

3.02 EQUIPMENT

- A. All equipment used to mix, transport, handle, and/or place construction material shall be washed clean and free from sediment, debris, or any other materials which could negatively impact performance of the bioswale.

3.03 EXCAVATION

- A. The pervious concrete subgrade shall be excavated to the dimensions, side slopes, and elevations as shown in the Contract Drawings.
- B. The method of excavation shall minimize compaction and surface sealing of the subgrade.
- C. Unless otherwise approved by the City, equipment used to excavate the subgrade shall operate on the adjacent ground and not within the pervious concrete footprint.
- D. Excavated materials shall be removed and disposed of in conformance with all laws, rules, regulations, codes, and ordinances.
- E. Prior to installation of the stone base, the bottom of the excavation shall be scarified to a minimum depth of 6 inches with the bucket teeth of a backhoe or other method as approved by the Engineer. The soil shall not be saturated at the time of scarifying and the stone base shall be placed after the soil has been scarified and before rain is forecast.
- F. The Contractor shall install any measures necessary to stabilize the excavation sidewalls and protect adjacent utilities and infrastructure.

3.04 GEOTEXTILE INSTALLATION

- A. Geotextile shall be installed along the sides of the excavated basin as shown on the Contract Drawings.
- B. Geotextile shall be protected from all damage prior to installation, including other construction activities and UV degradation.
- C. Geotextiles shall be cut and fit to the dimensions shown on the Contract Drawings with a minimal amount of seams and with excess materials removed and disposed of properly.
- D. Wrinkles and folds shall be removed by stretching and pinning, where applicable.
- E. Geotextiles shall be overlapped by a minimum of 3 feet at roll edges and ends and secured with a minimum of pins or staples 1 foot on center at the seam.
- F. Geotextiles shall be secured to the excavation wall with pins or staples at all turns and a minimum of 5 feet on center.

3.05 STONE BASE INSTALLATION

- A. The stone base shall be installed in the bottom of the pervious concrete system. Underdrains, if required, shall be installed within the stone base.

- B. Do not install aggregate when rainfall or other weather conditions will detrimentally affect the quality of the Work.
- C. Evenly place and spread aggregate on the prepared sub-grade in 8-inch lifts of uniform thickness without segregation.
- D. Aggregate shall be compacted with two passes per lift with a low-amplitude, high-frequency vibratory 10 t drum roller or a static drum roller.
- E. Installation of the gravel drainage layer shall be completed with equipment which minimizes compaction of underlying soils.
- F. The surface tolerance of the stone base shall be +/- 3/8 in under a 10 ft straightedge.
- G. The leveling course shall be installed to a uniform depth and compacted as specified in the Contract Drawings.
- H. The leveling course shall be free of depressions, protrusions, or gaps that would cause the precast pervious concrete slab to be unevenly supported.

3.06 UNDERDRAIN INSTALLATION

- A. The underdrains shall be installed within the stone base as shown in the Contract Drawings.
- B. Newly placed pipe shall be protected from damage during construction.
- C. Construction traffic on exposed pipe material is strictly prohibited.
- D. Prevent any aggregate and other construction materials and debris from entering underdrain pipes.
- E. Observation wells and cleanouts shall be installed vertically as indicated in the Contract Drawings.
- F. Solid pipe used to convey runoff from the pervious concrete facility shall have a minimum slope of 0.5%.

3.07 PRECAST SLAB PLACEMENT

- A. Lay slabs as shown on the Contract Drawings and as approved by the Engineer.
- B. Slabs must only be lifted and placed using swivels and spreader chains. Chains, cables, or slings should never be wrapped around slabs for lifting under any circumstances. Swivels shall be bolted securely, but not over-tightened.
- C. Precast pervious concrete paving slabs must be placed so they are separated with 1/8-inch spacers provided by the manufacturer of the slabs. Joint widths and lines must be continually straight as paving proceeds.

