heat of hydration during the placement and curing process, the following shall be observed:
  - 1. When proportioning mass concrete mix design, the use of ground granulated blast furnace slag (GGBFS) may be considered.
  - 2. Internal heat of concrete could be removed using an appropriate combination of cooling coils, adding cooled water to the mix, and spraying aggregate for evaporative cooling effect.
  - 3. Insulation shall be provided for the exterior surface of concrete to prevent rapid cooling.
  - 4. Concrete pours shall be placed in vertical lifts not exceeding 24 inches. Revibrate previously deposited concrete when new lifts are placed.
  - 5. CONTRACTOR shall engage the services of a qualified testing laboratory to monitor the internal and surface temperature for at least 7 days after placement is completed.



### 3.07 JOINTS

- A. Locate and install construction joints as shown or, if not shown, locate so as not to impair strength and appearance of structures, at intervals not to exceed 50 feet. For construction joints in water-containing structures or tanks or in water-restraining structures, use watertight joints.
- B. Continue reinforcement across construction joints, unless otherwise noted. Mechanical inserts with threaded studs are not accepted as substitutes for through-dowels.
- C. Locate construction joints in floor system at or near middle of span in slabs, beams, or girders unless beam intersects girders at this point. Then, where not shown on Drawings, joints in girders shall be offset distances twice the width of beams, and provisions made for shear by web reinforcement across joints.
- D. Provide watertight joints to prevent water seepage. Take special care in finishing surfaces to which succeeding concrete is bonded. Provide waterstops in joints if shown. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops according to manufacturer's printed instructions.
- E. Provide isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces of column pedestals, foundation walls, and grade beams.
- F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction (control) joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 3/16 inch by 1/4 slab depth or inserts 1/4-inch wide by 1/4 of slab depth unless otherwise noted.
  - 1. If joint pattern is not shown, provide joints at 15 feet at most in either direction, with locations to conform to bay spacing wherever practical (at column centerlines, half-bays, third-bays).
  - 2. Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
  - 3. Cut contraction joints in unexposed floor slabs by saw cuts as soon as practical after slab finishing when it can be safely done without dislodging aggregate.

### 3.08 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into Work anchorage devices and other embedded items required for other work that are attached to, or supported by, cast-in-place concrete. Use

setting drawings, diagrams, instructions and directions provided by suppliers of attachment items.

- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain set elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support screed strips by use of strike-off templates or accepted compacting screeds.
- C. Conduits and pipes of aluminum shall not be embedded in structural concrete unless they are effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- D. PVC Waterstops:
  - 1. Field butt splices shall be heat fused using a Teflon-coated thermostatically controlled waterstop splicing iron at approximately 380 degrees F following manufacturer's recommendations. Lapping of waterstop or use of adhesives shall not be allowed.
  - 2. Center the waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12 inches on center along length of waterstop and wire tie to adjacent reinforcing steel. Do not drive nails or otherwise puncture additional holes in the waterstop when forming.
- E. Bentonite and Hydrophylic Waterstops:
  - 1. Adhere waterstop to substrate using manufacturer's recommended adhesive.
  - 2. Tightly butt ends of waterstop together to form a continuous waterstop. Do not lap waterstop.
  - 3. Verify that minimum concrete per manufacturer's recommendations will occur along waterstop's entire length. Do not install waterstop in keyways.
  - 4. Follow manufacturer's recommended installation procedures.

### 3.10 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue, repair and patch to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with form-coating compounds before placing reinforcement.
- C. Thin form-coating compounds only with acceptable thinning agents, quantity, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete is placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with non-staining, rust-preventive form oil to protect against rusting. Rust-stained steel formwork is not acceptable.

