

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies all labor, materials and equipment necessary for providing and installing formwork for concrete.
- B. Related Work Described Elsewhere:
 - 1. Section 03200 "Concrete Reinforcement"
 - 2. Section 03300 "Cast-in-Place Concrete"
- C. General Design: The Contractor shall be responsible for the design of all formwork and for safety in its construction, use and removal.

1.02 QUALITY ASSURANCE

- A. Qualifications: Formwork shall be constructed in accordance with the specified standards, as well as all pertinent codes and regulations. In cases where requirements of pertinent codes conflict with the requirements of these specifications, the more stringent shall govern.
- B. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:
 - 1. Standard Building Code
 - 2. ACI 347 "Recommended Practice for Concrete Formwork"
 - 3. Local codes and regulations

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Materials: Submit manufacturer's literature on form ties, spreaders, corner formers, form coatings and bond breakers.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

- A. Form Lumber: Use form lumber when in contact with exposed concrete, conforming to the following or acceptable equivalent.
- B. Lumber: Douglas Fir/Larch No. 2 grade, seasoned, surfaced on four sides.
- C. Plywood: "Plyform", Class I or II, bearing the label of the Douglas Plywood Association. (Minimum 3/4-inch thickness).
- D. Form Ties: Use form ties which do not leave an open hole through the concrete and which permit neat and solid patching at every hole. Use embedded rods with integral waterstops and cones to provide a 1-inch breakback. Wire ties and wood spreaders will not be permitted.
- E. Form Coatings: Form release coating shall be a paraffin base oil or mineral oil coating which effectively prevents absorption of moisture; prevents bonding with concrete; is non-staining to concrete; and leaves the concrete with a paintable surface.
- F. Chamfer Strips: Chamfer strips shall be polyvinyl strips or acceptable equal, designed to be nailed in the forms to provide a 3/4-inch chamfer (unless indicated otherwise) at exposed edges of concrete members.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Construction of Formwork: Forms shall be sufficiently strong to withstand the pressure resulting from the placement and vibration of concrete and shall be sufficiently rigid to maintain specified tolerances. Forms shall be sufficiently tight to prevent loss of mortar, and shall be adequately braced against lateral, upward or downward movement.
- B. Coating of Forms: Apply form coating to board forms prior to placing reinforcing. Keep form coatings off steel reinforcing, items to be embedded, and previously placed concrete.
- C. Form Erection:
 - 1. Provide a means of holding adjacent edges, ends of panels, and ends of sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects of the finished concrete. Insure that forms may be removed without damage to the surface of the finished concrete.
 - 2. Provide a positive means of adjustment of shores and struts. Insure that all settlement is taken up during concrete placing.
 - 3. Temporary openings shall be provided in wall forms to limit the free fall of concrete to a maximum of 6-feet unless an elephant trunk is used. Such openings shall be located to facilitate placing and consolidation and shall be spaced no more than 8-feet apart. Temporary openings shall also be provided in the bottom of the wall, column forms, and elsewhere as necessary to facilitate cleaning and observation immediately prior to placing.

4. Do not embed any form-tying device or part thereof other than metal in concrete.
 5. Form surfaces of concrete members except where placement of the concrete is against the ground. The dimensions of concrete members shown on the Drawings apply to formed surfaces, except where otherwise indicated.
- D. Form Reuse: Reuse only forms which maintain a uniform surface texture on exposed concrete surfaces. Apply light sanding between uses to obtain such a uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side of the plug.
- E. Removal of Forms
1. Forms and shoring for elevated structural slabs, girders, and/or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and re-shore. The following table indicates the minimum allowable time after the last concrete is placed before forms, shoring, and/or bracing may be removed.

Structural Item	Minimum Allowable Time
Bottom side of slabs, girders, beams	When concrete reaches specified 28-day compressive strength
Vertical sides of girders, beams	48-hours
Walls not supporting vertical or horizontal loads	48-hours
Walls supporting vertical or horizontal loads	When concrete reaches specified 28-day compressive strength
Footings, pipe encasements, pipe supports	24-hours

2. Do not remove forms from concrete which has been placed with outside air temperature below 50° F without first determining if the concrete has properly set regardless of the minimum times specified in the table above. Do not apply heavy loading on recently poured concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.
- F. Formed Openings: Openings shall be of sufficient size to permit final equipment alignment without deflection or offsets of any kind. Where the items pass through the wall, allow space for packing to ensure watertightness. Provide openings with continuous keyways with waterstops where required. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide reinforcement as indicated and specified. Reinforcing steel shall be at least 2-inches clear from the opening.