- D. Place units hand tight without using metal hammers, pry bars, or drift pins. Make horizontal adjustments to placement of laid slabs with wood wedges and levers, and rubber mallets, as needed.
- E. Provide joints between slabs of 1/8-inch wide. No joints are to exceed 3/16-inch in width.
- F. Joint lines must not deviate more than +/- 0.5-inch over 50-ft from string lines.
- G. Joints must never be filled with loose material, including but not limited to sand, stone dust, stone chips, etc.
- H. Fill gaps at the edges of the paved area with properly-sized end slabs.
- I. Cut end slabs to be placed along the edge or corners with a masonry saw. Cut units must be not shorter than 1/4 of a whole slab.
- J. Adjust bond pattern at pavement edges such that cutting of edge slabs is minimized. Do not expose cut slabs to vehicular traffic. Cut slabs at edges as indicated on the Contract Drawings.
- K. Keep equipment off unrestrained paving slabs.
- L. After an area is completely paved, set the precast pervious concrete slabs into the leveling course layer by trafficking with light rubber-tired equipment.
- M. Remove and replace any slabs cracked or damaged during installation with new slabs. Reset slabs not in conformance with specified installation tolerances.
- N. Check final surface elevations of set slabs for conformance with Contract Drawings. The final surface tolerance from grade elevations must not deviate more than +/- 3/8-inch under a 10-ft straightedge.
- O. The surface elevation of set slabs shall be flush with manholes or the top of utility structures.
- P. After slabs are placed in their final position, apply clear, all weather silicone sealant to the surface of each lifting point hole in a manner such that the hole is completely covered, and debris and water will not enter the hole. Do not completely fill the hole with sealant. Follow manufacturer's recommendations for application and curing instructions.

3.08 FUNCTIONAL TESTING

- A. On-site infiltration testing shall be performed utilizing a single-ring infiltrometer to demonstrate compliance with infiltration criteria.
- B. Infiltration testing shall be conducted with clean water, free of suspended solids or other deleterious liquids.

3.09 LONG-TERM INSPECTION AND MAINTENANCE

- A. Monthly and after every rainfall during the first year:
 - 1. Inspect pervious concrete surface and underdrain cleanouts for signs of standing water.
 - 2. Identify and address potential sources of sedimentation.
 - 3. Remove all trash, leaves, sediment, and other debris from the pavement surface.
 - 4. Contact Engineer if standing water remains for longer than 48 hours after rainfall. Remediation may be necessary.
- B. Every six months for one year:
 - 1. Vacuum the pervious concrete surface with regenerative air sweeper or another device approved by the City to prevent clogging and maintain the permeability of the system. The pervious concrete surface shall be dry prior to vacuuming. Sweep broom and water spray attachments and/or pressure washers shall not be used unless approved by the City.
 - 2. Remove volunteered vegetation from pavement joints.
- C. Inspection and Maintenance Reporting
 - 1. All inspection and maintenance activities should be reported. Copies of the reports shall be sent to the Engineer monthly. The reports shall include the following.
 - a. Date of inspection
 - b. Name of inspector
 - c. Condition of the pervious concrete:
 - 1) Perimeter
 - 2) Paving surface
 - 3) Joint material
 - 4) Inlets and overflows
 - 5) Underdrain system
 - d. Maintenance work performed
 - e. Issues noted for future maintenance

- END OF SECTION -

SECTION 02796

PERMEABLE INTERLOCKING CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 THE REQUIREMENTS

- A. The Contractor is responsible for installing permeable interlocking concrete pavement (PICP) to manage post-construction stormwater runoff. This item covers the work necessary for installation of the PICP. The Contractor shall furnish all material, labor, and equipment necessary for the proper installation of this facility.
- B. It is the intent of this Specification that the Contractor conducts the construction activities in such a manner that the PICP functions as a stormwater management practice, which includes the minimization of upstream erosion and sedimentation.
- C. Installation of the PICP shall occur after the contributing watershed has been stabilized. It shall be the responsibility of the Contractor to make any necessary repairs if the performance of the system is impacted by sediment during construction or due to improper construction sequencing. The Contractor shall implement additional measures as deemed necessary to prevent sediment impacts to the PICP during construction.
- D. Activities related to the installation of PICP shall include but not be limited to the following items of work:
 - 1. Excavation of the subgrade.
 - 2. Installation of edge restraints.
 - 3. Installation of PICP components, including aggregate, underdrains, cleanouts, observations wells, and surface pavement materials.
- E. All Work shall be conducted in accordance with the most current version of all applicable codes, standards, and permits.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall submit the following:
 - 1. Name and location of all material suppliers.
 - 2. Certificate of compliance with the standards specified for each source of each material.
 - 3. Shop drawings including perimeter conditions, junction with other materials, expansion and control joints, paver dimensions and layout, interlocking pattern, and paver color.