### 3.11 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, reinforcing steel, waterstop installation, and other embedded or cast-in items.
  - 1. Notify other crafts to permit installation of their work.
  - 2. Cooperate with other trades in setting their work.
  - 3. Moisten wood forms immediately before placing concrete where form coatings are not used.
  - 4. Apply temporary protective covering to lower 2 feet of finished walls where adjacent floor slabs are poured to guard against spattering during slab placement.
- B. Comply with ACI 304R and as specified in this Section.
- C. Discharge Concrete at Site within 1-1/2 hours after cement is added to water or aggregates. When air temperature exceeds 85 degrees F, the discharge time shall be less than 45 minutes. The 45-minute requirement may be waived with the use of a water reducing, retarding admixture and approval of ENGINEER.
- D. Provide trip ticket in duplicate for each ready-mixed concrete load delivered, stating truck number, Project name, CONTRACTOR and producer, batching time, total yards of concrete and material contained therein. Show ticket to ENGINEER upon request. Fill in concrete discharge time and turn over to ENGINEER trip ticket copies at end of each day.
- E. Deposit concrete continuously or in layers so that no concrete is placed on concrete which has hardened sufficiently to cause seams or planes of weakness. If section cannot be placed continuously, provide construction joints as specified. Deposit concrete as nearly as practical to its final location to avoid segregation.
- F. When depositing by chute, provide equipment of size and design to ensure continuously flowing concrete. Provide discharge end of chute with baffle plate to prevent segregation. Position chute so that concrete need not flow more than 5 feet horizontally.
- G. Do not drop concrete from chute end distances greater than 3 times the deposited layer thickness, nor more than 5 feet. Where distance from chute end to surface of concrete exceeds these distances, use spout and maintain lower end as near to deposit surface as practical. When operations are intermittent, discharge chutes into hoppers.
- H. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches to avoid inclined construction joints. Where placement involves several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Fill bottom of wall space with 2 to 4 inches of cement slurry immediately before depositing concrete in walls. Use cement slurry composed of 1 part Portland cement, 2 parts fine aggregate, and sufficient water (but not to exceed 0.45 parts) for 7-inch slump mixture.
  2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for concrete consolidation in accordance with ACI recommended practices.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible machine effectiveness. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into concrete layers that have begun to set. At each insertion, limit duration to time necessary to consolidate concrete and complete reinforcement embedment and other embedded items without causing mix segregation. Keep vibrators away from waterstops to prevent displacement.
- I. Placing Concrete Slabs: Deposit and consolidate concrete slabs in continuous operations between construction joints until panel or section placement is complete.
1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces before beginning finishing operations.
  3. Maintain reinforcing in proper position during concrete placement operations.
  4. Maintain waterstop in proper position during concrete placement operations.
  5. Concrete Placement against Expanding Bentonite Waterstop. Direct concrete flow away from bentonite water stops. If flow cannot be away from bentonite, direct flow parallel to waterstop.
  6. Moisten soil when depositing concrete directly on granular soil.
- J. Cold Weather Placing: Protect concrete work from physical damage or reduced strength attributed to frost, freezing actions, or low temperatures by using techniques in ACI 306R and as specified in this Section.
1. When air temperature has fallen to, or is to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain concrete mixture temperature not less than 50 degrees F, and not more than 80 degrees F at placement point.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- K. Hot Weather Placing: When air temperature is above 85 degrees F, conditions could exist that would seriously impair quality and concrete strength; place concrete in compliance with ACI 305R and as specified in this Section.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85 degrees F. Chill mixing water or use chopped ice to control temperature. If using ice, water equivalent of ice is included in total mixing water quantity. Using liquid nitrogen to cool concrete is CONTRACTOR's option.
  2. Cover reinforcing steel with water-soaked burlap, if steel becomes too hot, to reduce steel temperature so not to exceed ambient air temperature immediately before embedment in concrete.
  3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete.
  4. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

