

PBCWUD
STANDARD DESIGN SPECIFICATION SECTIONS
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**20-009R -- PALM BEACH COUNTY LIFT STATION REHABILITATION CONTINUING
CONSTRUCTION CONTRACT 2020**

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SECTION 01 11 00 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 THE SUMMARY

The work covered by these Contract Documents (Construction Drawings as per each approved Work Authorization/Supplement and Technical Specifications) is in general the furnishing of all labor, materials, equipment, supplies, tools and manufactured articles of every kind required to conduct the work as described by the contract documents.

1. Provide the materials, equipment, and incidentals required to make the Project completely and fully operable.
2. Only the materials listed in Palm Beach County Water Utilities Department Engineering Services Division - Approved Materials and Equipment List (Latest Version) are approved for use within the PBCWUD service area, or as specified herein.
3. Provide the labor, equipment, tools, and consumable supplies required for a complete Project.
4. Provide the civil, and all other Work required for a complete and operable Project.
5. Test and place the completed Project in operation.
6. Provide the special tools, spare parts, lubricants, supplies, or other materials as indicated in Contract Documents for the operation and maintenance of the Project.
7. Arrange and coordinate with Supplier for deliveries of OWNER purchased products in accordance with construction schedule, coordinate to avoid conflict with work and conditions at the site. Unload the products at the site, and store and protect the products in accordance with the Supplier's instructions.
8. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR and coordinated with the ENGINEER as though originally so indicated, at no increase in cost to the OWNER.
9. CONTRACTOR shall comply with all applicable federal, state and local safety regulations, laws and standards, as well as any specific Palm Beach County or Water Utilities Department requirements while completing the work.
10. Except as specifically noted, the CONTRACTOR shall provide and pay for:
 - a. Labor, materials, and equipment.
 - b. Tools, equipment and machinery.

APPENDIX A

ASSET TAG LIST

- Actuator
- Air Conditioning (Package)
- Air Handler
- Air Release Valve
- Alarm
- Ammoniator
- Analyzer
- Auger
- Auto Flusher
- Automatic Transfer Switch
- Backflow Preventer
- Bar Screen
- Bar Screen Shock Relay
- Battery Charger Unit
- Belt Filter Press
- Blower
- Boat
- Boat, Pontoon
- Boiler
- Breaker
- Burner
- Calibration Column
- Camera
- Cart
- Cart, Golf
- Cart, Passenger
- Cart, Utility
- Catalyst Monitor
- Catalytic Converter
- Channel Monster
- Compressor
- Condenser
- Contactor
- Container
- Control Cabinet
- Control Panel

Electronic Equipment Data Sheet User Guide

- Controller
- Conveyor
- Dampener
- Defibrillator
- Diffuser
- Display
- Distiller
- Dryer
- Electrical Panel
- Elevator
- Emergency Shower Eye Wash
- Enclosure
- Engine
- Exhaust Fan
- Fencing
- Filter
- Filter Hood
- Fire Alarm
- Flame Arrestor
- Flow Meter
- Flow Meter Controller
- Flow Transmitter
- Fork Lift
- Fuel Monitor
- Furnace
- Gas Cleaner
- Gate
- Gate Operator
- Gear Box
- Generator
- Grate
- Grit Classifier
- Grit Separator
- Grounding Reel, Retractable
- Harmonic Filter
- Hatch
- Heat Exchanger
- Heater
- Heating Panel
- Heating Ventilation & Air Conditioning (HVAC)

- Hoist
- Hopper
- Hydrant
- Hydraulic Pressure Booster
- Hydrocyclone
- Ice Machine
- Incubator
- Injector
- Inverter
- Ladder
- Level Monitor
- Level Transmitter
- Lift
- Light
- Light Pole
- Lime Silo
- Load Bank
- Macerator
- Manhole
- Mixer
- Monitor
- Motor
- Odor Control Unit
- Oven/Lab
- Ozone Destructor
- Panel
- pH Meter
- Pipe
- Pipe, Clay
- Pipe, DI
- Pipe, Fiberglass Reinforced Plastic
- Pipe, Galvanized
- Pipe, High Density Polyethylene
- Pipe, PVC
- Pipe, Stainless
- Portable Fire Extinguisher
- Power Conditioner
- Power Disconnect
- Power Monitor
- Pressure Transmitter Indicator

Electronic Equipment Data Sheet User Guide

- Pressure Vessel Train
- Pressure Washer
- Probe
- Programmable Logic Controller
- Pump
- Pump, Centrifugal
- Pump, Diaphragm
- Pump, Fuel
- Pump, Positive Displacement
- Pump, Progressive Cavity
- Pump, Submersible
- Pump, Vacuum
- Pump, Vertical Turbine
- Rack
- Reactor
- Reduction Gear Box
- Regulator
- Relay
- Remote Transmitter Unit
- Roll Up Door
- Roto Screen
- Rotameter
- Sampler
- Scale
- Scraper Mechanism Clarifier
- SDI Meter
- Sensor
- Separator
- Silencer
- Slaker
- Sludge Press
- Solar Panel
- Solenoid
- Starter
- Strainer
- Surge Voltage Protector
- Switch, Limit
- Switch, Transfer
- Switchgear
- Tank

- Tank, Air
- Tank, Chemical
- Tank, Fuel
- Tank, Hydropneumatic
- Tank, Reclaim
- Tank, Surge
- Tank, Water
- Temperature Transmitter
- Thickener
- Tower
- Trailer
- Transceiver
- Transformer
- Uninterrupted Power Supply
- Valve
- Valve, Butterfly
- Valve, Check
- Valve, Gate
- Valve, Plug
- Valve, Pressure Relief
- Valve, Pressure Sustaining
- Vapor, Heater
- Variable Frequency Drive
- Venturi
- Vibration Transmitter
- Vibrator
- Volt Meter
- Waste Gas Torch
- Water Heater
- Water Meter
- Water Softener
- Water Softener Timer
- Weather Station
- Well
- Well, Deep Injection
- Well, Monitoring
- Well, Production
- Wet Well
- Winch

SECTION 02 00 00 – EXISTING CONDITIONS

PART 1 – GENERAL

1.1 GENERAL

- A. The plans depict the approximate locations of existing subsurface utilities.**
- B. Related sections:**
 - 1. Section 31 23 33 – Trenching and Backfilling**

PART 2 – PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 CONSTRUCTION

- A. Notify the owners of utilities at least 48 hours in advance of conducting construction near these existing utilities.**
- B. Locate cables, ducts, conduits, pipelines, casings, etc., in advance of the proposed construction in cooperation with the owners of such utilities.**
- C. Notify the ENGINEER of any substantial changes in the vertical or horizontal orientation of existing utilities that would require a deviation in the Contract Documents.**
- D. Repair all damage done to existing utilities at no additional expense to the OWNER of the project, or the owner of the utility.**

PART 4 -- OBSTACLES:

- 4.1 Obstacles encountered not shown on the Drawings which may cause a revision to final grades may be considered grounds for compensation to the CONTRACTOR on a force account (equipment rental) basis for the time expended to re-perform any WORK necessary. Such compensation will be agreed to by the OWNER prior to proceeding with the modified construction**

END OF SECTION

SECTION 02 41 00 – DEMOLITION

PART 1 – GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall demolish and reconstruct existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation facilities as indicated, in accordance with the Contract Documents.
- B. The CONTRACTOR shall be responsible for requesting, and obtaining all required demolition, hauling, transport, and disposal permits required from local, State, or Federal regulatory agencies. The CONTRACTOR shall be responsible for all permit fees associated with demolition activities.

1.2 TRACTOR SUBMITTALS

- A. All submittals shall be in accordance with Section 01 33 00 – Submittal Procedures. Demolition and reconstruction activities and procedures, including operational sequences, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included.
- B. Upon completion of the demolition WORK, the CONTRACTOR shall be required to modify the Contract Drawings to indicate the revised “as-built” condition of the site. Additional notes shall be added to the drawings to clearly identify what equipment, structures, piping, and infrastructure have been removed, abandoned, or modified. Record drawings associated with demolition activities shall comply with Section 01 77 00 – Closeout Procedures.
- C. Upon completion of the demolition WORK, the CONTRACTOR shall be required to provide the OWNER with copies of all permits and correspondence with local, State, and Federal regulatory agencies documenting the demolition WORK performed by the CONTRACTOR.

1.3 SEQUENCING

- A. The CONTRACTOR shall carefully coordinate the WORK in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The WORK as indicated is not all-inclusive, and the CONTRACTOR shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities such as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily shown. The CONTRACTOR shall comply with sequencing requirements in Section 01 14 00 – Work Restrictions.

- B. Prior to Bidding, the CONTRACTOR shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of WORK, and the extent of auxiliary utilities.
- C. The CONTRACTOR is advised that the OWNER may have previously completed an asbestos and lead containing material report of the site to be demolished by the CONTRACTOR. The CONTRACTOR is encouraged to request a copy of the reports from the OWNER.
- D. While demolition and reconstruction are being performed, the CONTRACTOR shall provide adequate access for the continued operation and maintenance of equipment and treatment processes. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the CONTRACTOR's employees and the OWNER's personnel at the plant. The CONTRACTOR shall remove such protection when reconstruction activities are complete, or as WORK progresses, or when requested by the ENGINEER.

1.4 DEMOLITION

- A. Existing pavement, structures, equipment, piping, valves, ductwork, electrical gear, instrumentation, utilities, and related appurtenances such as anchors, supports, and hardware indicated or required to be demolished as part of the WORK shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of off-site by the CONTRACTOR at no additional cost to the OWNER.