G. Embedded Items: Set anchor bolts and other embedded items accurately and hold securely in position in the forms until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concrete pour. Check all nailing, blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concrete pour.

H. Pipes and Wall Spools Cast in Concrete

1. Install wall spools, wall flanges, and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.
2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will be possible during Construction.

I. Form Tolerances

1. Failure of the forms to produce the specified concrete surface tolerance shall be grounds for rejection of the concrete work. Rejected Work shall be repaired or replaced at no cost to the County.
2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance
Sleeves and inserts	+1/4-inch to -1/4-inch
Projected ends of anchors	+1/4-inch to -0.0-inch
Anchor bolt setting	+1/4-inch to -1/4-inch
Finished concrete	+ 1/4-inch to -1/4-inch in 10 feet of length

The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts	Centerline of sleeve or insert
Projected ends of anchors	Plane perpendicular to the end of the anchor as located on the Drawings
Anchor bolt setting	Centerline of anchor bolts
Finished concrete	The concrete surface as located on the Drawings

3. Where equipment is to be installed, comply with manufacturer's tolerances if more stringent than above.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies reinforcing steel and welded wire mesh for cast-in-place or precast concrete structures.
- B. Related Work:
 - 1. Section 03100 "Concrete Formwork"
 - 2. Section 03300 "Cast-in-Place Concrete"
 - 3. Section 03410 "Precast Concrete Structures"

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship, and practices shall meet all requirements of the current editions of the following standards:
 - 1. Standard Building Code
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete
 - 3. ACI 315 Details and Detailing of Concrete Reinforcement
 - 4. CRSI Manual of Standard Practice, MSP-2

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Complete shop drawings shall be submitted for comment, including bar lists and placing drawings. Drawings shall show the type, spacing, and location of metal bar supports, the grade of the reinforcing and the name of the manufacturer. The type of coupler splice devices shall be designated.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed billet steel bars of a USA manufacturer.
- B. Welded Wire Fabric: ASTM A185, galvanized.
- C. Metal Bar Supports: CRSI MSP-2, Chapter 3, Class 2, Type B, Stainless Steel Protected Bar Supports.
- D. Coupler Splice Devices: Cadweld tension couplers capable of developing the ultimate strength of the bar, as manufactured by Erico Products, Incorporated, Solon, Ohio, or equal where acceptable to the County.

2.03 FABRICATION

- A. Fabrication shall meet all requirements of the specified standards. Unless otherwise indicated, the following shall apply:
 - 1. Hooks shall be standard hooks.
 - 2. Bottom bars shall extend a minimum of 6-inches into supporting members.
 - 3. Minimum cover shall be measured to the outermost stirrup, tie or bar.
 - 4. Splices are permitted only where indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Supporting Reinforcing: Bar supports shall be provided as required by CRSI MSP-2 and ACI 315. Top and bottom bars in slabs formed on earth shall be supported on precast concrete block supports except where such bars are properly supported from formwork. Precast concrete block supports are not required in slabs formed on tremie concrete but may be used at the Contractor's option.
- B. Placing Reinforcing: Placing of reinforcing steel and welded wire fabric shall conform to CRSI MSP-2, ACI 315, and the Drawings. Reinforcing shall be securely tied and supported to prevent displacement during concrete placement.
- C. Welded Wire Fabric: Splices in welded wire fabric shall be such that the overlap between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires, plus 2-inches. Fabric shall not be extended through expansion joints or construction joints in slabs on grade except as otherwise indicated on the Drawings.
- D. Coupler Splice: Unless indicated on the Drawings or where conventional lap splices cannot be achieved, full positive tension connections shall be provided. Such devices shall be installed in accordance with the recommendations of the manufacturer.