4. Minimum of 4 representative full-size samples of each paver type, thickness, color, and finish.
5. Proposed paver installation method and equipment.
6. Test results performed by an independent testing laboratory demonstrating compliance of concrete pavers with ASTM C 936.
7. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.
8. Results of functional testing.

1.03 GUARANTEE

- A. All work related to the installation of the PICP shall be subject to the guarantee period of the Contract as specified in the General Conditions.

PART 2 - MATERIALS

2.01 GENERAL

- A. All PICP facilities and facility components shall meet the latest ADA requirements and accessibility guidelines.
- B. All PICP facilities shall support AASHTO HS-20 loads.
- C. PICP materials shall at a minimum satisfy the safety and durability requirements established by the City for sidewalk and/or roadway pavement.

2.02 PAVING UNITS

- A. PICP paving units shall be precast concrete interlocking blocks with voids contained within the interlocking pattern to allow water movement through the installed pavement surface.
- B. Paving units shall comply with ASTM C 936.
- C. Paving units shall have a minimum depth of 3.5 in.
- D. Paving units shall be standard natural grey concrete unless otherwise directed by the Contract Documents or Engineer.
- E. All paving units shall be provided by the same manufacturer.

2.03 UNDERDRAINS

- A. Underdrains shall be constructed of Schedule 40 or SDR 35 smooth wall PVC pipe. The minimum pipe diameter shall be 4 inches. The underdrains shall be installed within the stone base.

- B. A minimum of 4 rows of perforations shall be provided around the diameter of the underdrain pipe and the perforations shall be placed 6 inches on center within each row for the entire length of the drainage lateral. Perforations shall be 3/8-inch diameter. More perforations shall be provided for pipes 10 inches in diameter and larger.
- C. Filter socks or geotextile fabric shall not be used to wrap the underdrain pipes within the stone base.
- D. Underdrain pipes directing flow outside the PICP facility shall be solid starting at a point a minimum of 1 foot from the interior wall of the PICP facility before exiting.
- E. The minimum slope of all non-perforated piping within the underdrain system shall be 0.5 percent.
- F. Connections within the underdrain system and to any outflow structures, manholes, or catch basins shall be watertight.
- G. Cleanouts shall be provided at the end of all underdrain lines (minimum one per every 1,000 square feet of surface area). Cleanouts shall consist of Schedule 40 or SDR 35 smooth wall PVC pipe with a threaded cleanout cover.
- H. All pipes and pipe system components including but not limited to joints, caps, and cleanouts, shall meet City requirements for structural loading when installed within areas subject to vehicular or pedestrian traffic loads.
- I. The maximum allowable angle for change in direction of any pipe segment shall not exceed forty-five (45) degrees, unless the change in direction occurs within a manhole or catch basin.
- J. The underdrain shall have sufficient capacity to drain the PICP facility within 8 hours.

2.04 STONE BASE

- A. A stone base layer shall be provided at the bottom depths of the PICP facility. Underdrains, if required, shall be installed within the stone base.
- B. The stone base shall consist of #57 stone per ASTM C33 (or AASHTO M 6/M 80).
- C. The stone base shall have a minimum installed porosity of 0.4.
- D. Aggregates used in the stone base shall consist of clean, tough, durable fragments of crushed stone of uniform quality.
- E. Aggregates shall be double-washed and free of fines and foreign material.
- F. Aggregates shall have no more than 0.5% wash loss per AASHTO T-11 wash loss test.
- G. Aggregates shall be free from clay balls, organic matter, and other deleterious substances.

2.05 LEVELING COURSE

- A. A leveling course with a minimum depth of 2” shall be installed between the PICP paver units and stone base.
- B. Leveling course shall consist of #8 stone per ASTM C33 (or AASHTO M 6/M 80).
- C. Leveling course stone shall consist of clean, tough, durable fragments of crushed stone of uniform quality.
- D. Aggregates shall be double-washed and free of fines and foreign material.
- E. Aggregates shall have no more than 0.5% wash loss per AASHTO T-11 wash loss test.
- F. Aggregates shall be free from clay balls, organic matter, and other deleterious substances.