### 3.12 FINISH OF FORMED SURFACES

- A. Rough Form Finish: Use for formed concrete surfaces not exposed to view in finish Work during normal operation or maintenance, or by other construction and not covered with coating or covering material applied directly to concrete. This concrete surface has texture imparted by form-facing material. Tie holes and defective areas are repaired and patched, and fins and other projections exceeding 1/4-inch in height are rubbed down or chipped off.
- B. Smooth Form Finish: Use for formed concrete surfaces exposed-to-view, during normal operation or maintenance, or are covered with coating or covering material applied directly to concrete, including waterproofing, dampproofing, painting, or other similar system. This is as-cast concrete surface obtained with selected form material, arranged orderly and symmetrically with minimum seams. Repair and patch defective areas. Remove and smooth fins or other projections completely. Fill major air void holes.
- C. Grout Cleaned Finish: Provide grout-cleaned finish to scheduled formed concrete surfaces that are painted, stained, or waterproofed after receiving smooth form finish treatment.
1. Combine 1 part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to consistency of thick paint. Proprietary additives may be used at CONTRACTOR's option. Blend standard Portland cement and white Portland

cement, quantities determined by trial patches, so that dry grout color matches adjacent surfaces.

2. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for 36 hours after rubbing.

- D. Related Unformed Surfaces: At horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with texture matching adjacent formed surfaces. Continue surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless shown otherwise.

### 3.13 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise shown.
1. After placing slabs, plane surface to tolerances for floor flatness (FF) of 15 and floor levelness (FL) of 13 in accordance with ASTM E 1155.
  2. Slope surfaces uniformly to drains. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified, and slab surfaces which are covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise shown.
1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit power-driven float operation. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units.
  2. Check and level surface plane to tolerances of floor flatness (FF) of 18 and floor levelness (FL) of 15 in accordance with ASTM E 1155.
  3. Cut down high spots and fill low spots.
  4. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.
- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces exposed-to-view, and slab surfaces covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
1. After floating, begin first trowel finish operation using power-driven trowels. Begin last troweling when surface produces ringing sound when trowel moves

over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance.

2. Check and level surface plane to tolerances of floor flatness (FF) of 20 and floor levelness (FL) of 17 in accordance with ASTM E 1155.
  3. Grind smooth surface defects that would telegraph through applied floor covering system.
- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- E. Nonslip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, ramps, and elsewhere as noted.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required finish with ENGINEER before application.
- F. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors and to exposed exterior top of supported slabs and domes, water-containing floors excepted. Apply liquid chemical-hardener after curing and drying of concrete surfaces.
1. Apply chemical hardeners, 3 coats, according to manufacturer's printed instructions.
  2. After chemical-hardener final coat has dried, remove surplus hardener by scrubbing and mopping with water.

### 3.14 CONCRETE CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. Maintain curing as follows:
1. All concrete unless otherwise noted: 7 days.
  2. High-early-strength concrete: 3 days.
  3. Mass concrete with ground granulated blast furnace slag: 14 days.
- B. Curing Methods: Cure concrete for water-retaining structures by moist curing. Cure concrete for other structures by curing compound, moist curing, moisture-retaining cover curing, or combinations thereof.
- C. Provide Moist Curing by following methods:
1. Keep concrete surface continuously wet by covering with water.

2. Continuous water-fog spray.
3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to cover concrete surfaces and edges, with 4 inches lap over adjacent absorptive covers.

D. Provide Moisture-Retaining Cover Curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped 3 inches and sealed by waterproof tape or adhesive.
2. Immediately repair holes or tears during curing period using cover material and waterproof tape.

E. Provide Curing Compound as follows:

1. Apply specified curing compound to concrete slabs as soon as last finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain coating continuity and repair damage during curing period.
2. Transparent curing compound shall be used for structural concrete (Class A concrete). White curing compound shall be used for exterior pavements (Class P concrete) and sidewalks (Class B concrete).
3. Do not use membrane curing compounds on surfaces that are covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to ENGINEER.

F. Curing Formed Surfaces: Cure formed concrete surfaces, including beam undersides, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If form removal occurs before curing period is up, continue curing by methods specified above as applicable.

G. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

### 3.16 FORM REMOVAL

- A. Vertical Forms not supporting concrete weight may be removed when concrete has sufficiently set to resist damage from removal operation.
- B. Other forms shall be left in place until concrete has attained strength to support its own weight and construction live loads, unless removed in sections, and each structural section immediately reshored.



- C. Time Periods: Forms remain in place as shown in table below. If form removal occurs before time shown in the table, apply curing procedures previously specified.