- E. Dowels: Dowels shall be wired in position prior to placing concrete.
- F. Field Bending: Heat shall not be used to bend bars. Bars shall not be bent after being embedded in concrete.
- G. Welding: Welding of reinforcing will not be permitted.
- H. Place reinforcement a minimum of 2-inches clear of any metal pipe or fittings.

END OF SECTION

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SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies cast-in-place concrete including all materials, mixing and transport, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing, and curing of concrete.
- B. Related Work Described Elsewhere:
 - 1. Section 03100 "Concrete Formwork"
 - 2. Section 03200 "Concrete Reinforcement"

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the requirements of the following standards:
 - 1. Standard Building Code
 - 2. Local Codes and Regulations
 - 3. ACI 318-83, Building Code Requirements for Reinforced Concrete
- B. Plant Qualification: Plant equipment and facilities shall meet all requirements of the checklist for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C 94.
- C. Evaluation and Acceptance of Concrete: Evaluation and acceptance of concrete will be in accordance with ACI-318, Chapter 4.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Materials and Shop Drawings: The following information shall be submitted for review. No concrete shall be furnished until the County has reviewed submittal and no exceptions taken or other favorable response has been returned.
 - 1. Plant Qualification: Satisfactory evidence shall be submitted indicating that the plant and operators have sufficient experience in providing the applicable design mix.

2. Materials: Satisfactory evidence shall be submitted indicating those materials to be used (including cement, aggregates and admixtures) meet the specified requirements.
3. Design Mix: The design mix to be used shall be prepared by qualified persons and submitted for review. Submit affidavit as to design mix performance over the preceding 6-months. The design of the mix is the responsibility of the Contractor subject to the limitations of the Specifications. Acceptance of this submission will be required only as minimum requirements of the Specifications have been met. Such acceptance will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the Specifications relative to strength and slump.
4. Ready Mix Concrete: Provide delivery tickets or weigh master's certificate per ASTM C 94, including weights of cement and each size aggregate, amount of water in the aggregate, and amount of water added at the plant. The amount of water added on the job shall be written on the ticket.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Cement

1. Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C 150 Type I, Type II or Type III. All sanitary sewer manholes, wetwells, pumping stations, tanks and structures exposed to wastewater shall be constructed with Type II cement. Type III cement for high early strength concrete shall be used only for special locations and only with the review and acceptance of the County. Type I cement may be used for buildings and tremie concrete.
2. Only 1 brand of cement shall be used in any individual structure unless acceptable by the County. Cement that has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container that contains such cement will be rejected. No salvaged or reclaimed cement shall be used.
3. Fly ash shall not be used in either Class A or Class B concrete.

B. Aggregates:

1. ASTM C 33. Coarse aggregates shall be size No. 57. Block cell fill shall be size No. 89.
2. In addition to requirements of ASTM C 33 for structures exposed to wastewater, the following shall apply:
 - a. Soft particles: 2% (2.0 percent)
 - b. Chert as a soft impurity (defined in Table 3 of ASTM C 33): 1% (1.0 percent)
 - c. Total of soft particles and chert as a soft impurity: 2% (2.0 percent)
 - d. Flat and elongated particles (long dimension > 5 times short dimension): 15%.

- C. Water: Clean and free from injurious amounts of deleterious materials.
- D. Air Entraining Admixture: ASTM C 260.
- E. Water Reducing and Retarding Admixture: ASTM C 494, Type D. Admixture shall not contain calcium chloride.
- F. Epoxy Bonding Agent: Sikastix 370, Sikadur Hi Mod, Concrevice 1001-LPL or acceptable equal.
- G. Waterproofing Material: Concrete admixture shall be manufactured and supplied by an approved manufacturer as shown in the Appendix D "List of Approved Products."

