

DIVISION 3

CONCRETE

SECTION 03300

CAST-IN-PLACE CONCRETE, REINFORCING AND FORMWORK

PART 1 - GENERAL

1.01 GENERAL

- A. Work included: Provide all labor, materials, equipment, fabrication, incidentals, transportation, placing and supervision necessary to complete all cast-in-place concrete work, its finishing, and all related work called for by the Contract Drawings and/or Specifications, or reasonably inferable from either or both, as needed for a complete and proper installation.

- B. Related work: Work affecting this Section includes, but is not limited to:
 - 1. Shop Drawings-Per General Conditions and as specified herein.
 - 2. Materials and storage thereof.
 - 3. Reinforcing-Bar and fabric.
 - 4. Accessories of every nature, including form tie system.
 - 5. Formwork and removal thereof, including shoring and reshoring.
 - 6. Concrete proportions and mixes.
 - 7. Placing of concrete.
 - 8. Admixtures.
 - 9. Joints, metal joint screeds and joint fillers.
 - 10. Finishes of all types.
 - 11. Protection and curing.
 - 12. Patching.
 - 13. Laboratory Testing.

1.02 SUBMITTAL

- A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the requirements of ACI 301-96 "Specifications for Structural Concrete for Buildings", except as modified by supplemental requirements hereinafter.

1.03 CONTENT

- A. ACI 301-96 Specifications for Structural Concrete.
- B. ACI 318-95 Building Code Requirements for Reinforced Concrete. Florida Building Code, latest edition.
- C. ACI 117-90 Standard Specifications for Tolerances for Concrete Construction and Materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials for Concrete:
 - 1. Cement shall conform to the following: Portland Cement ASTM C150, normal, type I or type II. Provide domestic cement of one type and from same source for entire project.
 - 2. Mineral Admixtures:
 - a. Fly Ash: Shall conform to ASTM C 618. 20% maximum of total cementitious weight.
 - b. Ground Blast Furnace Slag: Shall conform to ASTM C 989-93. 30% maximum of total cementitious weight.
 - 3. Chemical Admixtures
The following admixtures are permitted, but require written approval from the Engineer:
 - a. Air Entraining Admixture: Comply with ASTM C260. "Specifications for Air-Entraining Admixtures for Concrete.
 - b. Water Reducing Admixture: Comply with ASTM C494 "Specifications for Chemical Admixtures for Concrete, Type A and compatible with air entraining admixture.
 - c. Water Reducing and Retarding Admixture: Comply with ASTM C494, "Specifications for Chemical Admixtures for Concrete, Type D, and compatible with air entraining admixture.
 - d. High Range Water Reducing Admixture: Comply with ASTM C494, "Specifications for Chemical Admixtures for Concrete, Type F or G, and compatible with air entraining admixture. (Including superplasticizer to reduce water content.)
 - e. Admixtures containing added calcium chloride are not permitted.
 - 4. Aggregates: Shall conform to ASTM C 33 and shall be quarried/mined in fresh water.

Aggregates from salt water or brackish water are not permitted. Coarse aggregate size shall not exceed:

	Concrete member	Size	
a.	Walls	3/4"	67#
b.	Beams or structural slabs not on ground	3/4"	67#
c.	Columns and all other concrete	1"	57#
d.	Drilling concrete pad or slabs on ground	1"	57#

5. In sanitary sewage applications, where called for in the plans and/or specifications and antimicrobial admixture as specified below shall be utilized:
 - a. An antimicrobial agent, ConMICShield®, or approved equal, shall be used to render the concrete uninhabitable for bacteria growth.
 - b. Contractor shall mix the liquid antimicrobial additive with the total water content of the concrete mix design in a proportion of 1 gallon per cubic yard. In the case of repairs to damaged concrete a proportion of 2 gallons per cubic yard shall be utilized.
 - c. In some instances all of the concrete in the structure in will receive the additive and in other instances only a portion of the concrete will receive the additive. Hence, the Contractor shall apply the additive only as directed in the specific instance.
 - d. Contractor shall submit a letter of certification to the Department, stating that the correct amount and correct mixing procedure was followed for all antimicrobial concrete.
 - e. ConMICShield® antimicrobial additive shall be as manufactured by ConMICShield®
 - f. Technologies, Inc.; 541 Tenth Street NW #233, Atlanta, GA 30318; Phone: (877)543-2094.

- B. Portland cement and reinforcing steel: Comply with ACI 301-96 and, with all modifications and supplements thereto listed in Part 3 of this specifications.

- C. Burlap mats: Conform to AASHTO Specification M182. (Burleen non-staining mats.)

- D. Epoxy bonding agent: A two (2) component, solvent free, moisture insensitive structural epoxy adhesive conforming to ASTM C881-90 Type II, Sikadur 32 Hi-Mod, as manufactured by Sika Corp., Concsive 1090 Liquid by Master Builders or approved equal.

- E. Anchor bolts, nuts and washers: Conform to ASTM A449-89, hot-dip galvanized.

- F. Dovetail slots: Galvanized steel, 22 gauge, 1"x 1", with 5/8" throat, fiber filled.

G. Forms:

1. Plywood Forms: PS-1, B-B Concrete Form, Class I, exterior type, mill oiled and edge sealed. Thickness shall be as required to support concrete at the rate placed, but not less than 3/4".
2. Steel Forms: Uncoated steel, 3/16"-inch minimum thickness, fabricated to close tolerances, protected only by the specified release agent, braced so as not to dent, bend or dimple under wet concrete loads, vibrator impact and tool impact. Maintain steel forms in rust free condition by use of steel wool and light grinding, followed by coats of the specified release agent. Forms should be adjustable to be brought into true alignment without steps or ridges.