1.5 SALVAGE

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances indicated to be salvaged shall be removed without any degradation in condition from that prior to removal. Salvaged items shall be stockpiled and protected on the Site at a location chosen by the ENGINEER. The CONTRACTOR shall be responsible to properly safeguard the salvaged items against damage and loss during removal and handling.

1.6 RELOCATION

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances to be relocated shall be removed without any degradation in condition from that prior to removal. The CONTRACTOR shall be responsible to properly safeguard the relocated items against damage and loss during removal, handling, storage, and installation in the new location.

1.7 ABANDONMENT

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances to be abandoned shall be prepared by the CONTRACTOR as indicated.

1.8 REHABILITATION

- A. Existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation WORK disturbed or damaged by reconstruction activities shall be repaired and rehabilitated as indicated.
- B. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.
- C. In buildings with reconstruction WORK, the CONTRACTOR shall not use any OWNER equipment (e.g., bridge cranes and monorails) unless authorized in advance in writing by the ENGINEER. Such authorization shall be subject to documentation by the CONTRACTOR of the proposed load on the equipment and be subject to OWNER requirements for usage on operating and maintenance needs. Any damage to a crane shall be repaired or replaced to the ENGINEER's satisfaction.

1.9 DISPOSAL

- A. The CONTRACTOR shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, state, and federal codes and requirements. No materials or equipment shall be disposed on-site.

1.10 SCHEDULING

- A. The CONTRACTOR shall be required to submit a demolition schedule and complete all demolition activities associated with the site by this schedule, including removal, transportation, and off-site disposal, site regrading and restoration, and sodding. Any penalties incurred by the OWNER after the approved demolition schedule shall be the sole responsibility of the CONTRACTOR in the event all WORK is not completed by demolition completion date.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall coordinate demolition and reconstruction WORK with the OWNER and ENGINEER. Unless otherwise indicated, the CONTRACTOR shall be responsible for the sequence of activities. WORK shall be performed in accordance with applicable safety rules and regulations.
- B. The CONTRACTOR shall verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.
- C. The CONTRACTOR shall take precautions to avoid damage to adjacent facilities and to limit the WORK activities to the extent indicated. If demolition or reconstruction beyond the scope indicated is required, the CONTRACTOR shall obtain approval from the ENGINEER prior to commencing.

3.2 PREPARATION

A. Protection:

1. Before beginning any WORK, the CONTRACTOR shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of demolition or reconstruction and coordination with the WORK. Existing facilities not subject to demolition or reconstruction shall be protected and maintained in accordance with Section 01 76 10 - Protection of Existing Facilities. Damaged existing facilities shall be repaired to the previous condition or replaced.
2. Persons shall be afforded safe passages around areas of demolition.
3. Structural elements shall not be overloaded. The CONTRACTOR shall be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of WORK performed under this Section. The CONTRACTOR shall remove temporary protection when the WORK is complete or when so authorized by the ENGINEER.
4. The CONTRACTOR shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.
5. The CONTRACTOR shall provide and maintain temporary safety barriers and other safety and security devices as necessary to protect the public and project personnel from injury due to the WORK. The CONTRACTOR shall protect from damage all existing WORK, equipment, and improvements that are to remain and restore all damage caused by the demolition work at no cost to the OWNER.

B. DEMOLITION, SALVAGE, AND RELOCATION

1. The Contract Documents indicate existing facilities to be demolished, salvaged, and/or relocated. Auxiliary utilities including such services as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily indicated. The CONTRACTOR shall verify the scope of the WORK to remove the equipment indicated; coordinate its shutdown, removal, replacement, or relocation; and submit an outage plan in accordance with Section 01 14 00 - Work Restrictions. The removal of existing facilities for demolition, salvage, and relocation shall include the following requirements:
 - a. Equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed. Damage to the existing structure shall be repaired as indicated.
 - b. Exposed piping including vents, drains, and valves shall be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2-inches. Resultant openings in the structure shall be repaired as indicated.

- c. Electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed.
- d. Exposed electrical conduits and associated wiring shall be removed. Resultant openings in structures shall be repaired as indicated.
- e. Connections to embedded electrical conduits shall be removed a minimum of 2-inches inside the finished surface of the existing structure. Wiring shall be removed and the resulting openings shall be repaired as indicated.
- f. Associated instrumentation devices shall be removed.
- g. Auxiliary utility support systems shall be removed.
- h. The area shall be thoroughly cleaned such that little or no evidence of the previous equipment installation will remain.
- i. Asphalt and concrete pavement, curbs, and gutters shall be removed as necessary to perform reconstruction. The limits of removal shall be sawcut. When the required improvements have been constructed, new asphalt and concrete pavement, curbs, and gutters shall be placed to match the original unless otherwise indicated.
- j. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed to a depth which will not interfere with new construction, but not less than 36-inches below existing ground surface or future ground surface, whichever is lower.
- k. Below-grade areas and voids resulting from demolition of structures shall be completely filled. Fill and compaction shall be in accordance with Section 31 23 00 – Excavation and Fill. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.
- l. When existing pipe is removed, the CONTRACTOR shall plug the resulting open ends whether or not so indicated. Where removed piping is exposed, the remaining piping shall be blind-flanged or fitted with a removable cap or plug.
- m. When existing piping is removed from existing structures, the CONTRACTOR shall fill resulting openings in the structures and repair any damage such that the finished rehabilitated structure shall appear as a new homogeneous unit with little or no indication of where the new and old materials join. The openings in water-bearing structures shall be filled with non-shrink grout to be watertight and reinforced as required or indicated. In locations where the surface of the grout will be exposed to view, the grout shall be recessed approximately 1/2-inch and the recessed area filled with cement mortar grout.
- n. Electrical demolition or reconstruction shall be conducted by the CONTRACTOR in a safe and proper manner to avoid injury from electrical shock to the OWNER's and CONTRACTOR's personnel. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal

and made inoperable. At no time shall electrical wiring or connections which are energized or could become energized be accessible to CONTRACTOR, OWNER, or other personnel without suitable protection or warning signs.

- o. The CONTRACTOR shall perform a functional test of existing equipment that is relocated and reinstalled to ensure the equipment functions in the manner documented during the initial inspection. The CONTRACTOR shall inform the ENGINEER in writing a minimum of 5 Days prior to the functional testing in order for the OWNER and ENGINEER to witness the test. If, in the opinion of the ENGINEER, the relocated equipment does not function in a satisfactory manner, the CONTRACTOR shall make repairs and modifications necessary to restore the equipment to its original operating condition at no additional cost to the OWNER.

C. ABANDONMENT

1. Existing facilities to be abandoned shall be prepared as indicated. Where existing buried piping is to be abandoned, the CONTRACTOR shall remove the abandoned pipe for a distance of 5-feet from any connecting structures. Openings at the existing structures shall be repaired. The remaining pipe shall be capped at both ends prior to backfill. Buried piping, 12-inches diameter or greater shall be completely sand-filled prior to closure of the piping ends.

D. REHABILITATION

1. Certain areas of existing structures, piping, conduits, and the like will be affected by WORK necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by its construction activities.
2. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or floor slab) by saw-cutting clean straight lines to a minimum depth of 1-inch and then chipping out the concrete. Alternately, the sides of the opening (not the corners) may be formed by saw cutting completely through the slab or wall. Saw cuts deeper than 1-inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling and chipping or grinding. Necessary precautions shall be taken during removal of concrete to prevent debris from falling into or entering adjacent tanks in service or from damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with non-shrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 2-inches from the finished face of the new opening and be painted with epoxy paint. The inside face of the new opening shall be grouted with an epoxy cement grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
3. Where new piping is installed in existing structures, the CONTRACTOR shall accurately position core-drilled openings in the concrete as indicated or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines

and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through the wall to provide watertightness around openings so formed. The boxes or cores shall be provided with continuous keyways to hold the filling material in place, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the non-shrink grout, concrete surfaces shall be sandblasted, thoroughly cleaned of sand and any other foreign matter, and coated with epoxy bonding compound.

4. Pipes, castings, or conduits shall be grouted in place by pouring in grout under a head of at least 4-inches. The grout shall be poured or rammed or vibrated into place to fill completely the space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same watertightness as through the wall itself. The grouted casings shall then be water cured.
5. In locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed approximately 1/2-inch and the recessed area filled with cement mortar grout.
6. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection. Any damage to the lining and coating of the existing piping shall be repaired. Dielectric insulating joints shall be installed at interconnections between new and existing piping.
7. Where existing equipment, piping, and supports, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceilings from piping, conduit, and fastener penetrations shall be filled with non-shrink grout and finished to match the adjacent area. Concrete pads, bases associated with equipment, supports, and appurtenances shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 2-inches below finished grade and be painted with epoxy paint. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and concrete within the scored lines removed to a depth of 1-1/2 inches (or the depth of cover over reinforcing steel, whichever is less). The area within the scored lines shall be patched with non-shrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.
8. Existing reinforcement to remain in place shall be protected, cleaned, and extended into new concrete. Existing reinforcement not to be retained shall be cut-off as follows:
 - a. Where new concrete joins existing concrete at the removal line, reinforcement shall be cut-off flush with the concrete surface at the removal line.
 - b. Where the concrete surface at the removal line is the finished surface, the reinforcement shall be cut back 2-inches below the finished concrete surface, the ends painted with epoxy paint and the remaining holes patched with a cement mortar grout.