Minimum Time Forms are to Remain in Place:

Part of Structure	Average Air Temperature* During Period	
	40 - 50 degrees F	50 degrees F
Walls, columns and sides of beam (hours)	72	24
Bottom forms for slabs, beams arches not reshored (days)	12	7
Bottom forms for slabs, beams and arches if reshored (days)	7	4

\* Air temperature near form.

### 3.18 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in Work. Split, frayed, delaminated, or damaged form-facing materials are not acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When extending forms for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

### 3.19 MISCELLANEOUS CONCRETE ITEMS

- A. Fill-in holes and openings left in concrete structures for work by other trades, unless otherwise shown or directed. Do fill in after other trades' work is in place. Mix, place, and cure concrete to blend with in-place construction. Provide other miscellaneous concrete filling shown to complete Work.
- B. Concrete Curbs: Provide concrete curbs wherever shown on Drawings. Open stairwells, floor openings, and balcony edges usually require curbs. Construct curbs as detailed, with 1-inch radius top edges. Coves are not required at intersections with structural floors. Coves are required at intersections with top course floor finishes or monolithic floor finishes.

- C. Removal of Existing Concrete: Remove existing concrete where shown or required. Neatly finish concrete edges remaining in place and exposed to view in finished structure with cement mortar.
  - 1. Concrete cutting shall be done competently without injury to remaining portions of structures.
- D. Bonding New to Old Concrete: Where shown on Drawings, existing concrete surfaces against which new concrete is placed shall be thoroughly cleaned and brush-coated with bonding agent. Follow manufacturer's directions, especially on material working time.
- E. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with approved Shop Drawings from manufacturer-furnishing machines and equipment.
  - 1. Grout baseplates and foundations using specified and approved nonshrink grout.

### 3.20 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after form removal.
  - 1. Cut out honeycomb, rock pockets, voids over 1/4-inch in dimension, and holes left by tie rods and bolts, down to solid concrete but no less than 1 inch deep. Make cuts perpendicular to concrete surface. Thoroughly clean, dampen with water, and brush-coat patched area with specified bonding agent. Place patching mortar after bonding compound has set as recommended by manufacturer.
  - 2. For exposed to view surfaces, blend white Portland cement and standard Portland cement so, when dry, patching mortar matches surrounding color. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and install new concrete having defective surfaces if defects are irreparable to satisfaction of ENGINEER. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins, and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
  - 1. Repair concealed formed surfaces, where practical, containing defects which affect concrete durability. If defects are irreparable, remove and install new concrete.

- C. Repair of Unformed Surfaces: Test unformed surfaces for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as specified in this Section. Test unformed surfaces sloped to drain for slope trueness using templates having required slope.
1. Repair finished unformed surfaces containing defects which affect concrete durability. Defects include crazing, cracks more than 0.01-inch wide or which penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
  2. Correct high areas in unformed surfaces by grinding, after concrete has cured 14 days.
  3. Correct low areas in unformed surfaces during or immediately after surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to ENGINEER.
  4. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with 3/4-inch clearance around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete to provide same concrete type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- D. Repair isolated random cracks and single holes not over 1-inch in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete. Clean out dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing No. 16 mesh sieve, using only enough water as specified for handling and placing. Place dry-pack after bonding compound has set per manufacturer's instructions. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
- E. Repair Leaking Cracks: Where practical, seal off cracks on water contact face with waterproofing or dampproofing material. If this is not practical or if leakage persists, then repair cracks on exposed faces by routing out square groove not less than 1-inch wide by 1-inch deep, applying slurry bond coat and filling with stiff nonshrink mortar. Bond coat and mortar shall be cementitious crystalline concrete waterproofing material. Follow manufacturer's application and curing instructions. Match repair patch finish in color and texture to original.
- F. Structural Repairs: Do structural repairs with prior approval by ENGINEER for method and procedure using specified epoxy adhesive and mortar.

- G. Repair Methods: ENGINEER may allow use of other nonspecified methods subject to review and acceptance by ENGINEER.