H. Form release agent:

1. For plywood forms use a natural non-petroleum base, non-staining and non-retarding release agent that will effectively prevent absorption of moisture and prevent bond with concrete, and leaves the concrete with a paintable surface.
2. For steel forms, use an approved material that will not stain, color or otherwise affect the finish of the concrete. Form coating shall not be detectable on finished surfaces.
3. Round column forms: Provide seamless fiber forms with the three plies nearest to the interior surface of the form deckled or scarfed and overlapped to minimize spiral gaps or seams on the column surface.

I. Form Ties: Steel rod type with integral waterstops and cones, and with ends or end fasteners that can be removed without spalling the concrete and which leave a hole equal in depth to the required reinforcement clearance, but not less than 2 inches from the formed face of the concrete. Wire tie, banding wire and wood spreaders will not be permitted.

J. Form Inserts:

1. Bevel or chamfer strips: Wood or non-staining plastic, 3/4" wide on each leg at exposed edges of concrete members, unless otherwise noted on plans.
2. Tongue and Groove Joint Forms: Minimum 24 gauge with steel stakes and splice plates. Forms shall be designed for joints not to receive a poured seal.
2. Pipe hangers and other utility supports: AISI Type 316 stainless steel.

K. Non-Shrink Grout: Non-shrink, non-metallic grout conforming to ASTM C 1107 Grade B or Grade C only. Grout must meet ASTM C 1107 at a temperature range

of 50 F to 90 F at a flowable consistency.

L. Grout for Surface Repair and Bond Coat:

1. For repair, one part Portland cement to two parts fine sand, and a 50% of water and 50% Acryl 60 or equal (Thoroseal or Acryl Set Bonding Agent by Master Builders) to produce a stiff mortar.
2. For bond coat, one part Portland cement to one part sand, and a 50% of water and 50% Acryl 60 or equal (Thoroseal or Acryl Set Bonding Agent) to produce a slurry mix.

M. Moisture Barrier: Kraft paper and glass reinforcing fibers sandwiched between 2 layers of polyethylene film with a permeance rating of maximum 0.1 as per ASTM E-96, Procedure A.

N. Preformed Expansion Joint Filler: Non-extruding type, self expanding cork, 3/4", 1", and 1 1/2" cork (not to be used for sidewalks), conforming to plans or as otherwise noted on drawings, conforming to the requirements of ASTM D1752, Type II, and compatible with joint sealant compound.

O. Joint Sealant Compound: Non-sag, 2 component, solvent free, moisture insensitive, flexible, epoxy resin conforming to the requirements ASTM C920-87 Type M, Grade NS. Additionally, the sealant must be recommended by the manufacturer to perform under continuous immersion in water.

P. Polyurethane Elastomeric Sealant: Sikaflex-2c, NS/SL or approved equal. Provide a 2-component, premium-grade, polyurethane-based, elastomeric sealant. It is principally a chemical cure in a non-sag and self-leveling consistency. Sealant shall meet ASTM C-920 and Federal Specifications TT-S-00227E.

1. Joint Movement: +50%.

Q. Waterstops:

1. Volclay Waterstop-RX or approved equal. Flexible strip of bentonite waterproofing compound in coiled form.

a. Chemical Composition:

- 1) Butyl Rubber-Hydrocarbon: 24.9% by weight; ASTM D-297.
- 2) Bentonite: 75 % by weight; SS-S-210-A.
- 3) Volatile Matter: Below 1 %; ASTM D-6.
- 4) Waterstop shall not contain any asbestos fibers or asphaltics.

b. Physical Properties:

- 1) Specific Gravity: 1.57; ASTM D-71.
 - 2) Application Temperature Range: 5-125 F.
 - 3) Flash Point: 365; ASTM D 93-97.
 - 4) Accelerated Aging: Maintained 99% solids.
 - 5) Dimensions: 1" x 3/4" x 16'-6"
3. Polyvinyl chloride (PVC): Conforming to the requirements of U.S. Army Corps of Engineers Specification CRD-C-572 and of the following type:
- a. Expansion Joints: 9-inches by 3/8-inch, ribbed center bulb.
 - b. Construction Joint: 9-inches by 3/8-inch, flat ribbed.
 - c. Only where specified on Plans at construction and expansion joints: 9-inches by 3/8-inch, split ribbed.
 - d. Install waterstops as shown as manufactured structures.
- R. Fiber Reinforcement: Fiber reinforcement shall not be used in the concrete unless ordered by the Engineer in writing. It shall consist of 100% virgin polypropylene fibrillated fiber-dosage of 2 lbs. per cubic foot.
1. Compressive Strength: 1 psi (.006895 M Pa), ASTM C-39.
 2. Flexural Strength: 288 psi (2.0 M Pa) after 7 days, 390 psi (2.7 M Pa) after 28 days; ASTM C-78.
 3. Splitting Tensile Strength: 194 psi (1.3 M Pa) after 7 days, and 290 psi (2.0 M Pa) after 28 days; ASTM C-496.
 4. Source: Fibermesh Micro-Reinforcement System by Fibermesh Company, Division of Synthetic Industries, Inc. Or approved equal.
- S. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.
- T. A shrinkage reducing admixture (Teraguard) or equivalent at the rate of 2.2% by weight of cement may be used in the concrete to meet the shrinkage limitations.
- U. To protect the concrete slab against the elements, the Engineer may direct the Contractor to spray an evaporation retarder on the finished concrete slab immediately behind the cement finishing process at no additional cost to the Department. This is not a curing compound.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be

performed. Correct conditions detrimental to timely and proper completion of the Work.