2.03 MIXES

A. General Requirements

1. Mix Design: Proportioning shall be on the basis of field experience and/or trial mixtures as specified in ACI 318, Section 4.3. Data on consecutive compression tests and standard deviation shall be submitted. Proportioning for small structures may be by the water/cement ratio under special review and acceptance by the County. Concrete mix design shall comply with the Standard Building Code requirements.
2. Air Content: 5% plus or minus ($\pm$) 1% (Class A and B).
3. Slump: 4-inches plus or minus ($\pm$) 1-inch. 8-inches plus or minus ($\pm$) 1-inch for tremie concrete.
4. Water/cement ratio = 0.45 maximum (all concrete exposed to hydrostatic loading), 0.50 maximum (all other concrete).
5. Minimum Compressive Strength at 28-days
 - a. Class A, 4,000-psi: Water and wastewater structures inclusive of tanks, ditches, pumping stations, tremie concrete and other structures in contact with process water.
 - b. Class B, 3,000-psi: Building structures, curb and gutters, slabs, walks, encasements, thrust blocks, and pipe supports, etc. not in contact with process water.
 - c. Class C, 2,500-psi: Mix wherever specified in the standard drawings such as A103, A112, A303, A406 and A407-2.

B. Production of Concrete

1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C 94, except as otherwise indicated.
2. Air Entraining Admixture: Air entraining admixture shall be charged into the mixture as a solution and shall be measured by means of an acceptable mechanical dispensing device. The liquid shall be considered a part of the mixing water.

3. Waterproofing admixture: New concrete structures shall contain a crystalline waterproofing concrete admixture. Crystalline waterproofing concrete admixture shall be added to the concrete during the batching operation. The admixture concentration shall be added based upon manufacturer design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admixture was added to the concrete for all precast structures. Colorant shall be added and provided at the admixture manufacturing facility, not at the concrete batch plant. It is recommended that the admixture be added first to the rock and sand and blended thoroughly before adding cement and water or per the manufacturer's recommendations. Concrete structures without crystalline waterproofing admixture or admixture without colorant for field verification shall be rejected. Contractor shall provide certification the admixture was installed in accordance with the manufacturer's recommendations.
 4. Water Reducing and Retarding Admixture: Water reducing and retarding admixture shall be added and measured as recommended by the manufacturer. The addition of the admixture shall be completed within 1-minute after addition of water to the cement has been completed, or prior to the beginning of the last 3/4 of the required mixing, whichever occurs first. Admixtures shall be stored, handled and batched in accordance with the recommendations of ACI 68.
- C. Delivery Tickets: In addition to the information required by ASTM C 94, delivery tickets shall indicate the cement content and the water/cement ratio.
- D. Temperatures: The temperature of the concrete upon delivery from the truck shall not exceed 90° F.
- E. Modifications to the Mix: No modifications to the mix shall be made in the plant or on the job which will decrease the cement content or increase the water/cement ratio beyond that specified.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Preparations before Placing: No concrete shall be placed until the review and acceptance of the County has been received. Acceptance will not be granted until forms are clean and reinforcing and all other items required to be set in concrete have been placed and thoroughly secured. The County shall be notified a minimum of 24-hours before concrete is placed.
- B. Conveying:
1. General: Concrete shall be handled from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete. No concrete shall be placed more than 90-minutes after mixing has begun for that particular batch.

2. Buckets and Hoppers: Buckets and hoppers shall have discharge gates with a clear opening equal to no less than 1/3 of the maximum interior horizontal area, or 5 times the maximum aggregate size being used. Side slopes shall be no less than 60° (degrees). Controls on gates shall permit opening and closing during the discharge cycle.
3. Runways: Extreme care shall be exercised to avoid displacement of reinforcing during the placing of concrete.
4. Elephant Trunks: Hoppers and elephant trunks shall be used to prevent the free fall of concrete of more than 6-feet.
5. Chutes: Chutes shall be metal or metal lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-feet long and chutes not meeting the slope requirements may be used only if they discharge into a hopper before distribution.
6. Pumping Equipment: Pumping equipment and procedures shall conform to the recommendations contained in the report of ACI Committee 304 on "Placing Concrete by Pumping Methods," ACI 304.2R-71. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1-1/2-inches.
7. Conveying equipment Construction: Aluminum or aluminum alloy pipe for tremies or pump lines and chutes, except for short lengths at the truck mixer shall not be permitted.
8. Cleaning: Conveying equipment shall be cleaned at the end of each concrete operation.