2.06 GEOTEXTILE

- A. The Contractor shall furnish and install non-woven geotextile in accordance with the Contract Drawings and as directed by the Engineer.
- B. Geotextile fabric shall not be installed horizontally across the base of the PICP facility or between any stone layers unless directed by the Engineer.
- C. Fibers used in the manufacture of drainage geotextiles, and the threads used in joining geotextiles by sewing, must consist of long-chain, synthetic polymers, composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The fibers must be formed into a stable network such that the filaments or yarns retain their dimensional stability relative to each other including selvages.
- D. The geotextile must not have tears or defects which adversely alter its physical properties.
- E. The geotextile shall be mildew and rot resistant.
- F. Geotextiles shall conform to the following properties:

Property	ASTM Test	Requirements
Structure		Non-Woven
Elongation	ASTM D4595	≥ 50%
Grab Strength (min)	ASTM D4632	700 N (157 lbs)
Tear Strength (min)	ASTM D4533	250 N (56 lbs)
Puncture Strength (min)	ASTM D4833	250 N (56 lbs)
Apparent Opening Size (max)	ASTM D4751	0.25 mm (0.0098 inch)
Allowable Flow Rate (min)		110 gal/ft ² /min

2.07 EDGE RESTRAINT

- A. Edge restraints shall consist of one of the following:
 - 1. Existing curb.
 - 2. Cast-in-place edge restraints as shown on the Contract Drawings.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall keep the construction site neat at all times and free of debris at the conclusion of each workday. The Contractor shall conduct work such that debris and other construction materials do not unintentionally leave the construction site. Any debris or construction material that does leave the construction site shall be immediately removed and properly disposed of at no additional cost to the City.
- B. Installation of PICP shall be in accordance with manufacturer's recommendations and the requirements herein.
- C. All pavement and curbing disturbed or damaged during construction shall be repaired and/or replaced in accordance with City requirements.
- D. PICP shall be handled and transported in a position consistent with their shape and design in order to avoid stresses which could cause cracking or damage.
- E. The Contractor shall test the bearing capacity of underlying soils for all PICP subject to vehicular traffic in accordance with ASTM D4429-09a. The Contractor shall consult the Engineer before proceeding if the measured CBR is below 4%.
- F. Protection of PICP facilities:
 - 1. The Contractor shall protect PICP surfaces, excavations, and materials storage areas from severe weather conditions and contamination by dust, dirt, mud, cement, or other fine-grained material or sediment.
 - 2. PICP footprints and all materials, including aggregates, shall be protected from the start of construction until final acceptance of the project. Any damage caused by the Contractor's equipment or lack of compliance with these requirements shall be repaired by the Contractor at no cost to the City.
 - 3. Runoff onto PICP or areas where materials are stored shall be prohibited until the site is fully stabilized.
 - 4. Any sediment or debris accumulation onto the PICP or underlying layers may require cleaning or removal and replacement of those materials to the satisfaction of the Engineer at no cost to the City.

3.02 EQUIPMENT

- A. All equipment used to mix, transport, handle, and/or place construction material shall be washed clean and free from sediment, debris, or any other materials which could negatively impact performance of the bioswale.

3.03 EXCAVATION

- A. The PICP subgrade shall be excavated to the dimensions, side slopes, and elevations as shown in the Contract Drawings.
- B. The method of excavation shall minimize compaction and surface sealing of the subgrade.
- C. Unless otherwise approved by the Engineer, equipment used to excavate the subgrade shall operate on the adjacent ground and not within the pervious concrete footprint.
- D. Excavated materials shall be removed and disposed of in conformance with all laws, rules, regulations, codes, and ordinances.
- E. Prior to installation of the stone base, the bottom of the excavation shall be scarified to a minimum depth of 6 inches with the bucket teeth of a backhoe or other method as approved by the Engineer. The soil shall not be saturated at the time of scarifying and the stone base shall be placed after the soil has been scarified and before rain is forecast.
- F. The Contractor shall install any measures necessary to stabilize the excavation sidewalls and protect adjacent utilities and infrastructure.