3.02 SUPPLEMENTAL REQUIREMENTS

- A. All phases of concrete construction, including materials formwork, and all other related procedures shall comply with the most stringent allowed tolerances of ACI-301 and ACI-117 Standards (Latest Edition) - Non compliance with these standards will cause full rejection of any work done.
- B. Comply with ACI 301-96 and with all modifications and supplements thereto listed herein. In addition to the ACI Standards on finished concrete, the Engineer will only approve quality finished concrete which in his opinion is ready to receive a grout finish, paint or liquid membrane.
- C. The following modifications and supplements to ACI 301-96 shall also apply to the work.
 - 1. General
 - a. These specifications cover cast-in-place structural concrete for use in buildings and appurtenances, including foundations, curbs, sidewalks, concrete pavements and utility structures, water containment tanks, and piles.
 - b. Keep minimum two (2) copies of ACI 301-96 "Specifications for Structural Concrete" in field office at all times.
 - 2. Proportioning and Design of Mixes:
 - a. General: Proportion concrete to meet properties as specified. Prepare mix designs for each type and strength of concrete. Submit with mix design the chemical admixture manufacturer's statement that the admixture proposed complies with the requirements of this specification. Where concrete of different strengths are specified for the same location, the higher strength concrete shall be used. Concrete proportions shall be established on the basis of previous field experience, or laboratory trial batches as specified in ACI 301-96 Sections 4.2.2 & 4.2.3.
 - b. Classes of Concrete:
 - 1) Structural concrete of normal weight for portions of the structure that are required to be watertight containments or tremie concrete, the water/cementitious ratio shall not exceed 0.45 if exposure is to be to fresh water.
 - 2) If the concrete is exposed to salt or brackish water, or if

exposed to injurious concentrations of sulfate-containing solutions (1500 ppm or more of Sulfate in water) or other chemically aggressive solutions, use Type II cement with Rheobuild 1000 admixture by Master Builders, or approved equal; water/cementitious ratio shall not exceed 0.34.

- 3) Other Concrete: (This would be slabs-on-grade, concrete thrust blocks, and miscellaneous concrete). The water cementitious ratio shall not exceed 0.50 to 0.55.
- 4) Minimum $f'c$ @ 28 days shall be 4000 KSI with a Water/Cement ratio of 0.45.
- 5) Minimum $f'c$ @ 28 days shall be 7000 KSI with a Water/Cement ratio of 0.34.

c. Slumps:

- 1) All structural concrete, pumped concrete and tremie concrete shall contain a High Range Water Reducing Admixture and be designed with a maximum water content of 270 pounds per cubic yard. The initial water slump prior to addition of the High Range Water Reducing Admixture shall be 2-inch maximum. Concrete at point of placement shall not exceed 10-inches. Concrete shall be non-segregating.
- 2) Slabs including slabs-on-grade, and all other concrete shall have a maximum water content of 287 pounds per cubic yard and have a 5-inch maximum slump with a water reducer, or water reducer and retarder admixture added.

3. Formwork

- a. Earth cuts are not permitted for forms for vertical surfaces. Footings, grade beams and slab edges shall be formed. Provide moisture barrier under all slabs on grade. Lap 6-inches and tape punctures.
- b. The contractor is responsible for the adequacy of forms and shoring including placing, fill and equipment on roof, and for safe practice in their use and removal. Submit formwork calculations, and shop drawings including shoring and reshoring. In addition, the calculations and shop drawings for formwork, shoring, and reshoring, if required by the Engineer or Building Department, shall be signed and sealed by a Professional Engineer registered in the State of Florida.
- c. Design forms for the loads and lateral pressures resulting from the placement and vibration of concrete and for design considerations, wind loads, allowable stresses, and other applicable requirements of the South Florida Building Code.
- d. Provide form facing materials as required by the specified finish of the formed surface. Do not use facing material with raised grain,

torn surfaces, worn edges, patches, dents or other defects. No form may be reused more than three times without the Department's approval. The maximum deflection permitted of facing materials reflected in concrete surfaces exposed to view is 1/240 of the span between structural members.

- 1) Forms shall be free from surface defects, tight to prevent leakage and braced to keep its position and shape when filled with concrete. Adjacent edges and end panels and sections shall be held together to provide accurate alignment and prevent forming ridges, fins, offsets or similar type defects in finished concrete. It shall be tight to prevent loss of water, cement or fines during placing and vibrating concrete. The bottom of the forms placed in continuous straight even footings or slabs shall be watertight to prevent loss of water, cement and fines during placement and vibration of concrete, a gasket may be required by the Engineer under the forms to provide water tightness at the Contractor expense. The Contractor shall not proceed to place forms for concrete work adjacent to or on top of previous placed concrete without the Engineer's approval, if the stripped forms reveals columns, walls or beams are out of level or plumb or there are cold joints or other objectionable work in the opinion of the Engineer. Contractor shall submit to the Engineer for approval, how he intends to correct or remove the defective work promptly at his expense. Contractor shall perform such corrections prior to proceeding to place concrete in the next Section.
- e. Provide positive means of adjustment (wedges or jacks) of shores and struts, and all settlement shall be taken up during concrete placing operation. Brace forms securely against lateral deflection. Do not anchor form bracing to poured concrete floors, or make holes in floor.
- f. Provide temporary openings in columns and wall forms to limit the free fall of concrete to five (5) feet. Place such openings at no more than eight (8) feet apart to facilitate placing and consolidation of concrete. Elephant trunks may be used to vertical heights of fifteen (15) feet for tremie and other purposes, if approved by the Engineer. Provide temporary openings at the bottom of wall and column forms and elsewhere as necessary to facilitate cleaning and observation immediately before concrete is placed. Blow formwork entirely clean of all saw dust, dirt, or other items not specifically intended to be a part of the final concrete. Any evidence of non-intended items in the forms is considered sufficient cause to stop concreting operation and/or require removal of concrete placed in such contaminated forms.