### 3.21 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Provide qualified personnel and employ testing laboratory, approved by ENGINEER, to do tests and to submit test reports.
- B. Sampling Fresh Concrete: ASTM C 172, except modified for slump and air-content tests to comply with ASTM C 94.
  - 1. Slump: ASTM C 143, one each time compression test specimens are made; additional tests when concrete consistency seems to have changed.
  - 2. Air Content: ASTM C 231, pressure method, one each time compression test specimens made.
  - 3. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F and above; and each time compression test specimens are made.
  - 4. Compression Test Specimen: ASTM C 31, four standard cylinders for each compressive strength test set, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens.
  - 5. Compressive Strength Tests: ASTM C 39, one set for each day's pour exceeding 5 cubic yards plus additional set for each 100 cubic yards over and above first 50 cubic yards of each concrete class placed in 1 day; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and 1 specimen retained in reserve for later testing if required.
- C. Test Results: Report test results in writing to ENGINEER and CONTRACTOR within 24 hours after tests. Compressive strength test reports shall contain Project identification name and number, concrete placement date, concrete testing service name, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and break type for both 7-day tests and 28-day tests.
- D. Acceptance: Concrete strength shall be considered satisfactory if averages of 3 consecutive strength test results equal or exceed specified 28-day compressive strength ( $f'c$ ), and no individual strength test result falls below specified compressive strength by more than 500 psi.
- E. Failure to Meet Requirements:
  - 1. Should 7-day compressive strengths shown by test specimens fall below 65 percent of required 28-day strength ( $f'c$ ), ENGINEER will have the right to

require changes in proportions for remaining Work. Furthermore, ENGINEER will have the right to require additional curing, as specified in this Section, on those portions or structures represented by failed test specimens.

2. Should 28-day compressive strengths ( $f'c$ ) test results fail to meet required strength, core-boring tests conforming to ASTM Standard C 42 shall be made at CONTRACTOR's expense within 60 days of that concrete placement.
- F. At locations where concrete quality is deemed questionable by ENGINEER, core-boring tests shall also be made at CONTRACTOR's expense.
  - G. Concrete is acceptable if average strength of 3 cores is at least 85 percent and no single core is less than 75 percent of required minimum allowable 28-day compressive strengths ( $f'c$ ). If core-boring test results fail to meet strength requirements, ENGINEER will have right to require strengthening or replacing those portions of structures which failed to develop specified strength.
  - H. Provide additional curing when ordered by ENGINEER because of failure to meet requirements. It shall be done at CONTRACTOR's expense, and no claim for extra compensation for additional curing will be allowed. Additional curing shall extend period of protection. Additional curing is limited to 60 days.
  - I. Additional Tests: Testing service shall make additional in-place concrete tests when test results suggest specified concrete strengths and other characteristics have not been attained. Testing service may conduct tests to determine adequacy by cored cylinders complying with ASTM C 42, or by other approved methods. CONTRACTOR shall pay for additional tests when unacceptable concrete is verified.

END OF SECTION

## SECTION 15060

### PVC PRESSURE PIPE, SOLVENT-WELDED (ASTM D 1785, MODIFIED)

#### PART 1 -- GENERAL

##### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents. This Section specifies PVC pressure pipe with solvent-welded or flanged. Screwed or threaded PVC joints are not allowed.

##### 1.2 CONTRACTOR SUBMITTALS

- A. CONTRACTOR shall submit manufacturer's data.
- B. The CONTRACTOR shall provide manufacturer's list of approved solvent and primers for each type of pipe.

#### PART 2 -- PRODUCTS

##### 2.1 PIPE MATERIAL

- A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, Schedule 80, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 80, as called out on the Drawings.

##### 2.2 PIPE JOINTS

- A. Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM D 2564 - Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems, and with primer in accordance with ASTM F 656 - Primers for use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings. Thread sealant will not be permitted. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene.

##### 2.3 FITTINGS

- A. Solvent Welded: Solvent-welded shall be Schedule 80 PVC fittings in accordance with ASTM D 2464 - Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
- B. Flanged Fittings: Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. Flanges in accordance with ANSI/ASME B 16.5.