9. Where existing handrailing is removed, post embedments and anchors shall be removed and post holes shall be filled with non-shrink grout flush to the floor surface. At the point of continuation of existing handrailing, a new post with rail connections matching the existing handrailing system shall be installed. New posts in existing concrete floors shall be installed in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout.
10. Where reconstruction activities damage the painting and coating of adjacent or nearby facilities, the damaged areas shall be surface prepared and coated in accordance with Section 09 96 00 – Protective Coatings to match the original painting and coating with a compatible system. Surfaces of equipment items that are to be relocated shall be prepared and be coated in accordance with Section 09 96 00 – Protective Coatings.

E. DISPOSAL

1. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities that shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.
2. Site debris, rubbish, and other materials resulting from reconstruction operations shall be legally removed and disposed of. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.
3. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

F. OCCUPANCY AND POLLUTION CONTROL

1. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. The CONTRACTOR shall comply with government regulations pertaining to environmental protection.
2. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

G. CLEANING

1. During and upon completion of WORK, the CONTRACTOR shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by WORK in a clean, approved condition.
2. Adjacent structures shall be cleaned of dust, dirt, and debris caused by reconstruction, as requested by the ENGINEER or directed by governing authorities, and adjacent areas shall be returned to condition existing prior to start of WORK.
3. The CONTRACTOR shall clean and sweep the access roadways and plant roadways used during the WORK on a daily basis. The CONTRACTOR shall be responsible

for keeping all materials on the project site. In the event materials are carried over onto off-site roadways, the CONTRACTOR shall sweep and clean such roadways.

4. All interrupted utilities shall be returned to their pre-demolition state and temporary services shall be disconnected, unless otherwise specified.

END OF SECTION

SECTION 02 41 13.23 – UTILITY LINE REMOVAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. Removal or abandonment of existing utilities and underground structures shall include, but not necessarily be limited to, the removal, salvage, demolition in place, abandonment, or other disposition of existing utilities, underground structures, or other facilities shown on the Plans, encountered in the course of the work, and/or as directed by the Engineer and in accordance with the Contract Documents.**
- B. This Section includes abandonment in place of existing sewers, junction structures, manholes, service lines, and force mains. It also includes water lines, fire hydrants, valves and valve boxes. Abandonment using flowable fill will be at the direction of the Owner as field conditions dictate, or as specified on the Drawings.**

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The following standards are referenced in this specification:**
 - 1. ASTM C 150 - Standard Specification for Portland Cement**
 - 2. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete**
 - 3. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete**
 - 4. ASTM C 937 - Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete**
 - 5. ASTM C 940 - Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory**
 - 6. ASTM C 1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete**
 - 7. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)**
- B. The following sections are referenced in this specification:**
 - 1. Section 01 33 00 - Submittal Procedures**
 - 2. Section 31 23 33 – Trenching and Backfilling**
 - 3. Section 32 16 00 – Curbs and Gutters**
 - 4. Section 32 16 23 – Sidewalks**

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5. Section 32 16 33 – Driveways

1.3 CONTRACTOR SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittal Procedures.
- B. Submit product data for proposed plugs for approval.
- C. Flowable fill mix design report:
 - 1. Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.
 - 2. Use of ballast. Provide percentage of ballast of total placement and size limits for ballast if fill is intended to be used with ballast.
 - 3. Aggregate gradation of fill. Aggregate gradation of mix (excluding ballast) shall be used as pilot curve for quality control during production.
 - 4. Fill mix constituents and proportions including materials by weight and volume, and air content but excluding ballast. Give types and amounts of admixtures including air entrainment or air generating compounds.
 - 5. Fill densities and viscosities, including wet density at point of placement.
 - 6. Initial time of set.
 - 7. Bleeding and shrinkage.
 - 8. Compressive strength.
- D. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.
- E. Experience record for proposed crew, showing minimum of 100 cubic yards of flowable fill placed using proposed or similar equipment and methods.
- F. At least 60 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, bypass pumping requirements and plugging, if any, and other information pertinent to completion of work.

1.4 QUALITY ASSURANCE

- A. The Engineer will inspect all materials and work to ensure compliance with the Contract Documents.

PART 2 -- PRODUCTS

2.1 FLOWABLE FILL

- A. **Design Mix Criteria.** Provide design of one or more mixes to meet design criteria and conditions for placement. Present information required by Paragraph 1.05.B in mix design report including following:
1. **Cement:** ASTM C 150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 100 pounds per cubic yard.
 2. **Fly ash:** ASTM C 618 Class C or F. Volume and weight per cubic yard of fill. Provide minimum Fly ash content of 200 pounds per cubic yard.
 3. **Potable water:** Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
 4. **Aggregate gradation:** 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes 3/8-inch, Nos. 4, 8, 16, 30, 50, 100, and 200. Do not deviate from pilot gradation by more than plus or minus 10 percentage points for any sieve for production material.
 5. **Aggregate source material:** Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent of natural aggregate to provide workability.
 6. **Admixtures:** Use admixtures meeting ASTM C 494 and ASTM C 1017 as needed to improve pumpability, to control time of set, and reduce bleeding.
 7. **Fluidifier:** Use fluidifier meeting ASTM C 937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
 8. **Performance additive:** Use flowable fill performance additive, such as Darafill or approved equal, to control fill properties.
- B. **Flowable Fill Requirements**
1. **Unconfined compressive strength:** minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
 2. **Placement characteristics:** self-leveling.
 3. **Shrinkage characteristics:** non-shrink.
 4. **Water bleeding for fill to be placed by grouting method in sewers:** not to exceed 2 percent according to ASTM C 940.

5. Minimum wet density: 90 pounds per cubic foot.

2.2 BALLAST

- A. Ballast Material: Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.
- B. Ballast Composition: Free of regulated waste material.

2.3 PLUGS

- A. Grout Plugs: Cement-based dry-pack grout conforming to ASTM C 1107, Grade B or C.
- B. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned

PART 3 -- EXECUTION

3.1 CUTTING AND CAPPING OF MAINS

- A. Do not begin cut, plug, and abandonment operations until replacement utility has been constructed and tested, and all service connections have been installed.
- B. Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.
- C. Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on drawings.
- D. After main to be abandoned has been cut and capped, check for other sources feeding abandoned pipeline. If sources are found, notify Construction Manager immediately. Cut and cap abandoned main at point of other feed as directed by Construction Manager.
- E. Plug or cap ends or opening in abandoned main in manner approved by Construction Manager. Install concrete around cap and over pipe to ensure its not penetrable by groundwater. Before backfilling of a capped service line is started, the capping must be observed by a representative of the Owner
- F. Removed and dispose of surface identifications such as valve boxes. Valve boxes in improved streets, other than shell, may be filled with concrete after removing cap.
- G. Backfill excavations in accordance with Section 31 23 33 – Trenching and Backfilling.
- H. Repair street surfaces in accordance with Section 32 16 13 – Curbs and Gutters, Section 32 16 23 – Sidewalks, and Section 32 16 33 – Driveways.
- I. Mark location of abandoned sewer laterals on drawings and provide to Owner.

3.2 CUTTING AND CAPPING OF SERVICES

- A. Do not begin cut, plug, and abandonment operations until replacement service, if necessary, has been constructed and tested, and all service connections have been installed.
- B. Service lines shall be cut and capped in two locations. The service line shall be cut and capped as close to the main as practical but no more than 5' from the main unless obstacles exist to prevent the same (pavement, other utilities, etc.). Services shall also be cut and capped 5' from the building envelope.
- C. Before backfilling of a capped service line is started, the capping must be observed by a representative of the Owner.
- D. After service to be abandoned has been cut and capped, check for any other sources feeding abandoned service. When sources are found, notify Construction Manager immediately. Cut and cap abandoned main at point of other feed as directed by Construction Manager.
- E. Plug or cap ends or opening in abandoned service in manner approved by Construction Manager. Install concrete around cap and over pipe to ensure it's not penetrable by groundwater.
- F. Removed and dispose of surface identifications such as cleanouts or meter boxes. Cleanouts in improved streets, shall be filled with concrete.
- G. Backfill excavations in accordance with Section 31 23 33 – Trenching and Backfilling.
- H. Repair paved surfaces in accordance with Section 32 16 13 – Curbs and Gutters, Section 32 16 23 – Sidewalks, and Section 32 16 33 – Driveways.
- I. Mark location of abandoned service on drawings and provide to Owner.

3.3 ABANDONMENT OF FORCE MAINS

- A. Do not begin cut, plug and abandonment operations until replacement force main has been constructed and tested, and all service connections have been installed.
- B. Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.
- C. Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on Drawings.
- D. After force main to be abandoned has been cut and plugged, check for other sources feeding abandoned force main. When sources are found, notify Construction Manager immediately. Cut and plug abandoned force main at point of other feed as directed by Construction Manager.

- E. Plug or cap ends or openings in abandoned force main in manner approved by Construction Manager.
- F. Remove and dispose of surface identifications such as valve boxes. Valve boxes in improved streets, other than shell, may be filled with concrete after removing cap.
- G. Backfill excavations in accordance with Section 31 23 33 - Trenching and Backfilling.
- H. Repair street surfaces in accordance with Section 32 16 13 – Curbs and Gutters, Section 32 16 23 – Sidewalks, and Section 32 16 33 – Driveways.

3.4 PREPARATION FOR FLOWABLE FILL

- A. Have fill mix design reports and other submittals required by Section 01 33 00 – Submittal Procedures accepted by the Construction Manager prior to start of placement. Notify the Construction Manager at least 24 hours in advance of grouting with flowable fill.
- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.
- C. Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to the Construction Manager. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.
- D. Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.
- E. Remove free water prior to starting fill placement.