- g. Provide inserts, conduits, boxes, sleeves, anchors, ties, bolts, hangers, dowels, thimbles, nailers, grounds and other devices in coordination with other trades.
- h. Set anchor bolts and other embedded items accurately and hold securely until concrete is placed and set. Anchor bolts shall be galvanized and of size and length as indicated on the Contract Drawings. Bolts not sized shall be 3/4-inch diameter.
- i. Insert galvanized dovetail anchor slot in forms, in columns, beams and slabs completely around in-fill masonry panels.
- j. 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.
- k. Do not use pinch bars, wrecking bars or other metal tools against as-cast concrete to wedge forms loose; use only wooden wedges carefully and gradually. Driving shall be accomplished by light tapping.
- l. The Contractor is responsible for the removal of forms and shores. Do not remove forms or shores before the member has attained sufficient strength to support its weight and the loads imposed, nor sooner than listed below:
 - 1) Wall forms: 24 hours.
 - 2) Column forms: 24 hours.
 - 3) Beam and girder side forms only (not bottom form): 24 hours.
 - 4) Beam and Girder bottom forms: 7 days minimum unless otherwise approved by the Engineer.
 - 5) Slab forms: 14 days.
 - 6) Arch centers: 7 days.
 - 7) Pan joist forms: 4 days.

4. Reinforcement

- a. Prior to fabrication, submit for review shop drawings showing all fabrication dimensions, bar lists and location for placing of the reinforcing steel and accessories, including spacing of reinforcing, splices (lap, welded, Cadweld and/or mechanically threaded), grade of reinforcing and name of manufacturer. Note all deviations from the Contract Drawings and use the same designation mark as shown on the Contract Drawings where possible.
- b. Reinforcing bars: ASTM A615, Grade 60, deformed bars of USA manufacturer.
- c. Welded wire fabric: ASTM A185, galvanized.

- d. Metal bar supports: CRSI MSP-1, Chapter 3, Class 2, Type B stainless steel protected bar supports.
- e. Coupler Splice Devices: Cadweld, tension couplers capable of developing the ultimate strength of the bar.
- f. Reinforcing steel upon which unauthorized welding has been done, shall be removed and replaced at no additional cost to the Department.
- g. Place reinforcing bars to the most stringent tolerances indicated in ACI 301 and ACI 117 (Latest Edition). Tolerances specified in those standards shall govern over any other reference code or standard.
- h. All reinforcement at time concrete is placed, shall be free of mud, oil or other materials that may affect or reduce the bond. Reinforcing with rust or mill scale will not be accepted without cleaning and/or brushing to remove scale and rust.
- i. Support rebar and mesh reinforcing for slabs on grade 1 1/2 inches from top of slab on masonry blocks not less than 4 sq. in., having a compressive strength equal to or greater than the specified strength of the concrete being placed. Space blocks at no more than 4 feet apart each way for rebars, and no more than 3 feet apart for mesh reinforcement.
- j. Support reinforcing off from formwork for columns, walls and beams with stainless steel protected bar supports. Support slab reinforcing on #5 bars, or larger, spaced at no more than 48 inches on center. Space individual high chairs no more than 48 inches apart and support bars shall not exceed 24 inches past outermost chairs.
- k. Overlap welded wire fabric in such a manner that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches or 6 inches, whichever is greater. Do not extend fabric through expansion and/or contraction joints, unless otherwise noted on the Contract Drawings.
- l. The minimum clear distance between parallel bars, both vertical and horizontally, shall not be less than the nominal diameter of the bars, or less than 1 1/2 times the maximum size of the aggregate, or 1-inch in beams, or 1 1/2 inches in columns, whichever is greater. Where reinforcement in beams is placed in two or more layers, the upper layer shall be placed directly above the bars in the bottom layer. Misplacement, misalignment or improper length of dowels shall be sufficient cause to require removal and reconstruction of affected work.
- m. Unless allowed by the Engineer, bending of reinforcing partially embedded in concrete is not permitted. When permitted, bending shall be in accordance with CRSI Manual of Standard Practice.

5. Joints and Embedded Items.

- a. Provide premolded expansion joint filler strips of proper width and

length as specified in the Contract Drawings. Place 1/2" expansion joint fillers every 20 feet in straight runs of walkways or sidewalks, at right angle turns and wherever concrete butts into vertical surfaces, unless otherwise noted on the Contract Drawings.

- b. Provide waterstops in all construction joints, unless otherwise indicated on the Contract Drawings.
- c. Join all waterstops at all intersections so that a continuous seal is provided. Center the waterstop in the joint. Hold water stop positively in correct position. In the event of damage to the waterstop, repair the water stop in an acceptable manner. Vibrate concrete to obtain impervious concrete in the vicinity of all joints.
- d. Install waterstop in accordance with instructions of the manufacturer. Prior to use of the waterstop material in the field, submit to the Engineer for approval a sample of each size and shape to be used. Fabricate sample so that the material and workmanship represent in all respects the fittings to be furnished under this Specification.
- e. Place all sleeves, inserts, anchors, and other embedded items prior to placing concrete. Anchors and bolts cast in concrete shall be hot dip galvanized or stainless steel. Where permitted by the Engineer, concrete expansion bolts shall be stainless steel and of the wedge anchor type. Take all necessary precautions to prevent embedded items from being displaced, broken or deformed during concreting operation. Protect drains from intrusion of concrete.

6. Placing:

- a. Equipment for mixing and transporting concrete must be clean. Forms shall be thoroughly clean and damp, and reinforcing shall be secured in place. Runways for transporting concrete shall not rest on reinforcing. When concrete is placed against earth, sprinkle sufficiently before placing.
- b. Deposit of concrete in forms no longer than ninety (90) minutes after the initial design water has been added to the cement and aggregates. Concrete which can not be so placed shall not be used and shall be wasted. No additional water shall be added. No retempering with water is permitted.
- c. In addition to the requirements of ASTM C94, the concrete delivery tickets shall indicate the cement content and water/cement ratio.
- d. During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection and curing. Comply with ACI 305R "Hot Weather Concreting" recommendations.
- e. Do not place concrete in forms unless the water level is below the concrete to be placed, even if it is necessary to maintain the dewatering, or under rain.