3.04 GEOTEXTILE INSTALLATION

- A. Geotextile shall be installed along the sides of the excavated basin as shown on the Contract Drawings.
- B. Geotextile shall be protected from all damage prior to installation, including other construction activities and UV degradation.
- C. Geotextiles shall be cut and fit to the dimensions shown on the Contract Drawings with a minimal amount of seams and with excess materials removed and disposed of properly.
- D. Wrinkles and folds shall be removed by stretching and pinning, where applicable.
- E. Geotextiles shall be overlapped by a minimum of 3 feet at roll edges and ends and secured with a minimum of pins or staples 1 foot on center at the seam.
- F. Geotextiles shall be secured to the excavation wall with pins or staples at all turns and a minimum of 5 feet on center.

3.05 STONE BASE INSTALLATION

- A. The stone base shall be installed in the bottom of the PICP facility. Underdrains, if required, shall be installed within the stone base.

1. Do not install aggregate when rainfall or other weather conditions will detrimentally affect the quality of the Work.
 2. Evenly place and spread aggregate on the prepared sub-grade in 8-inch lifts of uniform thickness without segregation.
 3. Aggregate shall be compacted with two passes per lift with a low-amplitude, high-frequency vibratory 10 t drum roller or a static drum roller.
 4. Installation of the gravel drainage layer shall be completed with equipment which minimizes compaction of underlying soils.
 5. The surface tolerance of the stone base shall be +/- 1 in under a 10 ft straightedge.
- B. The leveling course shall be installed to a uniform depth and compacted as specified in the Contract Drawings.
1. The leveling course shall be free of depressions, protrusions, or gaps that would cause the PICP to be unevenly supported.
 2. The surface tolerance of the leveling course shall be +/- 3/8 in under a 10 ft straightedge.

3.06 UNDERDRAIN INSTALLATION

- A. The underdrains shall be installed within the stone base as shown in the Contract Drawings.
- B. Newly placed pipe shall be protected from damage during construction.
- C. Construction traffic on exposed pipe material is strictly prohibited.
- D. Prevent any aggregate and other construction materials and debris from entering underdrain pipes.
- E. Observation wells and cleanouts shall be installed vertically as indicated in the Contract Drawings.
- F. Solid pipe used to convey runoff from the PICP facility shall have a minimum slope of 0.5%.

3.07 PAVER UNIT PLACEMENT

- A. Lay paver units as shown on the Contract Drawings and as approved by the Engineer.
- B. Paver units shall be installed in a manner that maintains straight pattern lines.
- C. Fill gaps at the edges of the paved area with cut units.
- D. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit.

- E. Pavers shall be cut using a masonry saw.
- F. Joints and openings shall be filled with double-washed #8 stone per ASTM C33 (or AASHTO M 6/M 80).
- G. Remove excess aggregate on the surface by sweeping pavers clean.
- H. Compact and seat the pavers into the bedding material with two passes of a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf.
- I. Do not compact within 6 ft of the unrestrained edges of the paving units.
- J. Apply additional aggregate to the openings and joints if needed, filling them completely. Remove excess aggregate by sweeping then compacting the pavers.
- K. The final surface tolerance of compacted pavers shall not deviate more than +/- 3/8 in under a 10 ft straightedge.
- L. The surface elevation of installed pavers shall be 1/8 to 1/4 in above adjacent drainage inlets, concrete collars, or channels.

3.08 FUNCTIONAL TESTING

- A. On-site infiltration testing shall be performed utilizing a single-ring infiltrometer to demonstrate compliance with infiltration criteria.
- B. Infiltration testing shall be conducted with clean water, free of suspended solids or other deleterious liquids.

3.09 LONG-TERM INSPECTION AND MAINTENANCE

- A. Monthly and after every rainfall during the first year:
 - 1. Inspect PICP surface and underdrain cleanouts for signs of standing water.
 - 2. Identify and address potential sources of sedimentation.
 - 3. Remove all trash, leaves, sediment, and other debris from the pavement surface.
 - 4. Contact Engineer if standing water remains for longer than 48 hours after rainfall. Remediation may be necessary.
- B. Bi-annually:
 - 1. Vacuum the PICP surface with regenerative air sweeper or another device approved by the City to prevent clogging and maintain the permeability of the system. The PICP surface shall be dry prior to vacuuming. Sweep broom and water spray attachments and/or pressure washers shall not be used unless approved by the City. Following pavement vacuuming, apply #8 stone (ASTM C33) to voids and openings and sweep clean.