3.5 EQUIPMENT FOR FLOWABLE FILL

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.6 DEMOLITION OF SEWER MANHOLES, PIPELINE STRUCTURES, AND FORCE MAINS PRIOR TO ABANDONMENT

- A. Remove manhole frames and covers and castings from other existing pipeline structures. Deliver castings to nearest maintenance facility for future use. Alternatively, salvaged castings may be used upon approval by the Construction Manager, for constructing new manholes on this project.

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- B. Demolish and remove precast concrete adjustment rings and corner section, or brick and mortar corbel and chimney, or other pipeline structure, to minimum depth of 4 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.
- C. When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.
- D. Excavate overburden from force mains to be abandoned at locations indicated on Drawings, conforming to Section 31 23 33 - Trenching and Backfilling. Cut existing force main, when necessary, to provide an end surface perpendicular to axis of pipe and suitable for plug to be installed. Remove force main piping material remaining outside of segment to be abandoned.

3.7 INSTALLATION OF FLOWABLE FILL

- A. Abandon sewer lines by completely filling sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within depth of structures left in place.
- B. Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.
- C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.
- D. Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.
- E. Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.
- F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.
- G. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.
- H. Remediate placement of flowable fill which does not fill voids in sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sewer or from surface.
- I. Plug each end of force main being abandoned.

J. Force main abandonment

1. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare exterior pipe surface if manufactured cap is to be used.
2. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
3. When using manufactured plug or cap, install fitting as recommended by manufacturer's instructions, to form water tight seal.

K. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 23 33 - Trenching and Backfilling.

L. Collect and dispose of excess flowable fill material and other debris as directed by the Construction Manager.

3.8 FIELD QUALITY CONTROL

- A. Provide batch plant tickets for each truck delivery of flowable fill. Note on tickets addition of admixtures at site.**
- B. Check flow characteristics and workability of fill as placement proceeds.**
- C. Obtain at least three test cylinders for each placement area for determination of 56-day compressive strength and bleeding. Acceptance of placement will be based on average strength of three tests.**
- D. Record volume of ballast together with flowable fill placement for same space to demonstrate that voids have been filled.**

3.9 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions for employees throughout demolition and removal operations in accordance with Section 01 35 53 - Security Procedures. Observe safety requirements for work below grade.**
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.**

- END OF SECTION -

SECTION 03 00 00- CONCRETE

PART 1 -- GENERAL

1.1 WORK INCLUDED

- A. Formwork, shoring, bracing and anchorage.**
- B. Concrete reinforcement and accessories.**
- C. Cast-in-Place concrete.**

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings.**
- B. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.**
- C. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.**
- D. ASTM C33 - Concrete Aggregates.**
- E. ASTM C94 - Ready Mixed Concrete.**
- F. ASTM C150 - Portland Cement.**
- G. ASTM C260 - Air Entraining Admixtures for Concrete.**
- H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.**
- I. ASTM D2103 - Polyethylene Film and Sheeting.**
- J. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.**
- K. ACI 350 - Concrete Sanitary Engineering Structures**

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.**
- B. Unless otherwise noted in the Contract Documents, reinforced concrete shall be designed to develop a minimum compressive strength of 4,000 pounds per square inch after 28 days.**
- C. Unless otherwise noted in the Contract Documents, unreinforced concrete shall be designed to develop a minimum compressive strength of 3,000 pounds per square inch after 28 days.**

1.4 REGULATORY REQUIREMENTS

- A. Conform to the Standard Building Code, with Palm Beach County Amendments.**

1.5 TESTS

- A. Testing and analysis of concrete will be performed under the provisions of Section 01 45 00 - Quality Control.
- B. Submit proposed mix design for each class of concrete prior to commencement of work.
- C. Testing firm will take cylinders and perform both slump and air entrainment tests in accordance with ACI 301. Three concrete test cylinders are to be taken for every 75 cubic yards or less of each class of concrete placed each day. One slump test will be taken for each set of test cylinders taken.

1.6 SHOP DRAWINGS

- A. Submit shop drawings of reinforcing steel.
- B. Indicate reinforcement sizes, spacing, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules, splicing, supporting and spacing devices.
- C. Indicate form dimensioning, materials and arrangement of joints and ties.

1.7 STORAGE

- A. Cement shall be stored in a thoroughly dry, weathertight and properly ventilated building with adequate provisions for the prevention of the absorption of moisture. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.
- B. Cement which has hardened or is otherwise unfit for use shall not be used.
- C. Fine and coarse aggregates shall be stored separately and in such a manner as to avoid the inclusion of any foreign material in the concrete.

PART 2 -- PRODUCTS

2.1 FORM MATERIALS

- A. Conform to ACI 301.

2.2 REINFORCING STEEL

- A. Reinforcing steel conforming to ASTM A615, 40 ksi and 60 ksi yield grade billet steel deformed bars with uncoated finish.
- B. Welded Steel Wire Fabric, plain type, ANSI/ASTM A185, in coiled rolls with uncoated finish.

2.3 CONCRETE MATERIALS

- A. Type II Portland cement, grey color, conforming to ASTM C150. Fine and coarse aggregates conforming to ASTM C33. Clean water not detrimental to concrete.

2.4 ADMIXTURES

- A. Air entrainment admixture conforming to ASTM C260-77. Air entrained concrete shall have an air content of 4.5%, plus or minus 1.5% of the volume of the concrete.**
- B. A water reducing retarder shall be one that acts as a cement dispersing agent and retards the setting of the concrete in the early stages. Retarder shall conform to ASTM Designation C494-77a and shall be added to concrete according to the manufacturer's recommendations.**
- C. All admixtures may be used only with the written approval of the ENGINEER.**

2.5 ACCESSORIES

- A. Premixed non-shrink grout compound with non-metallic aggregate, cement, water reducing and plasticizing agents, capable of minimum compressive strength of 3,000 psi.**
- B. Chemical Hardware: Burke Company "Burk-O-Lith"; Sonebonn "Lapidolith"; Anti-Hydro "Armortap".**

2.6 CURING MATERIALS

- A. Clean, drinkable water.**
- B. Membrane curing compound conforming to ASTM C309.**

2.7 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.**
- B. Compressive strength of 3,000/4,000 psi at 28 days; Slump of 3 inches plus or minus 1 inch; Water-Cement ratio of 0.48.**

2.8 WATERSTOPS

- A. Not used.**

PART 3 -- EXECUTION

3.1 FORMWORK ERECTION

- A. Verify lines, levels and measurements before proceeding with formwork.**
- B. Align form joints.**
- C. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agents.**
- D. Coordinate work of other Sections in forming and setting openings, slots, recesses, sleeves, bolts, anchors and other inserts.**

3.2 REINFORCEMENT

- A. Place, support and secure reinforcement against displacement.
- B. All reinforcement shall be entirely free of rust, scale, grease or other coating which might destroy or reduce its bond with the concrete.
- C. Bars shall conform to the requirements of the "Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement," ASTM designation A615-76a, Grade 60.
- D. Wire mesh reinforcement shall conform to ASTM designation A185-73.

3.3 PLACING CONCRETE

- A. Notify the ENGINEER at least 24 hours prior to the commencement of concrete operations.

3.4 FLOOR SLABS

- A. Not used.

3.5 TOLERANCES

- A. Not used.

END OF SECTION

SECTION SPEC 03 11 00– CONCRETE FORMING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall furnish all materials for concrete formwork, bracing, shoring, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Section 01 33 00 – Submittal Procedures
- B. Section 03 15 16 – Concrete Construction Joints
- C. Section 03 20 00 – Concrete Reinforcing
- D. Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Codes:

- 1. The Building Code, as referenced herein, shall be the Southern Standard Building Code (SSBC) as specified in Section 01 42 19 – Reference Standards.

B. Government Standards:

- 1. PS 1-74 U.S. Product Standard for Concrete Forms, Class I.

C. Commercial Standards:

- 1. ACI 347-78 Recommended Practice for Concrete Formwork.

1.4 QUALITY ASSURANCE

A. Tolerances

- 1. The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface.
- 2. All other tolerances shall be within those specified in Section 203 of ACI 347.

PART 2 -- PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

- A. Except as otherwise expressly accepted by the ENGINEER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material.
- B. All forms shall be smooth surface forms and shall be of the following materials:

1. Walls
2. Steel or plywood panel
3. Columns
4. Steel, plywood or fiber glass
5. Roof and floor
6. Plywood
7. All other work
8. Steel panels, plywood or tongue and groove lumber

2.2 FORM AND FALSEWORK MATERIALS

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured for concrete formwork, conforming to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlayed plywood, MDO Ext. Grade.
- B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.
- C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a minimum live load of 30 psf.

2.3 FORM TIES

- A. Form ties with integral waterstops shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
- B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when approved by the ENGINEER. A preformed neoprene or

polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced at the CONTRACTOR's expense.**
- B. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, State, and Federal regulations.**
- C. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by the CONTRACTOR's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.**
- D. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Contract Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage.**
- E. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.**

3.2 FORM DESIGN

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating concrete.**
- B. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.**
- C. Plywood, 5/8-inches and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete.**
- D. The bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form.**

- E. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be acceptable to the ENGINEER.

3.3 CONSTRUCTION

- A. Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. Construction joints will not be permitted at locations other than those shown or specified, except as deemed acceptable by the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Form Ties:
 - 1. Embedded Ties:
 - a. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar.
 - b. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete.
 - c. Ties shall not be removed in such a manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted.
 - d. If steel panel forms are used, rubber gromets shall be provided where the ties pass through the form in order to prevent loss of cement paste.
 - e. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
 - 2. Removable Ties:
 - a. Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures.
 - b. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for above-grade walls which are dry on both sides.