3.02 APPLICATION

A. Placing:

1. General: Concrete shall be deposited continuously, or in layers of such thickness (not exceeding 2-feet in depth) that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness.
2. Supported Elements: At least 2-hours shall elapse after depositing concrete in columns or walls before depositing in beams, girders, or slabs supported thereon.
3. Segregation: Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to procedures that will cause segregation.
4. Concrete Underwater: All concrete, except that indicated on the Drawings as tremie concrete, shall be placed in the dry.

B. Seals and Tremie Concrete

1. General
 - a. Wherever practicable, all foundation excavations shall be dewatered and the concrete deposited in the dry. Where conditions are encountered which render it impracticable to dewater the foundation before placing concrete, a concrete foundation seal shall be placed. The foundation shall then be dewatered, and the balance of the concrete placed in the dry.

- b. When seal concrete is required to be placed, the satisfactory performance of the seal in providing a watertight excavation for placing structural concrete shall be the responsibility of the Contractor. Seal concrete placed by the Contractor, which subsequently fails to perform properly, shall be repaired as necessary to perform its required function, at the expense of the Contractor.
 2. Method of Placing: Concrete deposited underwater shall be carefully placed in the space in which it is to remain by means of a tremie, a closed-bottom dump bucket of not less than 1-cubic yard capacity, or other approved method, and shall not be disturbed after it is deposited. All seal concrete shall be deposited in 1 continuous pour. No concrete shall be placed in running water. All formwork designed to retain concrete underwater shall be watertight, and the design of the formwork and excavation sheeting shall be by a Professional Engineer, registered in the State of Florida.
 3. Use of Tremie: The tremie shall consist of a tube having a minimum inside diameter of 10-inches, and shall be constructed in sections having tight joints. No aluminum parts that have contact with the concrete will be permitted. The discharge end shall be entirely seated at all times, and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised (but not out of the concrete at the bottom) until the batch discharges to the bottom of the hopper, after which the flow shall be stopped by lowering the tremie. The means of supporting the tremie shall be such as to permit the free movement of the discharge end over the entire top surface of the Work, and shall permit it being lowered rapidly when necessary to choke off or retard the flow. The flow shall preferably be continuous, and in no case shall be interrupted until the Work is completed. Special care shall be exercised to maintain still water at the point of deposit.
 4. Use of Bottom-dump Bucket: When the concrete is placed by means of a bottom-dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. The bucket shall then be raised very slowly during the discharge travel; the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture. Aluminum buckets will not be permitted.
 5. Time of Beginning Pumping: Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than 72-hours after placement of the concrete.
- C. Consolidating Concrete:
1. General: Concrete shall be consolidated by means of internal vibrators operated by competent workmen.
 2. Vibrators: Vibrators shall have a minimum head diameter of at least 2-inches, a minimum centrifugal force of 700-pounds and a minimum frequency of 8,000 vibrations per second.
 3. Vibrators for Confined Areas: In confined areas, the specified vibrators shall be supplemented by others having a minimum head diameter of 1-1/2-inches, a minimum centrifugal force of 300-pounds and a minimum frequency of 9,000 vibrations per second.

4. Spare Vibrator: One (1) spare vibrator for each 3 in use shall be kept on the site during all concrete placing operations.
 5. Use of Vibrators: Vibrators shall be inserted and withdrawn at points approximately 18-inches apart. The duration of each insertion shall be from 5 to 15-seconds. Concrete shall not be transported in the forms by means of vibrators.
- D. Protection: Rainwater shall not be allowed to increase the amount of mixing water, or to damage the surface finish. Concrete shall be protected from construction over-loads. Design loads shall not be applied until the specified strength has been attained.

3.03 CONCRETE FINISHING AND CURING

- A. All slabs exposed to view shall receive a steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.
- B. All other slabs and footings shall receive a smooth steel trowel finish.
- C. All walls of structures or parts of buildings exposed to view shall receive the following:
 1. Repair defective concrete, remove fins, fill depressions 1/4-inch or deeper, and fill tie holes.
 2. Any surface not receiving a special applied finish, shall receive a slurry finish consisting of 1 part cement and 1-1/2 parts sand by damp loose volume. Dampen surfaces and then apply the slurry with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
 3. Surfaces that will receive a special applied finish shall be of even color, have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff bristle fiber brush shall produce no dusting or dislodging of cement or sand.
- D. All concrete shall be wet cured a minimum of 7-days; or if not to receive special finishes, coatings or concrete toppings, an acceptable curing compound may be utilized.
- E. All surface defects shall be repaired by removing defective concrete down to sound concrete and repairing with patching mortar. Finished repair shall match adjacent concrete and be cured as specified.