2. Remove volunteered vegetation from pavement joints.

C. Inspection and Maintenance Reporting

- a. All inspection and maintenance activities should be reported. Copies of the reports shall be sent to the Engineer monthly. The reports shall include the following.
 - a. Date of inspection
 - b. Name of inspector
 - c. Condition of the PICP:
 - 1) Perimeter
 - 2) Paving surface
 - 3) Inlets and overflows
 - 4) Underdrain system
 - d. Maintenance work performed
 - e. Issues noted for future maintenance

- END OF SECTION -

SECTION 02911
SOIL PREPARATION

PART 1 - GENERAL

1.01 SEQUENCING AND SCHEDULING

- A. Rough grade areas to be planted or seeded prior to performing Work specified under this Section.

1.02 APPLICABLE STANDARDS AND SPECIFICATIONS

- A. Comply with the following standards and specifications for all materials, methods, and workmanship unless otherwise noted:
 - 1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
 - 2. City of Fort Lauderdale Code of Ordinances.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. General: Uniform mixture of 50 percent sand and 50 percent muck in a loose friable condition, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.
- B. Textural Amendments: Amend as necessary to conform to required composition.
- C. Source: Import topsoil if onsite material fails to meet specified requirements or is insufficient in quantity.

2.02 SOURCE QUALITY CONTROL

- A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.
- B. Should soil tests prove the topsoil to alkaline or above the accepted minimum for salt content, the topsoil shall be removed and replaced by acceptable material at Contractor's expense.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

- A. The subgrade shall be 4 inches lower than finished grade with 2 inches of topsoil added to sod areas.

- B. Scarify subgrade to minimum depth of 6 inches where topsoil is to be placed.
 - C. Remove stones over 2-1/2 inches in any dimension, sticks, roots, rubbish, and other extraneous material.
 - D. Limit preparation to areas which will receive topsoil within 2 days after preparation.
- 3.02 TOPSOIL PLACEMENT
- A. Topsoil Thickness:
 - 1. Sodded Areas: 2 inches.
 - 2. Planting Beds: 6 inches.
 - B. Do not place topsoil when subsoil or topsoil is excessively wet or otherwise detrimental to the Work.
 - C. Mix soil amendments with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding.
 - D. Uniformly distribute to within 1/2-inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.
 - E. Remove stones exceeding 1-1/2 inches, roots, sticks, debris, and foreign matter during and after topsoil placement.
 - F. Remove surplus subsoil and topsoil from site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

- END OF SECTION -

SECTION 02920

SODDING

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Maintenance Period: Begin maintenance immediately after each area is planted (sod) and continue for a period of 8 weeks after all planting under this Section is completed.
- B. Satisfactory Stand:
 - 1. Grass or section of grass that has:
 - a. No bare spots larger than 3 square feet.
 - b. Not more than 10 percent of total area with bare spots larger than 1 square foot.
 - c. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.02 DELIVERY, STORAGE, AND PROTECTION

- A. Sod:
 - 1. Do not harvest if sod is excessively dry or wet to the extent survival may be adversely affected.
 - 2. Harvest and deliver sod only after laying bed is prepared for sodding.
 - 3. Roll or stack to prevent yellowing.
 - 4. Deliver and lay within 24 hours of harvesting.
 - 5. Keep moist and covered to protect from drying from time of harvesting until laid.

1.03 WEATHER RESTRICTIONS

- A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.04 SEQUENCING AND SCHEDULING

- A. Prepare topsoil as specified in the Contract Documents, before starting Work of this Section.
- B. Complete Work under this section within ten (10) days following completion of soil preparation.
- C. Notify City at least three (3) days in advance of:

1. Each material delivery.
 2. Start of planting activity.
- D. Planting Season: Those times of year that are normal for such Work as determined by accepted local practice. At a minimum, Contractor shall avoid planting in January or February.
- 1.05 MAINTENANCE SERVICE
- A. Contractor: Perform maintenance operations during maintenance period to include:
1. Watering: Keep surface moist.
 2. Washouts: Repair by filling with topsoil, and replace sodded areas.
 3. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3 1/2 inches.
 4. Re-sod unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced, at which time maintenance period shall recommence.
 5. Re-sod during next planting season if scheduled end of maintenance period falls after September 15.