- c. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER.
- B. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.
- C. Forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete.
- B. No heavy loading on green concrete will be permitted.
- C. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75% of the 28-day strength specified in Section 03 30 00 - Cast-in-Place Concrete, provided that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75% of the specified 28-day strength and has been in place for a minimum of 7 days.
- D. The time required to establish said strength shall be as determined by the ENGINEER based on several test cylinders made by the CONTRACTOR for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7 day minimum, then that time shall be used as the minimum length of time.
- E. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the WORK not specifically mentioned herein shall remain in place for periods of time as determined by the ENGINEER.

3.6 MAINTENANCE OF FORMS

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. When in place, forms shall conform to the established alignment and grades.
- B. Before concrete is placed, forms shall be thoroughly cleaned. Form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the ENGINEER.
- C. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least 2

weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.**
- B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.**
- C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening.**
- D. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons.**
- E. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.**

END OF SECTION

SECTION 03 15 16- CONCRETE CONSTRUCTION JOINTS

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

- A. The CONTRACTOR shall construct all joints in concrete at the locations shown. Joints required in concrete structures are of various types and will be permitted only where shown, unless otherwise pre-approved by the ENGINEER.
- B. Construction joints, expansion joints, contraction joints, and control joints shall be provided at the locations shown and formed in accordance with the details shown.
- C. Waterstops shall be provided in all water-bearing joints in hydraulic structures unless specifically noted otherwise. Shapes of the waterstops shall be as shown.

1.2 RELATED WORK

- A. Section 03 11 00 – Concrete Forming.
- B. Section 03 20 00 – Concrete Reinforcing.
- C. Section 03 30 00 – Cast-in-Place Concrete.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Federal Specifications:
 - 1. TT-S-00227E(3) Sealing Compound, elastomeric type, multi-component (for caulking, sealing, and glazing buildings and other structures).
- B. U.S. Army Corps of Engineers Standard Specifications:
 - 1. CRD-C572
- C. Commercial Standards:
 - 1. ASTM C 920-79 Specification for Elastomeric Joint Sealants
 - 2. ASTM D 624-81 Test Method for Rubber Property – Tear Resistance
 - 3. ASTM D 638-84 Test Method for Tensile Properties of Plastics
 - 4. ASTM D 746-79 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 5. ASTM D 747-84a Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
 - 6. ASTM D 1752-84 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

7. ASTM D 2240-84 Test Method for Rubber Property - Durometer Hardness.

1.4 TYPES OF JOINTS

- A. Construction joints occur when fresh concrete is placed against a hardened concrete surface. Unless otherwise specified, all joints in water bearing members shall be provided with a waterstop and/or sealant groove of the shape specified. The surface of the first pour may also be required to receive a coating of bond breaker.
- B. Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified or shown.
- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as shown. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise specified, all expansion joints in water bearing members shall be provided with a center-bulb type waterstop.
- D. Pre-molded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
- E. The space so formed shall be filled with a joint sealant material. In order to keep the two wall or slab elements in line, the joint shall also be provided with a sleeve-type dowel.
- F. Shall provide a weaker plane in the concrete where shrinkage cracks are likely to occur. A groove is formed or saw-cut in the concrete. This groove is later filled with a joint sealant material.

1.5 CONTRACTOR SUBMITTAL

- A. Waterstops: Prior to production of the material required, qualification samples shall be submitted. Samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished. The balance of the material to be used shall not be produced until after the ENGINEER has reviewed the qualification samples.
- B. Joint Sealant: Prior to ordering sealant material, the CONTRACTOR shall submit to the ENGINEER for review sufficient data to show general compliance with the requirements of the Contract Documents.
- C. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished to the ENGINEER before the sealant is used on the job.
- D. The CONTRACTOR shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to the project meets or

exceeds the physical property requirements of the Contract Documents. Supplier certificates are not acceptable.

- E. The CONTRACTOR shall submit placement shop drawings showing the location and type of all joints for each structure.

1.6 QUALITY ASSURANCE

- A. All waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER to provide for the required inspections. Not less than 24 hours notice shall be provided to the ENGINEER for scheduling such inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point.
- C. All defective joints shall be replaced with material passing inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at its own expense.
- D. The following defects represent a partial list of defects which shall be grounds for rejection:
 - 1. Offsets at joints greater than 1/16-inch or 15% of material thickness at any point, whichever is less.
 - 2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15% of material thickness at any point, whichever is less.
 - 3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15% of material thickness at any point, whichever is less.
 - 4. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2-inch in 10 feet.
 - 5. Porosity in the welded joint as evidenced by visual inspection.
 - 6. Bubbles or inadequate bonding which can be detected with a pen-knife test. (If while prodding the entire joint with the point of a pen knife the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
- E. Waterstop Samples:
 - 1. Prior to use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the ENGINEER for review.
 - 2. Samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this Contract.

3. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the ENGINEER for testing by a laboratory at the OWNER's expense. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.
- F. Construction Joint Sealant: The CONTRACTOR shall prepare adhesion and cohesion test specimens as specified herein, at intervals of 5 working days while sealants are being installed.
- G. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1/2-inch. Coated spacers (2-inch by 1-1/2 inch by 1/2 inch) shall be used to insure sealant cross-sections of 1/2-inch by 2-inches with a width of 1/2-inch.
 2. Sealant shall be cast and cured according to manufacturer's recommendations except that the curing period shall not exceed 24 hours.
 3. Following the curing period, the gap between blocks shall be widened to 1-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

PART 2 -- PRODUCTS

2.1 PVC WATERSTOPS

A. General

1. Waterstops shall be extruded from an elastomeric PVC compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements herein.
2. No reclaimed or scrap material shall be used.
3. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job site meets the physical requirements outlined in the U.S. Army Corps of Engineers Specification CRD-C572.

B. Flatstrip and Center-Bulb Waterstops:

1. Shall be as manufactured by Kirkhill Rubber Company, Water Seals, Inc., Progress Unlimited, Inc., or approved equal.
2. At no place shall the thickness of flat strip waterstops, including the center-bulb type, be less than 3/8-inch.

C. Multi-Rib Waterstops:

1. Shall be as manufactured by Water Seals, Inc., Progress Unlimited, Inc., or approved equal.

2. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.
- D. When other types of waterstops not listed above are required they shall be subject to the same requirements described herein.
- E. When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Materials	Value	ASTM Standard
Min. Tensile Strength (psi)	1750	D 638-82a, Type IV
Min. Ultimate Elongation (%)	350	D 638-82a, Type IV
Max. Low Temp. Brittleness (deg. F)	-35	D 746-79
Min. Stiffness in Flexure (psi)	400	D 747-70
Accelerated Extraction (CRD-C572)	Value	ASTM Standard
Min. Tensile Strength (psi)	1500	D 638-82a, Type IV
Min. Ultimate Elongation (%)	300	D 638-82a, Type IV
Effect of Alkalies (CRD-C572)	Value	ASTM Standard
Change in Weight (%)	+0.25/-0.1	-
Change in Durometer, Shore A	+5	D 2240-81
Finish Waterstop	Value	ASTM Standard
Min. Tensile Strength (psi)	1400	D 638-82a, Type IV
Min. Ultimate Elongation (%)	280	D 638-82a, Type IV

2.2 JOINT SEALANT

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete which is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.
- B. Joint sealant material shall meet the following requirements:
1. Work Life 45 to 90 minutes
 2. Time to Reach 20 Shore Hardness (at 77°F, 200 gr quantity) 24 hours, maximum
 3. Ultimate Hardness 30 to 40 Shore A
 4. Tensile Strength 250 psi, minimum
 5. Color Light gray
- C. All polyurethane sealant for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C 920, or Federal Specification TT-S-0027 E(3) for 2-part material, as applicable.
 2. For vertical joints and overhead horizontal joints, only non-sag compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class B, or Federal Specification TT-S-0027 E(3), Type II.
 3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class A, or Federal Specification TT-S-0027 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore A hardness range of 25 to 35 shall be used.
 4. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
- D. All sealant required hereunder shall be as manufactured by **Products Research Company, General Sealant Corp.**, or approved equal.

2.3 PREFORMED JOINT FILLER

- A. Shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture.
- B. Bituminous fiber type will not be permitted.
- C. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752, Type I, except as otherwise specified herein.

2.4 BACKING ROD

- A. Shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25% at 8 psi.
- B. The rod shall be 1/8-inch larger in diameter than the joint width except that a 1-inch diameter rod shall be used for a 3/4-inch wide joint.

2.5 BOND BREAKER

- A. Shall be as manufactured by the **Burke Company, Hunt Process Company, Select Products Company**, or approved equal.
- B. Shall contain a fugitive dye so that areas of application are readily distinguishable.

2.6 BENTONITE WATERSTOP

- A. Shall expand in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

- B. Shall be composed of 75% bentonite. The balance of the material shall be butyl rubber-hydrocarbon with less than 1.0% volatile matter.
- C. The waterstop shall contain no asbestos fibers or asphaltics.
- D. The manufacturer's rated application temperature range shall be from 5 to 125 degrees F. The service temperature range shall be from -40 to 212 degrees F.
- E. The cross sectional dimensions of the unexpanded waterstop shall be 1-inch by 3/4-inch.
- F. The waterstop shall be provided with an adhesive backing which will provide excellent adhesion to concrete surfaces.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise shown, waterstops of the type specified herein shall be embedded in the concrete across joints. All waterstops shall be fully continuous for the extent of the full joint.
- B. Splices necessary to provide continuity shall be accomplished in conformance to printed instructions of the waterstop manufacturer.
- C. The CONTRACTOR shall take suitable precautions and means to support and protect waterstops during the progress of the WORK and shall repair or replace at its own expense any waterstops damaged during the progress of the WORK.
- D. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- E. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.2 SPLICES IN WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed instructions. Unless specified otherwise, it is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60% of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.

- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated by the CONTRACTOR prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

3.3 JOINT CONSTRUCTION

- A. **Setting Waterstops:** To eliminate faulty installation that may result in joint leakage, care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support the waterstops during the progress of the WORK and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
- B. In placing flat-strip waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
- C. **Joint Location:** Construction joints, and other types of joints, shall be provided where shown. When not shown, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. Where joints are shown spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted for acceptance by the ENGINEER.
- D. **Joint Preparation:** Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03 30 00: Cast-In-Place Concrete.
- E. Except on horizontal wall construction joints, wall to slab joints, or where otherwise shown or specified, at all joints where waterstops are required, the joint face of the first pour shall be coated with a bond breaker as specified herein.
- F. Adequate means shall be provided for anchoring the waterstop in concrete. Waterstops shall be positioned so that they are equally embedded in the concrete on each side of the joint.

- G. Sealant application shall be in accordance with the manufacturer's printed instructions. The surfaces of the groove for the sealant shall not be coated. Concrete next to waterstops shall be placed in accordance with Section 03 30 00: Cast-In-Place Concrete.
- H. Construction Joint Sealant:
1. Construction joints in water-bearing floor slabs, and elsewhere as shown, shall be provided with tapered grooves which shall be filled with a construction joint sealant.
 2. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant.
 3. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted.
 4. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed and filled with the construction joint sealant.
 5. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer.
 6. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant filler shall be thoroughly cleaned, as outlined for tapered grooves, prior to application of the sealant.
- I. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. All sealant shall cure at least 7 days before the structure is filled with water.
- J. All sealant shall be installed by a competent waterproofing specialty contractor with a successful record of performance in similar installations. Before WORK is commenced, the crew doing the WORK shall be instructed in the proper method of application by a representative of the sealant manufacturer.
- K. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the CONTRACTOR shall arrange to have the crew performing the WORK carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- L. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the WORK hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the specified joint sealant. All costs of such removal, joint treatment, re-sealing, and appurtenant work shall be at the expense of the CONTRACTOR.

M. Bentonite Waterstop:

1. Where a bentonite waterstop is called for in the Contract Documents, it shall be installed with the manufacturer's instructions and recommendations, except as modified herein.
2. When requested by the ENGINEER, the manufacturer shall provide technical assistance in the field.
3. The bentonite waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint.
4. Where a bentonite waterstop is used in combination with PVC waterstop, the bentonite waterstop shall overlap the PVC waterstop for a minimum of 6-inches and shall be placed in contact with the PVC waterstop.
5. The bentonite waterstop shall not be placed when the temperature of the waterstop material is below 40 degrees F. The waterstop material may be warmed so that it shall remain above 40 degrees F during placement; however, means used to warm the material shall in no way harm the material or its properties. The waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
6. The bentonite waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive backing provided with the waterstop.

END OF SECTION

SECTION 03 20 00– CONCRETE REINFORCING

PART 1 – GENERAL

1.1 THE SUMMARY

- A. The work shall consist of fabricating and placing all concrete reinforcement as required for concrete construction in accordance with the details shown.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Section 03 30 00 – Cast-in-Place Concrete

1.3 QUALITY ASSURANCE

- A. Furnish reinforcement materials from manufacturer's regularly engaged in the production of steel bar and welded wire fabric reinforcing.
- B. Installer Qualifications:
 - 1. Three years experience in installation of steel bar and welded wire fabric reinforcing.
 - 2. Welders qualified in accordance with AWS D12.1-72.
- C. Testing agency shall be an independent testing lab licensed by the State of Florida.
- D. Allowable Tolerances (Reinforcing Steel):
 - 1. Fabrication:
 - a. Sheared length not more than 1-inch.
 - b. Depth of truss bars between 0 and 1/2-inch.
 - c. Stirrups, ties and spirals not more than 1/2-inch.
 - d. All other bends not more than 1-inch.
 - 2. Placement and Handling:
 - a. Concrete cover to form surfaces not more than 1/4-inch.
 - b. Minimum spacing between vertical bent bars not more than 3/4-inch.
 - c. Crosswise of members to be spaced evenly within 2 inches of stated separation.
 - d. Lengthwise of members not more than 2 inches.
 - e. Maximum bar movement to avoid interference with other reinforcing steel, conduits or embedded items shall be 4 inches.

E. Source Quality Control:

1. Mill test certificates identifying chemical and physical analysis of each load of reinforcing steel delivered.

1.4 SUBMITTALS

- A. Furnish shop drawings showing sizes and dimensions for fabrication and placing of reinforcing steel, bar supports and welded wire fabric. Indicate bar schedules, stirrup spacing and diagrams of bent bars.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver reinforcement to the project or pre-casting site in bundles or rolls marked with metal tags indicating bar size and length.

PART 2 -- PRODUCTS

2.1 MATERIALS

A. Bars

1. Round carbon steel: ASTM A306 (latest edition), Grade 45.
2. Deformed billet steel: ASTM A615-79, Grade 40.

B. Wire

1. Cold drawn steel: ASTM A82-72.
2. Deformed steel: ASTM A496-72.

C. Wire Fabric:

1. Welded steel: ASTM A185-72.
2. Welded deformed steel: ASTM A497-79.

D. Tie Wire:

1. FS QQ-W-461 (latest edition), annealed steel, black, 16 gage minimum.

E. Welding Electrodes

1. AWS A 5.1-72, low hydrogen, E70 Series.

2.2 FABRICATION

- A. In accordance with CRSI Manual of Standard Practice.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Concrete coverage over reinforcing steel and welded wire fabric shall be in strict accordance with the clearances shown on the plans and details.**
- B. All reinforcing steel placed against the ground shall have a concrete coverage of 3 inches.**
- C. The use of proper reinforcing steel support chairs or other supports will be required to rigidly locate the reinforcement within the concrete at the dimensions indicated. No concrete will be placed until all steel is rigidly secured in its proper position.**
- D. Steel reinforcing shall be free of loose rust, scale or other coatings.**
- E. Placing of all reinforcing steel shall be in accordance with the American Concrete Institute Building Code (ACI 318-71).**
- F. Wire Fabric:**
 - 1. Install in longest practicable length.**
 - 2. Lap adjoining pieces one full mesh minimum and lay splices with 16 gage wire.**
 - 3. Bend all tie wire away from the outer surface to maintain minimum cover or greater.**
 - 4. Offset end laps in adjacent widths to prevent continuous laps.**
- G. Unless otherwise shown on the Contract Drawings, the minimum overlap for a lapped splice shall be in accordance with ACI 318-77 Chapter 12 (12.15). Lapped splices shall be made only at locations approved by the ENGINEER.**

END OF SECTION

SECTION 03 30 00- CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Performing all cast-in-place concrete work and related items as shown on the Contract Drawings and as specified herein.**
- B. Notify the ENGINEER at least 24 hours in advance of the placement of all concrete. No concrete is to be placed without the prior approval of the ENGINEER.**
- C. Related sections:**

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Section 03 00 00 – Concrete.**

1.3 CODES

- A. All work shall comply with the current edition of the Palm Beach County Building Code.**

1.4 CONTRACTOR SUBMITTALS

- A. Provide original test reports of concrete compression, yield and slump tests.**
- B. Certificates:**
 - 1. Manufacturer's certification that materials meet the specification requirements.**
 - 2. Material content per cubic yard of each class of concrete furnished:**
 - a. Dry weights of cement.**
 - b. Saturated surface-dried weights of fine and coarse aggregate.**
 - c. Quantities, types and names of admixtures.**
 - d. Weight of water.**
 - 3. Ready-mix delivery tickets, ASTM C94-72.**

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Allowable Concrete Temperatures:**
 - 1. Cold weather maximum and minimum per ASTM C94-72.**
 - 2. Hot weather maximum of 90 degrees Fahrenheit, unless otherwise approved by the ENGINEER.**
- B. Do not place concrete during rain unless protection is provided.**

PART 2 -- PRODUCTS

2.1 PORTLAND CEMENT

- A. ASTM C-150 - Type II Portland cement shall be used for all precast items.

2.2 FINE AGGREGATE SAND

- A. Meeting the requirements of F.D.O.T. Section 902.1 Standard Specifications (latest edition).

2.3 COARSE AGGREGATE

- A. Grade 9, meeting the requirements of Section 901 of the F.D.O.T. Standard Specifications.

2.4 MIXING WATER

- A. Furnish clean potable water from a source approved by the ENGINEER.

2.5 MIX PROPORTIONING

- A. All cast-in-place concrete shall have a minimum 28-day compressive strength of 4,000 psi ($f_c=4,000\text{psi}$) and shall conform to F.D.O.T. Section 345, Class II Portland cement concrete.
- B. All Class II concrete shall be made using Type III high early strength Portland cement.
- C. Concrete slump shall be between 2-1/2 inches minimum and 5 inches maximum.

2.6 MIXES

- A. Equivalent to ASTM C94-72.
- B. Mix concrete only in quantities sufficient for immediate use. Do not re-temper or use set concrete.