- f. Do not place concrete under water except for tremie concrete as called for on the Contract Drawings. Submit for approval plan and details of means and methods for installation of seal tremie concrete prior to commencement of work. Seal concrete which subsequently fails to perform, shall be repaired or replaced at no additional cost to the Department.
- g. Place seal concrete under water in the space in which it is to remain, by means of a tremie, a closed-bottom dump bucket of not less than one cubic yard capacity, or other approved method, and do not disturb after it is deposited. Deposit all seal concrete in one continuous pour. Do not place concrete in running water. Design all formwork, to retain concrete under water, to be watertight. Submit shop drawings for the design of formwork and excavation sheeting signed and sealed by a Florida Registered Professional Engineer.
- h. The tremie shall consist of a tube having a minimum inside diameter of ten (10) inches, and shall be constructed of sections having tight joints. No aluminum parts which 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. Exercise special care to maintain still water at the point of deposit.
- i. 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.
- j. Do not commence pumping, to dewater a sealed cofferdam, until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than 72 hours after placement of concrete.
- k. Notify Engineer a minimum of 24 hours prior to concreting and request a specific time for observation of reinforcing and formwork for portions of concrete work to be placed. No observation will be made by the Engineer until rebar installation for all work to be done and all formwork has been completed and approved by the Contractor's field superintendent. Do not order concrete until all correction and additions indicated by the Engineer have been made. Should the Engineer's observation reveal that work is improperly prepared and

an additional observation will be required, he will so inform the Contractor and all above requirements shall also govern.

7. Repair of Surface Defects:

- a. Repair all concrete surface defects, which includes, but not limited to cracks, tie holes (no plastic cones), uneven holes, honey combs, rough frame work and other objectionable conditions deemed unacceptable to the Engineer immediately after form removal. This repair work is to be done for all concrete expose surfaces, liquid applied surface or painted surfaces in or out of the water. Repair all cracks and defects in the concrete floors, beams, joists, columns, and other structural members, roof and walls, to the satisfaction of the Engineer, that may occur up to one year after acceptance of work regardless of the cause. Test unformed, surfaces such as monolithic slabs, for smoothness and verify placement tolerances specified for each surface and finish. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness. Repair unformed surfaces that contain surface defects which affect durability of concrete. Surface defects, as such, include cracking, cracks which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets and other objectionable and rough conditions.
- b. Proprietary compounds for adhesion or as patching ingredients may be used, if approved by the Engineer. All structural repair of surface defects to be made require the approval of the Engineer, as to the method and procedure. Approval of the completed work must be obtained from the Engineer.

8. Finishing of Formed Surfaces.

- a. Apply rough form finish to exterior walls below grade not exposed to water.
- b. Apply smooth form finish to exterior and interior walls and columns exposed to water.
- c. Apply smooth form finish to interior walls and underside of floors, stairs and slabs.
- d. In addition to the smooth form finish, apply a grout cleaned finish to concrete walls and surfaces exposed to public view and underside of formed floors, stairs or slabs.
- e. Apply a rubber float grout mix to properly prepared concrete surface, only when approved by the Engineer. Mix shall have one part Portland cement to two parts fine sand in a 50% water and 50% Acryl #60 (Thorseal or Acryl Set) mix or Acryl Set by Master Builders. Make a 10' by 10' sample on the concrete wall for the approval of the Engineer. Finished surface shall be a non dusting

hard finish, when scratched with a 1/4" metal edge.

f. Finish concrete surface, interior or exterior, below or above water shall include all:

- 1) Exposed concrete.
- 2) Grout finished concrete.
- 3) Painted surface concrete.
- 4) Liquid membrane finished concrete shall comply with manufacturer's requirements.
- 5) The entire surface of finished concrete shall have a smooth uniform surface, there shall be no offsets, visually bulges, or wavering in the finished surfaces. The joints must be accurately aligned, they can not be uneven or in or out, a higher and lower, there shall be no fins, projection or unevenness between forms.
- 6) If after stripping the forms the Engineer determines that the finished concrete does not comply with any or all of the above requirements, the Contractor shall submit his proposal in writing to the Engineer as to his methods of correcting the work at no added cost to the Department, which shall include, but not limited to all grinding of fins, projections, unevenness between joints, form high spots and uneven spots.
- 7) In addition to all other requirements, concrete surfaces exposed to public view, irrespective of size, area or location shall be completely clean and free of: (1) Stains of any nature, (2) Parts of forms or other wood of any nature, (3) laitance, (4) "Run-downs" of leaked water from secondary pours, (5) Nails, (6) Strips, (7) Ties and (8) all other extraneous, deleterious materials and/or substances which may affect the finished appearance and condition of exposed concrete. Surfaces not meeting the above requirements are to be repaired and treated at no additional cost to the Department.

9. Slabs

- a. Unless otherwise noted on the Contract Drawings, place strips alternately at maximum 20 feet center-to-center and to align with column centerline. Do not place adjacent strips until elapse of twenty four hours after first strip is placed. Place slabs on grade by the "strip-cast" method. Method to be reviewed by the Engineer. Provide saw-cut joints at maximum 20 feet center-to-center and to align with column center lines within four hours of final finishing.
- b. Provide doweled construction joints where shown on the Contract Drawings.

- c. Provide a hard steel troweled finish, free from trowel marks and irregularities, to slabs and floors.
- d. Provide a light hair-broom finish to exterior slabs and floors exposed to public view. Leave hair-broom lines parallel to direction of the slab drainage.
- e. Provide a stiff bristle broom finish to slabs and floors with slopes greater than 10 percent. Leave broom lines parallel to slope drainage.
- f. Finish exposed edges of slabs, floors and tops of walls with a 1/4-inch radius edge unless a chamfer is called for on the Contract Drawings.