3.04 TESTING

- A. A testing laboratory, acceptable by the County, shall perform required testing. The Contractor shall pay for all tests indicating a failure to comply with the Specifications. The Contractor shall keep the laboratory informed of his schedule.

- B. Standard laboratory compressive test cylinders shall be obtained by the laboratory when concrete is discharged at the point of placing (i.e., discharge end of pumping equipment), and cylinders shall be made and cured in accordance with the requirements of ASTM Designation C 31. A set of 4 cylinders shall be obtained for each 50-cubic yards, or fraction thereof, placed each day for each type of concrete. The cylinders shall be cured under laboratory conditions and shall be tested at 7 and 28-days of age in accordance with the requirements of ASTM Designation C 39.
- C. The testing laboratory shall make slump tests of Class A and Class B concrete as it is discharged from the mixer at the point of placing. Slump tests shall be made for each 25-cubic yards or "pour" of concrete placed. Slump tests may be made on any batch, and failure to meet specified slump requirements shall be sufficient cause for rejection of that batch.

END OF SECTION

SECTION 03410
PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies the materials, labor and equipment required to construct manholes, wetwells, valve vaults, mitered end sections, meter boxes and all other precast concrete structures, as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards.
 - 1. Standard Building Code
 - 2. Local Codes and Regulations
 - 3. ACI Building Code Requirements for Reinforced Concrete
 - 4. American Society for Testing and Materials (ASTM)
 - 5. American Concrete Institute (ACI)
- B. The forms, dimensions, concrete, and construction methods shall be acceptable to the County in advance of construction.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. The Contractor shall submit Shop Drawings to the County, showing all details of construction, reinforcing and joints.
- C. Submit manufacturer's data on certifications and testing for concrete waterproofing additive, joint mastic, gaskets and grout material to be used.

1.04 INSPECTION

- A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and acceptance by the County. Such inspection may be made at the place of manufacture or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time due to failure to meet any of the specification requirements; even though sample sections may have been acceptable as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All damaged sections will be rejected. If damaged sections have already been installed; they shall be acceptably repaired if authorized by the County, or removed and replaced at the Contractor's expense.
- B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified and the acceptable manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch strength", blisters, cracks, roughness, and soundness. The surface shall be dense and close textured.
- C. Imperfections may be repaired subject to the review and acceptance of the County after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final review and acceptance. Cement mortar used for repairs shall have a minimum compressive strength of 4,000-psi at the end of 7-days and 5,000-psi at the end of 28-days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the review and acceptance of the County.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 PRECAST CONCRETE SECTIONS

- A. Precast concrete wetwell sections, manhole barrel and eccentric top sections shall conform to specifications for precast reinforced concrete manhole sections, ASTM Designation C478, except as otherwise specified below or as shown on the Drawings. Details of precast sections shown on the Drawings, including thickness and reinforcing, shall supersede ASTM C-478 when such details are more stringent than ASTM C-478. The method of construction shall conform to the detailed Drawings appended to these specifications and the following additional requirements:
 - 1. The minimum wall thickness for the various size barrel sections shall be 5-inches, or as indicated in the Drawings.
 - 2. Barrel sections shall have tongue and groove joints. Joints shall be sealed with cold adhesive preformed plastic gaskets set in double rows on the tongue and in the groove prior to setting the next section. Gaskets shall be K.T. Snyder "Ram-Nek", Conseal "CS-102" or acceptable equal. All extension joints shall be sealed with Portland Type II cement after setting of gasket and placement of manhole section into a watertight joint.