2.7 EXPANSION JOINT FILLERS

- A. Asphalt impregnated fiberboard conforming to ASTM C-1751 shall extend the full depth of joints. Thickness where not indicated shall be 1/2-inch.

2.8 CURING

- A. Approved curing compounds shall be used and shall be such as to not strain or cause imperfection on the finished concrete.

PART 3 -- EXECUTION

3.1 INSPECTION

- A. Assure that excavations and forms are complete. Check that reinforcement is secure.

- B. Verify that joint material, anchors and other embedded items are secured in position. Check that forms are sufficiently tight to prevent leakage of mortar.

3.2 INSTALLATION

A. Placing Concrete:

1. Convey concrete from mixer to final position by a method that will prevent separation or loss of material.
2. The maximum allowable height of concrete free fall is 8 feet. Where free fall exceeds 4 feet, the CONTRACTOR shall first place a minimum of 2 inches of neat cement grout in the bottom of forms prior to placing concrete.
3. Regulate the rate of placement so concrete remains plastic and flows into position.
4. Deposit concrete in a continuous operation until each panel or section is completed. Place concrete in horizontal layers of 18 inches maximum thickness.
5. All concrete must be placed in the dry. All forms must be free of standing water.
6. All other items of handling and placing concrete shall be in accordance with ACI 318-71.

B. Consolidating Concrete:

1. Use mechanical vibrating equipment for consolidation.
2. No placement of concrete will be allowed to commence unless the CONTRACTOR has a minimum of two operable vibrators on the job.
3. Vertically insert and remove hand-held vibrators at points 18 to 30 inches apart.
4. Do not use vibrators to transport concrete in forms.
5. Vibrators shall be 2-1/4 inches to 2-5/8 inches in diameter and shall have a minimum frequency of 10,000 impulses per minute. Vibrate concrete the minimum amount required for consolidation.

C. Construction Joints:

1. Clean and roughen the surface of concrete and remove lattice.
2. Wet concrete surfaces and flush with neat cement before placing additional concrete.
3. Construction joints and/or expansion joints not shown on the plans will be made only with the approval of the ENGINEER.

D. Curing:

1. Keep concrete moist by keeping surfaces continually dampened and continuing for a minimum of 78 hours, or apply an approved (white pigmented) membrane curing compound - AASHTO M148 Type 2.

3.3 PROTECTION OF COMPLETED WORK

- A. During curing periods, protect concrete from damage due to mechanical disturbances, water flow, loading, shock and vibration.

3.4 TESTS FOR CONCRETE

- A. An independent testing laboratory shall make all concrete tests at locations designated by the ENGINEER. The CONTRACTOR shall pay for all testing.
- B. When the ultimate compressive strength of any test cylinder falls below the specified strength for the class of concrete, the design mix and water content shall be adjusted to produce the specified strength for concrete that is subsequently placed. In addition, the ENGINEER may order additional curing for the portion of the work where the questionable concrete has been placed.
- C. In the event the additional curing does not give the strength required as determined by load tests made in accordance with ACI 318, or cored cylinder tests, and if such tests indicate the necessity, the defective parts shall be removed and replaced, or shall be reinforced as directed by the ENGINEER, at the CONTRACTOR's expense, including the expense of the tests.

3.5 CONSTRUCTION TOLERANCES:

- A. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Where tolerances are not indicated, permissible deviations will be in accordance with ACI 117 - Standard Tolerance for Concrete Construction and Materials.
 1. The variation from required lines or grades shall not exceed 1/4-inch in 10-feet and there shall be no offsets or visible waviness in the finished surface.

END OF SECTION

SECTION 03 60 00- GROUTING

PART 1 - GENERAL

1.1 THE SUMMARY

- A. The Contractor shall furnish provide grout, complete and in place, in accordance with the Contract Documents.
- B. The following types of grout are covered in this Section:
 - 1. Non-Shrink Grout: This type of grout is to be used wherever grout is indicated, unless another type is specifically referenced.
 - 2. Cement Grout
 - 3. Epoxy Grout
 - 4. Topping Grout and Concrete Fill

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as listed in Section 03 30 00 - Cast-In-Place Concrete, and as indicated herein.

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. **Shop Drawings:** Include certified test results verifying compliance with the compressive strength, shrinkage, and expansion requirements herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout proposed for the WORK.

1.4 QUALITY ASSURANCE

- A. **Field Tests:**
 - 1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER to insure continued compliance with these specifications. The specimens will be made by the independent testing laboratory.
 - 2. Compression tests and fabrication of specimens for cement grout and non shrink grout will be performed in accordance with ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in or 50 mm Cube Specimens) at intervals during construction selected by the ENGINEER. A set of three specimens will be made for testing 7 days, 28 days, and each additional time period as appropriate.
 - 3. Compression tests and fabrication of specimens for epoxy grout will be performed in accordance with ASTM C 579 - Test Methods for Compressive Strength of Chemical

Resistant Mortars and Monolithic Surfacing, Method B, at intervals during construction selected by the ENGINEER. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.

4. All grout which fails to meet requirements is subject to removal and replacement at no increased cost to the OWNER.
 5. The cost of all laboratory tests on grout will be borne by the CONTRACTOR. The CONTRACTOR shall be responsible for the cost of testing and inspection of Defective Work which has been replaced. The CONTRACTOR shall furnish all materials necessary for fabricating the test specimens.
- B. **Construction Tolerances:** Construction tolerances shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete, unless indicated otherwise.

PART 2 – PRODUCTS

2.1 CEMENT GROUT

- A. **Cement Grout:** Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.
- B. Cement grout materials shall be as indicated in Section 03 30 00 – Cast-in-Place Concrete, except that no cement from kilns burning metal-rich hazardous waste fuel shall be used.

2.2 PREPACKAGED GROUTS

A. Non-shrink grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas liberating, non-metallic, cement based grout requiring only the addition of water. Cement from kilns burning metal rich hazardous waste fuel shall not be used. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout herein shall be that recommended by the manufacturer for the particular application.
2. Class A non-shrink grouts shall have a minimum 28 days compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827-Test Method for Early Volume Change of Cementitious Mixtures; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621-Corps of Engineers Specification for Non-shrink Grout.
3. Class B non-shrink grouts shall have a minimum 28-day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

4. Application:

- a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is required by the Contract Documents except where Class B non-shrink grout and epoxy grout are specifically required. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
- b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be **BurkEpoxy Anchoring Grout** by The Burke Company.
2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.
5. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.
6. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30×10^{-6} inches/inch/degree F when tested according to ASTM C 531-Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacing or ASTM D 696-Test Method for Coefficient of Linear Thermal Expansion of Plastics.

7. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for other applications specifically required in the Contract Documents.

2.3 TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures. All materials and procedures for concrete in Section 03 30 00 Cast-in-Place Concrete shall apply except as noted otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, site work concrete in accordance with Section 03 30 00 Cast-in-Place Concrete may be used if accepted by the ENGINEER.
- C. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent by Weight Passing
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- D. Final mix design shall be determined by trial mix design under supervision of the approved testing laboratory.
- E. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 3000 psi.

2.4 CURING MATERIALS

Curing materials shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete for cement grout and be as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

- A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is required by the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.
- B. The manufacturer of Class A non-shrink grout and epoxy grout shall provide On-Site technical assistance upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 GROUTING PROCEDURES

- A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Base Plate Grouting:
 - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a one inch thickness of grout or a thickness as indicated on the Drawings.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink type grout. The mixture shall be of a trowelable consistency and be tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted for acceptance.
- C. Topping Grout
 - 1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting, exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 03 70 00 - CONCRETE REPAIR

PART 1 - GENERAL

A. Description:

1. Provide materials labor and equipment necessary to repair concrete. Concrete repair will be for the following:
 - a. Items damaged by the Contractor during the course of construction and required to be restored to existing or better conditions at his sole expense. No additional payment will be provided.
 - b. Unforeseen existing conditions encountered during the course of construction. Payment will be negotiated and paid under the Unknown Conditions Construction Allowance Account.
2. Complete repair mortar system installation in accordance with these specifications and the mortar system manufacturer's instructions regarding surface preparation, application, inspection and requirements for safety.
3. Complete crack repair work in accordance with these specifications and crack repair material manufacturer's instructions.
4. Complete joint repair work in accordance with these specifications and the joint repair material manufacturer's instructions.
5. If repair work is required for an area indicated to receive protective lining or coating, provide such repair in accordance with the requirements of this specification and the related coating specifications.
6. The repair work specified herein is intended to cover the requirements for repair of concrete only, to a maximum depth of approximately 2-inch. If after blasting and cleaning, an area is discovered that requires a repair greater than 2-inch deep, or an area is discovered that requires repair or replacement of reinforcing steel notify the Engineer so that details may be provided to the Contractor to complete the repair.

B. Submittals:

1. Submit procedures proposed for the accomplishment of repair work. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations to be coordinated with other works in progress.
2. Submit manufacturer's recommendations and product data sheets for all repair materials including performance criteria, surface preparation, ambient

condition requirements and applications, curing requirements, volatile organic compound (VOC) data, and safety requirements.

3. Submit Material Safety Data Sheets (MSDS) for any materials brought on-site including all repair system materials, solvents and abrasive blast media.
4. Submit qualifications of foreman and epoxy gun operators and demonstration of meeting the minimum requirements specified.
5. Submit concrete and cement mortar in conformance with Section 03300 and as specified herein.