10. Curing and Protection

- a. Comply with ACI 305 "Hot Weather Concreting", Chapter 4, with the supplements and modifications to ACI 301 listed herein.
- b. Only concrete water curing for not less than 7 days (24 hours/day continuously) will not be accepted; Burlen mats shall be used in curing. Water cure by ponding or continuous sprinkling covering complete surface with minimum runoff. The application of water to wall may be interrupted for grout cleaning only over the areas being cleaned at the time, and the concrete surfaces shall not be permitted to become dry during such interruption.
- c. Begin all water curing as soon as concrete is set and concrete will not be damaged. Keep concrete and wall forms wet the first 24 hours. Remove forms as indicated in Formwork, Section 3.02-C.4, and continue with 7 day water curing. Recoat damaged surfaces subject to heavy or surfaces damaged by construction procedures within 3 hours of damage. Method of repair shall be approved by the Engineer.

11. Testing

- a. Testing laboratory will be selected and paid for by the Department. Send results of all test to the Department and to the Contractor. The Contractor shall notify the Testing laboratory at least 24 hours before each concrete placing.
- b. Obtain and mold 3 specimens for each fifty (50) cu. yds., or fraction thereof, of each class of concrete placed each day or as directed by the Engineer.
- c. Cure specimens from each sample in accordance with ASTM C31. Record in test report any deviations from this Standard.
- d. Test specimens in accordance with ASTM C39. Test one specimen at twenty eight (28) days for acceptance and, one specimen at three (3) days and seven (7) days respectively, for information. If one specimen in a test manifests evidence of improper sampling,

- molding or testing, it shall be discarded and the strength of the remaining cylinders shall be considered the test result.
- e. Contractors Superintendent shall color code on a set of structural drawings the extent of days work and date to conform to cylinders test.
 - f. Perform slump test at discharge of mixer, one for each strength test in accordance with ASTM C143. In the event slump is excessive, testing laboratory will immediately notify the Contractor's superintendent and the Engineer's representative on site. The Contractor shall then reject all concrete with excessive slump and/or deposit time.
 - g. **Drying Shrinkage Test:** A drying shrinkage test shall be conducted on the preliminary trial batch with the maximum water-cementitious materials ratio used to qualify each proposed concrete mix design using the concrete materials, including admixtures, that are proposed for the project. Three test specimens shall be prepared for each test. Drying shrinkage specimens shall be 4 x 4 x 11 inch prisms with an effective gauge length of 10 inches fabricated, cured, dried, and measured in accordance with ASTM C 157 except with the following modifications:
 - 1) Specimens shall be removed from the molds at an age of 23 hours \pm 1 hour after trial batching, shall be placed immediately in water at 73° F \pm 3°F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in lime-saturated water as specified in ASTM C157. Measurement to determine expansion expressed as a percentage of original length shall be taken at age 7 days. The length at 7 days shall be the base length for drying shrinkage calculations (“0” days drying age). Specimens then shall be stored immediately in a humidity controlled room maintained at 73° F \pm 3°F and 50% \pm 4% relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be reported separately for 7, 14, and 21 days \pm 4 hours of drying from “0” day after 7 days of moist curing.
 - 2) Drying shrinkage deformation for each specimen shall be computed as the difference between the base length (at “0” days drying age) and the length after drying at each test age. Results of the shrinkage test shall be reported to the nearest 0.001 percent. If drying shrinkage of any specimen deviates from the average for that test age more than 0.004 percent, the results for that specimen shall be disregarded.

- 3) The average drying shrinkage of each set of test specimens cast in the laboratory from a trial batch as measured at the 21 days drying age shall not exceed 0.036 percent and 0.042 percent at the 28-day drying stage for all concrete.
 - a) The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.
 - b) If the required shrinkage limitation is not met during construction, the Contractor shall take any or all of the following actions at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures, including Tetra Guard AS 20 or approved equal; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

- 4) Alkali-aggregate reactivity potential shall be determined in accordance with Appendix XI of ASTM C 33. Aggregates shall be tested in accordance with ASTM C 289 and C295 to determine potential reactivity. Aggregates which do not indicate a potential for alkali reactivity or reactive constituents may be used without further testing. Aggregates which indicate a potential for alkali reactivity shall be further tested in accordance with ASTM C227 or C1105, as appropriate, using a cement containing less than 0.6 percent alkalis. At the discretion of the Engineer, testing in addition to that indicated in Appendix XI of ASTM C33 may be performed on potentially reactive aggregates. Nonreactive aggregates shall be imported if, in the opinion of the Engineer, local aggregates exhibit unacceptable potential reactivity.

12. Evaluation And Acceptance of Concrete.

- a. If tests are insufficient or inadequate, test and evaluate by core tests. Failure of any concrete cylinder to meet specified requirements shall be deemed as non-complying and costs of additional tests to determine the adequacy or inadequacy shall be borne by the Contractor. Concrete rejected for any reason is to be removed and replaced, including labor, forms and reinforcing, to meet specifications at no additional cost to the Department and no

additional time extension.

14. Additional Requirements.
 - a. Submit shop drawings as required per General Conditions and elsewhere in these specifications. Prime Contractor shall check and approve all shopdrawings prior to submission. Do not fabricate any item requiring shopdrawings until approval of shopdrawings has been granted by the Department. Partial shopdrawings are not accepted, submit drawings for complete submittal.
 - b. Provide precast or cast-in-place reinforced concrete lintels at all masonry openings and sills at all windows. Reinforce to suit loads and span. Provide minimum 8" bearing at each end and, pour integral with columns where opening abuts columns.
 - c. Sidewalks in R.O.W.: Provide poured-in-place 4" thick concrete slab, 3000 psi concrete, with continuous 8" deep thickened slab edges. Isolate walks from vertical surfaces with 1/2" expansion joint material. Provide 1/2" expansion bituminous joint material flush with top of concrete slabs at 20 feet on center and tooled joints at 5 feet on center. Tool all open edges to a smooth radius and all edges adjacent to the forms.