3. Type II cement shall be used except as otherwise accepted.
4. New concrete structures shall contain a crystalline waterproofing concrete admix for all new concrete structures including but not limited to manholes, ARV vaults, wetwells, and wetwell top slabs. Crystalline waterproofing concrete admix shall be added to the concrete during the batching operation. Admixture concentration shall be added based upon manufacturer's design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admixture was added to the concrete. Colorant shall be added and provided at the admixture manufacturing facility, not at the concrete batch plant. It is recommended that the admixture be added first to the rock and sand and blended thoroughly before adding cement and water or per the manufacturer's recommendations. Concrete structures without crystalline waterproofing admixture or admixture without colorant for field verification shall be rejected. Contractor shall provide certification from the pre-caster that the admixture was added in accordance with the manufacturer's recommendations. Concrete admixture shall be manufactured and supplied by an approved manufacturer as shown in Appendix D "List of Approved Products."
5. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section. Each section must be inspected and stamped by an accredited testing laboratory.
6. Sections shall be cured by an acceptable method for at least 28-days.
7. Manhole top sections shall be eccentric except that precast concrete slabs shall be used where cover over the top of the pipe is less than 4-feet for all manholes. Lift rings or non-penetrating lift holes shall be provided for handling precast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the manhole sections.
8. Precast concrete slabs over top section, where required, shall be capable of supporting the overburden plus a live load equivalent to ASHTO H 20 loading.
9. The tops of bases shall be suitably shaped to mate with the adjoining precast section.
10. Precast leveling rings for setting cast iron frames over manholes shall be 2-inch thick and have 1 (one) Number 2 continuous reinforcing steel bar.
11. Concrete surfaces shall have form oil, curing compounds, dust, dirt, and other interfering materials removed by brush sand blasting and shall be fully cured prior to delivery.
12. Interior surfaces of manholes, wetwells and valve vaults shall be lined in accordance with Appendix D "List of Approved Products."
13. Manholes to be installed around existing gravity sewers shall consist of a cast-in-place concrete base slab and precast concrete barrel and top sections; lined per Section 3410 – 2.01.11. The base slab shall be as shown on the Drawings and include a joint which is compatible with the bottom barrel section and acceptable to the County. The bottom barrel section shall include an inverted "U-shaped" slot to allow installation of the section over existing pipes. Flow channels shall be provided within the manholes as shown on the Drawings. Annular space between the existing pipe and slot shall be made watertight with non-shrink grout. Existing pipes shall be removed within the manhole and outlets plugged watertight with non-shrink grout as shown on the Drawings.

14. The manholes shall have an invert channel shaped to correspond with the lower half of the pipe. The top of the shelf shall be at the elevation indicated and shall be sloped to drain toward the flowing through channel. Every effort shall be made by the Contractor to construct watertight structures.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All manholes and other precast structures shall be set in the dry.
- B. Manholes and other precast structures shall be constructed to the dimensions as shown on the Drawings and as specified herein.
- C. The base structure may be cast-in-place concrete as specified in Division 3. The concrete structure shall be placed on the required crushed stone base as shown in the Drawings over a dry sub base of structural fill that has been compacted to 95% (percent) of the maximum dry density as determined by the modified proctor test, ASTM D1557. The tops of the cast in place bases shall be shaped to mate with the precast barrel section and shall be adjusted in grade so that the top of the dome section is at the correct elevation.
- D. Precast bases conforming to all requirements of ASTM C478 and other requirements for precast sections may be used and shall be set on a sub base as described above.
- E. Precast concrete structure sections shall be set vertically with sections in true alignment with a 1/4-inch maximum tolerance per 5-feet of depth. The outside and inside joint shall be filled with a non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24-hours before backfilling. Backfilling shall be accomplished bringing the fill up evenly on all sides. If leaks appear in the structures, the inside joints shall be caulked with non-shrink grout to the satisfaction of the County. The Contractor shall install the precast sections in a manner that will result in a watertight joint.
- F. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation.
- G. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.
- H. Cast iron frames shall be placed over precast concrete leveling rings, shimmed and set in cement mortar to the required grade. No more than 3 courses of leveling rings shall be used.

END OF SECTION

SECTION 03600

GROUTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies the grouting of the annular space between the host pipe and the new liner and the grouting of the space left void in the abandonment of the existing pipelines and structures. The Work consists of furnishing all labor, equipment and materials, and performing all Work connected with the placement of the cementaceous grout to fill the void.