C. Measurement:

1. **Crack Repair:** The quantities in linear feet to be measured for payment shall be the actual length of cracks repaired by the methods and materials specified.
2. **Spall Repair Depth 2-inch or Less:** The quantities in square feet to be measured for payment shall be the actual square footage of spalled concrete repaired by the method and materials specified under spall repair.
3. **Spall Repair Depth Greater Than 2-inch:** The quantities in cubic feet to be measured for payment shall be the actual cubic footage of spalled concrete repaired by the method and materials specified under spall repair.

D. Quality Assurance:

1. Furnish the names of all subcontractors proposed for use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.
2. Include in accepted applicator qualifications:
 - a. A minimum of five years experience in applying epoxy and polymer-modified and cement-based compounds similar to those specified in this Section.
 - b. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the

subcontractor/applicator is on the manufacturer's approved list of contractors.

3. Adhere strictly to the manufacturer's recommendations regarding temperature at time of application for all work. Do not use epoxy materials when either the temperature of the concrete to be repaired or the ambient temperature is below 50 degrees F. 24 hours before, during, or for a period of 48 hours after the completion of the repair. Temporary heat may be used to meet the specified requirements.
4. Use new epoxy, repair materials and use within the shelf life limitations set forth by the manufacturer. Clearly mark the shelf life limitations of each container.
5. The Contractor is ultimately responsible for the concrete repair work. Inspections by the Engineer or others do not limit the Contractor's responsibility.
6. Make all parts of the work accessible for inspections by the Engineer. Correct any conditions not in conformance with the specifications at no additional cost to the Owner.
7. Allow changes in the specified repair work methods only with the permission of the Engineer.
8. Provide technical field support or training services required by the accepted material manufacturers at no additional cost to the Owner.
9. Provide materials from a single manufacturer for all components of a single repair.

E. Delivery, Storage and Handling:

1. Provide shelter to store materials in area or areas designated by the Owner solely for this purpose. Confine mixing, thinning, clean-up and associated operations and storage of repair mortar materials debris before authorized disposal, to these areas.
2. Mix all specified materials in the sheltered mixing operation and materials from direct sunlight and inclement weather. Protect facilities from staining and damage.
3. Do not dispose of waste materials on-site.
4. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in Contractor's area longer than 24 hours.
5. Deliver all materials to the job site in new, unopened containers. Each container shall bear the manufacturer's name and label. Labels on all material containers shall contain the following information:

- a. Name of product.
 - b. Federal Specification Number if applicable.
 - c. Manufacturer's batch number.
 - d. Manufacturer's name.
 - e. Generic type of material.
 - f. Hazardous material identification label.
 - g. Shelf life date.
6. Clearly mark all containers indicating any safety hazards associated with the use of or exposure to the materials.
 7. Handle and store materials to prevent damage or loss of label. Protection of materials is the Contractor's responsibility.

F. Project/Site Conditions:

1. Environmental Requirements:
 - a. Comply with the repair material manufacturer's recommendations as to environmental conditions under which materials can be applied and cured.
 - b. Do not apply materials when dust is being generated.
2. Protection:
 - a. Cover or otherwise protect finish work or other surfaces not being repaired.
3. Ventilation:
 - a. Provide ventilation to meet product requirements prior to, during, and after application.

PART 2 - PRODUCTS

A. Water:

1. The water used for mixing concrete repair products shall be clear, potable and free of deleterious substances.

B. Aggregate:

1. All aggregates shall conform to ASTM C33 and section 03300.

C. Epoxy Bonding Agent:

1. Epoxy bonding compound shall be Sikadur 32 Hi-Mod, Sika Chemical Corporation, Lyndhurst, New Jersey; Concrevice by BASF; Duralcrete by Euclid Chemical Company; or equal.

D. Anti-Corrosion Coating:

1. Anti-corrosion coating shall be a three-component, epoxy-modified cementitious material.
2. Products:
 - a. Sika Corp.; Sika Armatec 110
 - b. Sto Concrete Restoration Division; CR 246
 - c. Euclid Chemical Company; Duralprep
 - d. Or acceptable equivalent product.

E. Epoxy Crack Repair Binder:

1. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive suitable for crack grouting by injection or gravity feed.
2. Products:
 - a. Sika Corp.; Sikadur 52
 - b. Euclid Chemical Company; Duralcrete LV
 - c. BASF Chemical Company; SBC Concrevice 1380
 - d. Or acceptable equivalent product.

F. Epoxy Repair Mortar:

1. Epoxy Repair Mortar shall be two-component, 100 percent solids, 100 percent reactive epoxy resin system.
2. Spall repair mortar for use in horizontal applications.
 - a. Products:

- (1) BASF Building Systems; Concreative Paste LPL
 - (2) Sika Chemical Corp.; Sikadur 22 Lo-Mod
 - (3) Or acceptable equivalent product.
 3. Spall repair mortar for use in vertical and overhead applications.
 - a. Products:
 - (1) Sika Chemical Corp.; Sikadur 23 Lo-Mod Gel
 - (2) Or acceptable equivalent product.
- G. Spall Repairs Using Non-Shrink Cementitious Mortar:
 1. Products:
 - a. BASF Building Systems; EMACO S88 CI
 - b. BASF Building Systems; Thorite
 - c. Sauereisen, Inc.; Underlayment F-120
 - d. Or acceptable equivalent product.
- H. Spall Repairs Using Polymer Modified Cementitious Mortar:
 1. Repair spalls repair not requiring formwork using a two-component, polymer-modified cementitious mortar having a minimum 28-day compressive strength of 7,000 psi.
 2. Spall repair mortar for use in horizontal applications.
 - a. Products:
 - (1) Sika Corp.; Sikatop 122 Plus
 - (2) Euclid Chemical Company; Duratop Fast Set
 - (3) Or acceptable equivalent product.
 3. Spall repair mortar for use in vertical applications.
 - a. Products:
 - (1) Sika Corp; Sikatop 123 Plus
 - (2) Euclid Chemical Company; Duratop Gel

(3) Or acceptable equivalent product.

I. Spall Repairs Requiring Formwork:

1. Repair spalls repair requiring formwork using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 6,000 psi. Mix each unit of mortar with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.
2. Products:
 - a. Sika Corp.; Sikatop 111 Plus
 - b. Euclid Chemical Company; Duratop Flowable Mortar
 - c. Or acceptable equivalent product.

J. Sealant:

1. Sealant shall be a two-component polyurethane sealant as specified in Section 03300. Primers and bond breakers shall conform to the sealant manufacturer's recommendations.

PART 3 - EXECUTION

A. General Requirements:

1. Perform exterior work during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. Protect unfinished work during inclement weather with tarpulins or heavy gage polyethylene sheeting.
2. Perform work in spaces within structures at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.
3. Coordinate concrete rehabilitation work with other work being performed.
4. Remove scaling, broken, loose and disintegrating materials by use of water-blasting or hand tools, down to solid unyielding material.
5. Clean surfaces thoroughly of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

B. Epoxy Bonding Agent:

1. Conform to all the requirements of ACI 503.4, and as specified herein.

2. Use epoxy bonding agent to adhere fresh mortar to existing concrete. Roughen existing concrete surfaces prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Place repair material while bonding agent is still tacky or per the written instructions of the manufacturer. Reapply bonding agent if bonding agent cures prior to placement of repair material.

C. Anti-Corrosion Coating:

1. Clean with a wire brush and coat reinforcing steel that is cut or exposed during alteration and/or repair operations with an anti-corrosive coating.
2. Cover all exposed parts of the steel with the coating and apply according to manufacturer's recommendations.

D. Epoxy Crack Repair:

1. Cracks on horizontal surfaces: When permitted by the Engineer, repair existing structural cracks by gravity feeding an epoxy crack repair binder into the prepared crack.
 - a. Rout concrete surface at the crack to form a minimum 1/4-inch wide by 1/4-inch deep V-notch and clean to remove all loose and foreign particles. Fill crack with clean, dry sand and pour epoxy crack repair binder into V-notch, completely filling crack.
 - b. As binder penetrates into crack, apply additional binder to the V-notch.
2. Cracks on vertical or horizontal surfaces: Repair existing structural cracks by pressure injecting an epoxy crack repair binder into the prepared crack. Seal cracked surfaces and install injection ports per manufacturer's recommendations.
 - a. Do not cut reinforcement steel when drilling holes injection ports. If rebar is encountered during drilling, abandon the hole and relocate. Patch the abandoned hole immediately with epoxy mortar flush with the surface of the existing concrete.
 - b. Once the surface sealing material has cured, inject crack with epoxy crack repair binder as directed by the manufacturer.
 - c. Remove injection ports upon satisfactory completion of crack injection and patch with epoxy mortar.

E. Spall Repair:

1. Saw cut the perimeter of the repair area to a minimum depth of 1/4-inch below the surface of the concrete. Chip all loose concrete in the repair area to

remove loose and degraded concrete to a minimum of 1/4-inch or until a sound substrate is reached. Clean the area and repair to the original dimensions with spall repair patching material according to the manufacturer's recommendations.

2. Make final finished surface of patches flat, level and even with the existing concrete surface. Do not feather repair mortar to meet existing concrete surface.
3. Finish final patches on horizontal surfaces consistent with the finish on the existing structure.

F. Curing:

1. Cure repair materials in accordance with manufacturer recommendations.

G. Cleaning:

1. Mechanically remove excess material from walls, floors, etc. after material has cured.
2. Clean excess materials caused by work under this Section from existing surfaces by the use of power sanders. Vacuum surfaces to receive final cleaning and finishing specified under other sections of the specifications. Sand cracks flush to adjacent surfaces.
3. Remove misplaced sealants using methods and materials recommended by the manufacturers. Leave finished work and work area in a neat and clean condition.

END OF SECTION

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