END OF SECTION

SECTION 03375

FLOWABLE FILL

PART 1 – GENERAL

1.01 SCOPE OF WORK

The Section specifies the requirements for flowable fill used for trenches, support for pipe structures, culverts, utility cuts and other works where cavities exist and where firm support is needed for pavements and structural elements.

PART 2 - PRODUCTS (Not Used)

2.01 MATERIALS

The materials used shall conform with the requirements specified in the FDOT Standard Specifications for Road and Bridge Construction, latest edition. References include:

- A. Portland Cement (Types I, II or II).....Section 921
- B. Fly Ash, Slag and other Pozzolanic
Materials for Portland Cement Concrete.....Section 929
- C. Fine Aggregate (Sand)*.....Section 902
- D. Water.....Section 923

*Any clean sand with 100% passing 3/8" sieve and not more than 10% passing with 200 mesh may be used.

2.02 MIX PROPORTIONS

- A. The Contractor shall be responsible for producing a flowable mixture using these guidelines and by adjusting his mixture design as called for by circumstances or as may be directed by the Engineer of Record.
- B. Excavatable flowable fill material shall be proportioned to produce a 28-day compressive strength of 100 psi.
- C. General mix quantities are as follows:

Components	Pounds per Cubic Yard
Cement	50-100*
Fly Ash or Granulated Blast Furnace Slag	0-600
Fine Sand	2,750 (adjust to yield one CY)
Water	500 (Maximum)

*The percentage of cement may be increased above these limits only when early strength is required and future removal is unlikely.

- D. Weights for fine aggregate and water shall be adjusted according to cementious content. The mix proportions shall be adjusted for removability, pumpability and flowability. If required, strength test data shall be provided prior to batching.
- E. If required by the Engineer of Record, the flowability can be measured by afflux time determined in accordance with ASTM C 939 and shall be 30 seconds \pm 5 seconds as measured on mortar passing the No. 4 sieve. The equipment required to perform this test shall be provided by the Contractor.

2.03 APPROVED MIXES OF “EXCAVATABLE FLOWABLE FILL”

FDOT - Approved Design Mixes for Miami-Dade County:

Plant	Mix Number
Tarmac	04-FF-65
Rinker Materials Corp.	04-FF-52
Central Concrete Supermix Inc.	06-FF-41
Cemex	06-FF-48

PART 3 - EXECUTION

3.01 Flowable fill shall be produced and delivered using concrete construction equipment. Placing flowable fill shall be done by chute, pumping or other methods approved by the FDOT or the City.

3.02 CONSTRUCTION REQUIREMENTS

The flowable fill shall be placed to the designated fill line without vibration or other means of compaction. Placement shall be avoided during inclement weather, e.g. rain or ambient temperatures below 40 degrees F. The Contractor shall take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Also, necessary means to confine the material within the designated space shall be provided by the Contractor.

3.03 ACCEPTANCE

- A. The flowable fill shall be proportioned and places as specified herein. In general, the strength desired is the maximum hardness that can be excavated at a later date using conventional excavating equipment. No curing protection is required.
- B. The fill shall be left undisturbed until material obtains sufficient strength. Sufficient strength is 250 psi penetration resistance as measured using a hand held penetrometer. The penetrometer shall be provided by the Contractor.

- C. All flowable fill areas subject to traffic loads must have a durable riding surface.
- D. An approved type of accelerator may be approved for the placement of "Flowable Fill" in traffic areas when submitted to the City and with FDOT approval.

END OF SECTION

SECTION 03400

PRECAST PRESTRESSED CONCRETE

PART 1 - GENERAL

1.01 INCLUDED

- A.** The work under this section includes the design, casting, delivery, erection and shoring of precast prestressed concrete structures as shown on the Contract Drawings.

1.02 Related work specified elsewhere

- A.** Section 03300 – Cast-in-Place Concrete, Reinforcing and Formwork
- B.** Section 01340 – Shop Drawings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A.** Without limiting the generality of other requirements of these Specifications all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section:

1. South Florida Building Code, latest edition.
2. ACI 318-95, Building Code Requirements for Reinforced Concrete.
3. PCI MNL 116, Manual for Quality Control for Plants and Production of Precast Concrete Products
4. ASTM A416, Specification for Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete.

1.04 QUALITY ASSURANCE

- A.** Fabricator shall be a recognized prestressed concrete manufacturer with minimum five (5) years experience in the manufacture and erection of similar units and whose design, fabrication and erection operations are supervised by a Florida Registered Professional Engineer.

1.05 CONTRACTOR SUBMITTALS

- A.** Shop Drawings: The Contractor shall submit shop and erection drawings for approval, showing concrete design strength; unit dimensions; unit weights; size, number, location and stress in prestressing strands; size, number and location of reinforcing bars including reinforcing for erection and handling stresses; concrete

cover over reinforcing and strands; bearing and anchorage details; concrete finish; curing method; erection marks; hoist points and shoring points.

B. Design Calculations: The Contractor shall submit for approval, neat, legible and complete design calculations prior to fabrication. Calculations shall be by a Florida Registered Professional Engineer whose seal shall appear on calculation sheets and shop drawings.

1. Calculations shall include predicted in-place cambers without superimposed loads, with superimposed dead loads and with superimposed dead loads and live loads.
2. Span length in calculations shall be from center of bearing to center of bearing.
3. Include bearing and anchorage details including those in the precast sections and those in the job cast concrete structure.

C. Certificates: The Contractor shall submit manufacturer's test certificates on prestressing strands and reinforcing.

D. Concrete Cylinder Tests: The Contractor shall submit copies of cylinder break reports by an approved commercial test laboratory, made from each casting for this project to verify that concrete has attained minimum ultimate prestressed transfer strength specified.