1.02 QUALITY ASSURANCE

- A. Grouting shall be performed by a crew under the direct supervision of a superintendent that has experience in grouting of this nature.
- B. Storage, mixing, handling and placement shall be in accordance with manufacturer's instructions and specifications.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. In addition, the following shall be submitted to the County for review and acceptance prior to construction.
 - 1. A detailed description of equipment and operational procedures to accomplish the grouting operation.
 - 2. Grout mixture design data, grout mixer type, grout samples, and test data.
 - 3. A detailed description of the grouting time schedule.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 GROUT MATERIAL

- A. The grout shall be a "flowable fill" consisting of a mixture of Type 1 Portland Cement, Type "F" Flyash (ASTM 618), sand and water.

The following is a suggested trial grout mixture for a 1-cubic yard yield:

Cement: 500-pounds
Fly Ash: 500-pounds
Water: 350-pounds (42-gallons)
Sand: 2,248-pounds
Darex (W.R. Grace): 3-ounces (Air Entrainment Additive or equivalent)

The actual grout mixture to be used shall meet the minimum requirements specified below.

- B. The mixture shall contain a minimum of 500-pounds cement and minimum of 400-pounds flyash per cubic yard of grout.
- C. Samples of the grout mixture when set aside in a standard concrete test mold shall show less than 1% of the mixture height of free water on the surface after standing not less than 12-hours.
- D. One (1) set of 3 (three) 3-inch by 6-inch sample test cubes shall be made for each mix preparation. The minimum 28-day strength shall be no less than 1,000-psi. The minimum required slump is 5-inches. The maximum allowable slump is 9-inches. Slump should be as low as practical to maintain viscosity, proper flow, and still retain the ability to pump.

2.03 EQUIPMENT

- A. All grout shall be mixed with a high shear, high-energy colloidal type mixer to achieve the best uniform density.
- B. The grout shall be pumped with a non-pulsating centrifugal or tri-plex pump.
- C. The mixer shall be capable of continuous mixing. Batch mixing shall not be permitted.

PART 3 - EXECUTION

3.01 GROUTING OF ABANDONED PIPE

- A. Where utility pipes are to remain in place (inactive) they shall be filled with a sand/cement grout as specified herein.
- B. The grouting program shall consist of pumping sand-cement grout with suitable chemical additives at pressures necessary to fill the pipe sections in order to prevent the potential for future collapse.

- C. Grouting of pipes shall be in sections not exceeding 300 linear feet.
- D. Grout shall be placed in a maximum of 3 stages, with the initial stage volume equal to or greater than 50% of the total volume for that section of pipe being grouted. The maximum time wait between grouting stages shall be 24-hours.
- E. For each stage, mix and pump the material in one continuous process so as to avoid partial setting of some grout material during that stage; thus, eliminating voids and possible subsequent surface damage due to cave-ins.
- F. Each section shall be grouted by injecting grout from the lowest point and allowing it to flow toward the highest point to displace water from the annulus and assure complete void-free coverage. Grout shall be placed through tubes installed in the bulkheads at the insertion pits or manholes. Grout tubes shall be at least 2-inch nominal diameter.
- G. After the ends of each section of pipe are exposed, the entire space, not to exceed 300 linear feet end to end, shall be sealed by controlled pumping of grout until it flows from the pipe at the opposite end of the grouting. Grouting shall be carried out until the entire space is filled. The ends of these sections shall be capped and/or plugged.
- H. Grout pressure in the void space is not to exceed 5-psi above maximum hydrostatic groundwater level. An open ended, highpoint tap or equivalent vent must be provided and monitored at the bulkhead opposite to the bulkhead through which grout is injected. This bulkhead will be blocked closed as grout escapes to allow the pressuring of the annular space.

3.02 FIELD QUALITY CONTROL

- A. The quality of the grout, application of the equipment, and installation techniques are the responsibility of the Contractor. The review and acceptance or approval of specific mix design, equipment, or installation procedures shall in no way relieve the Contractor of his obligation to provide the final product as specified herein.
- B. The County may stop the grouting operations at any time if the operation does not comply with these Specifications.

END OF SECTION

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