## 2.4 GLUE AND PRIMER

- A. Solvent cement shall meet the requirements of ASTM D 2564 – Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems.
- B. Primers shall meet the requirements of ASTM F 656 – Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.

## PART 3 -- EXECUTION

### 3.1 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Pipe fittings shall be thoroughly cleaned before assembly.

### 3.2 PIPE JOINTS

- A. General: PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. It is recommended that the CONTRACTOR obtain the assistance of the pipe manufacturer's field representative to instruct the pipefitters in the correct installation and support of PVC piping.
- B. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket. The pipe manufacturer shall approve cement and primer.
- C. Supports and Anchors: Piping shall be firmly supported with fabricated or commercial hangers or supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.
- E. Flange Joints: Flanged joints shall be made with gaskets and Type 316 American made stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

### 3.3 INSPECTION, FIELD TESTING, AND DISINFECTION

- A. Inspection: Finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Incomplete installation or damage shall be repaired to the satisfaction of the OWNER.
- B. Field Testing: The CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. When services are hot-tapped into an existing live pressure main, the PVC service piping shall be service tested with corporation stops open and curb stops closed. The service test shall be a witnessed visual inspection for leaks conducted at the existing main work pressure prior to backfilling and compacting the service. When the PVC service piping is installed as a part of a new system, the services shall be tested as a part of the main testing. CONTRACTOR shall verify that all new corporation stops are open prior to performing testing of the mains. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices.
- C. Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures. Testing shall be as specified in Section 02666 – Pressure Pipeline Testing and Disinfection.
- D. Leaks shall be repaired to the satisfaction of the OWNER, and the system shall be re-tested until no leaks are found.

-END OF SECTION-



## SECTION 15115

### VALVE ACTUATORS, ELECTRIC

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

Electric valve operators and appurtenances specified in this Section and shown on the Drawings.

##### 1.02 SYSTEM DESCRIPTION

- A. General: Furnish and install, electric, plug valve actuators for the following: two 16-inch plug valves located near ground level at the aeration tanks.

##### 1.03 SUBMITTALS

- A. General: As specified in:
  - 1. This Section.
- B. Submit the following prior to valve manufacture:
  - 1. Outline of manufacturer's representative services.
- C. Submit the following prior to valve installation:
  - 1. Manufacturer's installation instructions.
  - 2. Manufacturer's Operation and Maintenance Data.

##### 1.04 QUALITY ASSURANCE

- A. Testing: Test valve operators with valves.

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

- A. Rotork

##### 2.02 ELECTRIC ACTUATORS

- A. Electric actuator shall include motor, power gearing, limit switches, torque switches, built-in controls, de-clutch, and auxiliary handwheel for manual operation. Electric actuator shall have grease-tight, NEMA rated, weatherproof housing.

- B. Actuator shall be sized to operate valve from full open to full closed in not less than two seconds per inch of valve diameter, plus or minus 50%.
- C. Size actuators to deliver not less than 1.5 times required torque based upon maximum dynamic flow conditions.
- D. Actuator shall drive valve shaft through a worm gear operator and intermediate link. Power gearing shall consist of helical or spur type gears of alloy heat-treated steel. Worm gears shall be carbonized and hardened alloy steel and ground after heat treatment. Worm gear pinion shall be alloy bronze. Gearing shall be designed so that gear ratio can be field changed and gearing can be field repaired. Design gearing for 100% overload.
- E. Provide handwheel on electric actuator. Handwheel shall provide manual operation of valve. Handwheel shall not rotate during electric operation, and motor shall not rotate during hand operation. De-clutching lever shall mechanically (not electrically) disconnect motor drive from gear train. Failure of motor gearing or a fused motor shall not prevent hand operation. Hand operation shall not require more than 80 pounds of pull on handwheel rim. Handwheel shall rotate counterclockwise to open valve, unless otherwise specified. An arrow with the word OPEN shall be cast on handwheel. Operation shall automatically return to electric drive position when motor is energized.
- F. Provide mechanical-type valve position indicator. Valve position indicator shall show valve position at all times. Indicator shall be part of an intermediate gear head or electric motor actuator.
- G. Actuator motors shall be reversible, squirrel cage induction type. Actuator motors shall be designed for 480Volts, three phase, 60 Hertz power supply. Motors shall be totally enclosed, non-ventilated, with NEMA Class B insulation and a maximum continuous temperature rating of 120° C (rise plus ambient). Leads from motor shall be brought to limit switch compartment without external piping or conduit box.
- H. Actuators shall have integrally mounted, full-voltage NEMA rated, reversing starters.
- I. Actuators shall be provided with space heaters in the switch compartment and strip heaters in the motor.
- J. Provide two adjustable torque switches of the quick break type. Torque switches shall be responsive to excessive load encountered in either opening or closing direction. Furnish four fully adjustable, double pole, double throw limit switches in addition to switches required for built-in control. Torque and limit switches shall be rated 10 amp. at 120 VAC. Furnish switch compartments with case heater.