1.06 DEFINITIONS

A. In these Specifications, where the terms "Precast Concrete" and "Precast Concrete Specialties" are used, they shall have equivalent meaning.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete: Minimum 7 day ultimate compressive strength of 4000 p.s.i. Higher strength will be permitted to suit manufacturer's design. In other respects, concrete shall comply with requirements of Section 03300.

B. Prestressing Strands: High strength 7 wire strand conforming with ASTM A416-94. Elongation test conforming with ASTM A270-90 with minimum elongation at rupture of 3.5% in 24 inches. Tests need not be made if certification of conformance with specifications is provided by manufacturer. Use strand of U.S. manufacture.

C. Reinforcing Steel: ASTM A615, grade 60.

- D.** Forms: Provide smooth units true to size, shape and detail with flat panes, sharp lines and arises, free from warp, twist, bow or similar distortions, spalling, broken edges, cracks or similar defects. Dimensional tolerances to be as provided in ACI 525 Standards Minimum Requirements For Thin Section Precast Concrete Construction.

2.02 FABRICATION

- A.** General: Fabricate units accordance with approved shop drawings and approved design calculations.
- B.** Unit design and fabrication: Conform with ACI Standard Building Code Requirements for Reinforced Concrete and the Prestressed Concrete Institute Standards. Fabricator shall design joists and beams in accordance with loads indicated on drawings. Camber under dead load or deflection under total load shall not exceed 1/360 of span.
- C.** Inserts: Install hanger inserts and sleeves in unit forms for mechanical and electrical items as provided under other sections and as shown on Drawings.
- D.** Curing: Top surface to receive water curing only.
- E.** Marking: Distinctively mark each unit with manufacturer's name and mark indicated on erection drawings.
- F.** Age: Units shall be minimum 10 days old before shipping or erection.

2.03 PREFORMED JOINT SEALANT

- A.** The joint sealing compound shall be Quik-Seal, a preformed, cold applied, ready to use plastic joint sealing compound as supplied by Quikset Utility Vaults, Santa Ana, California; Ram-Nick by K.T. Snyder Company; or approved equal.

2.04 MORTAR

- A.** Mortar used between the sections of precast concrete manholes and vaults shall be as recommended by the manhole section manufacturer.

2.05 NON-SHRINK GROUT

- A.** Non-shrink grout shall be as specified in the Section 03600, "Grout".

2.06 QUALITY CONTROL

- A.** Precast concrete units shall be made by an experienced manufacturer and shall be constructed as shown on the Drawings and specified herein and shall be free of defects, checks and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above.

- B.** The Contractor shall notify the Department a minimum of 5 days before the units are cast and 5 days before shipment is made, in order to provide for plant inspection, if the Department so directs.

PART 3 – EXECUTION

3.01 ERECTION

- A.** Erection to be by manufacturer and supervised by manufacturer's Florida Registered Professional Engineer or his authorized representative. Handle and install units with precision, in conformance with drawings, details and erection drawings.

3.02 INSTALLATION

- A.** Required pads, plates and reinforcing bars shall be furnished for casting and anchorage in the adjoining work. The precast concrete units shall be installed in a workmanlike manner with the units tight and at right angles to the supporting beams or walls. The units shall be aligned and leveled in accordance with the procedures recommended by the manufacturer. Units shall be grouted by a mixture of not less than one part cement to three parts fine sand, care being taken to see that joints are filled. Damp grout that may have seeped through shall be removed before it hardens.

- B.** All openings in the precast units shall be made by the Contractor and are the responsibility of the Contractor. Where details for an opening are not shown on the Drawings, the opening shall be made in accordance with the recommendation of the manufacturer. When an opening causes a loss in carrying capacity of the unit, the adjacent units shall be designed to carry the additional dead and superimposed load transferred from the unit with the opening. The Contractor shall provide saddle headers as required.

- C.** Extreme care shall be used to avoid damaging or soiling concrete as no repairing or cutting will be permitted. Damaged units shall be replaced at the expense of the Contractor. Wooden hammers shall be used, with pinch bars being used on unexposed parts only.

3.03 CLEANING AND REPAIRS

- A.** Cleaning: Clean exposed surfaces of units of stains to a uniform appearance. Do not use caustic or acid cleaners.
- B.** Repairs: Repair nicks or chips in exposed areas.

END OF SECTION

SECTION 03600

GROUTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The scope of work involves 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 cementitious grout to fill the void. All work within FDOT right-of-ways will be required to comply with FDOT standards and specifications.

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.
- C. Contractor is to provide all field tickets for grout mix deliveries for review by the City and FDOT.

1.03 SUBMITTALS

- A. Shop Drawings: Shop drawings shall be submitted in accordance with Section 01340. In addition, the following shall be submitted to the Engineer for acceptance prior to construction.
 - 1. A detailed description of equipment and operational procedures to accomplish the grouting operation, including grout mixture design, grout mixer type, grout samples, and test data.
 - 2. A detailed description of the grouting time schedule and a plan showing the location of grouting injection ports and vent ports to ensure that the pipe is fully grouted for each section, from end to end.
 - 3. Submittals for caps to be installed on each end of the piping.

PART 2 – PRODUCTS

2.01 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.
- B. The mixture shall contain a minimum of 50 pounds cement and minimum of 400 pounds flyash per cubic yard of grout.

2.02 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

- A. Grouting of the annular space due to the abandonment of the existing water pipe will be allowed in continuous individually bulkheaded segments of up to 500 linear feet for 6” diameter piping, 750 linear feet for 8” to 12” diameter piping, and 1000 linear feet for greater than 12” diameter piping. Note that these lengths are recommended standards but each section and diameter of piping may vary from these maximum lengths on a case-by-case basis. The lengths of piping and locations of caps are to be included on the plan submitted by the Contractor as required in the Submittal section herein.
- B. Grout shall be placed in a maximum of three 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.
- C. 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".
- D. 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.

- E. 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.**
- F. Grout pressure in the void space is not to exceed five (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.

END OF SECTION