- K. Provide 12 contactor limit switches and gearing as an integral part of the actuator. Limit switch gearing shall be intermittent type. Limit switch gearing shall be totally enclosed in its own gear case and grease lubricated. Limit switch gearing shall be bronze.
- L. Provide limit switches for over-travel protection and four auxiliary SPDT limit switches, each rated at 8 amps, minimum. Switches shall be independently adjustable over the full range of travel. Limit switches shall be wired to a terminal board for remote output.
- M. Actuator shall respond to 3-wire control signals. The open signal shall be a pulse across the “open signal wire” and common wire. The close signal shall be a pulse across the “close signal wire” and the common wire. Latching circuits in the actuator shall cause the actuator to drive the valve to its limit of travel upon receipt of the pulse signal.
- N. Provide actuator with LOCAL/OFF/REMOTE selector switch and push buttons for local control.
  - 1. Local Control
    - a. When LOCAL/OFF/REMOTE selector switch is in the “LOCAL” position, valve shall be controlled by actuator push buttons.
    - b. Provide three push buttons for local manual operation. Push buttons shall be marked “OPEN”, “STOP”, and “CLOSE”. Actuator shall drive valve to its limit of travel when “OPEN” or “CLOSE” push buttons are depressed. Actuator shall stop when the “STOP” push-button is depressed.
  - 2. Off: When LOCAL/OFF/REMOTE selector switch is in the “OFF” position, actuator motor shall be off.
  - 3. Remote Control
    - a. When LOCAL/OFF/REMOTE selector switch is in the “REMOTE” position, valve shall be controlled by signals from a remote source.
    - b. Provide interposing relays to interface with remote devices as shown on the Electrical Drawings and specified in Division 16.
- O. Provide actuators with dry contact outputs indicating that the valve is in the “REMOTE” mode (available), and that the actuator is powered and not overloaded.
- P. Provide indicating lights as follows:
  - 1. Amber indicating light for “Power On”.
  - 2. Red indicating light for “Torque Overload”.

3. Red indicating light for "Valve Closed".
  4. Green indicating light for "Valve Open".
- Q. Wire leads for power and control signals shall be brought to a terminal board for field connection.
- R. Wiring, switches, relays, and other electrical components shall be provided in a NEMA 4X weatherproof enclosure.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

In accordance with actuator manufacturer's written instructions.

### 3.02 TESTS

- A. Hydrostatic Test: Test actuators with valves.
- B. Functional Test
1. Following installation, inspect, and operate valve actuators.
  2. After adjustments have been made and the actuator is properly lubricated, do the following:
    - a. Operate actuator with selector switch in "LOCAL" position.
      - (1) Run actuator through one complete cycle from full-closed to full-open to full-closed.
      - (2) Verify that that "STOP" push-button stops valve motion.
    - b. Operate actuator with selector switch in "REMOTE" position and test actuator operation from actuator terminal strip.
      - (1) Run actuator through one complete cycle from full-closed to full-open to full-closed.
      - (2) Verify that that remote stop signal stops valve motion.
    - c. Verify that contacts for remote monitoring of valve position and operation are functioning properly.
    - d. Verify that indicator lights are functioning properly.
    - e. Verify that limit switches are functioning properly.

END OF SECTION