PART 2 – MATERIALS

2.01 FERTILIZER

- A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.
- B. Mix:
1. Nitrogen: Sixteen.
 2. Phosphoric Acid: Four.
 3. Potash: Eight.

2.02 SOD

- A. Unless a particular type of sod is called for, sod may be of either St. Augustine Floritam, Bahia grass or Seashore Paspalum, in accordance with the following:
1. Use Bahia grass where no irrigation system exists.
 2. Use St. Augustine Floritam where an irrigation system is in place. If original sod being replaced is St. Augustine Floritam, replacement sod shall match.
 3. Seashore Paspalum sod will be used in areas prone to salt water flooding.

- B. Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.
 - 1. Grass Height: Normal.
 - 2. Strip Size: Supplier's standard, commercial size rectangles.
 - 3. Soil Thickness: Uniform; 1-inch plus or minus 1/4-inch at time of cutting.
 - 4. Age: Not less than 10 months or more than 30 months.
 - 5. Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted
 - 6. Any netting contained within the sod shall be certified by the manufacturer to be bio-degradable within a period of 3 months from installation.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Grade Areas to Smooth, Even Surface with Loose, Uniformly Fine Texture:
 - 1. Roll and rake, remove ridges, fill depressions to meet finish grades.
 - 2. Limit such Work to areas to be planted within immediate future.
 - 3. Remove debris, foreign material and stones larger than 1 1/2 inches diameter, and other objects that may interfere with planting and maintenance operations.
- B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.
- C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.
- D. Limit preparation to those areas that can be sodded within 72 hours after preparation.

3.02 FERTILIZER

- A. Apply evenly over area in accordance with manufacturer's instructions. Mix into top 2 inches of top soil.
- B. Application Rate: 20 pounds per 1,000 square feet (1,000 pounds per acre).

3.03 SODDING

- A. Do not plant dormant sod, or when soil conditions are unsuitable for proper results.
- B. Pre-wet the area prior to placing sod. Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap:

1. Stagger strips to offset joints in adjacent courses.
 2. Work from boards to avoid damage to subgrade or sod.
 3. Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.
 4. Complete sod surface true to finished grade, even, and firm.
- C. Fasten sod on slopes to prevent slippage with wooden pins 6 inches long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.
- D. Water sod with fine spray immediately after planting. During first month, water daily or as required to maintain moist soil to depth of 4 inches.

3.04 FIELD QUALITY CONTROL

- A. Eight weeks after sodding is complete and on written notice from Contractor, City will, within 15 days of receipt, determine if the sod has been satisfactorily established.
- B. If the sod is not satisfactorily established, Contractor shall replace the sod and repeat the requirements of this Section.

- END OF SECTION -

SECTION 02930
LANDSCAPE WORK

PART 1 - GENERAL

1.01 DEFINITIONS

A. Measurement:

1. In size grading balled and burlapped (B & B), caliper takes precedence over height.
2. Take trunk caliper 6 inches above the ground level (up to and including 4-inch caliper size) and 12 inches above the ground level for larger trees.
3. Measure size of container-grown stock by height and width of plant.
4. Measure herbaceous perennials pot size, not top growth.

1.02 DELIVERY, STORAGE, AND HANDLING

- A. Inspection and Transporting: Movement of nursery stock shall comply with all Federal, State, and local laws and regulations. Therefore, required inspection certificates shall accompany each shipment, and shall be submitted in accordance with Section 01300.
- B. Cover plants during shipment with a tarpaulin or other suitable covering to minimize drying.
- C. Balled and Burlapped Plants: Wrap each ball firmly with burlap and securely bind with twine, cord, or wire for shipment and handling. Drum-lace balls with a diameter of 30 inches or more. Wire wrap burlap if root ball is not sufficiently compacted. Palms will not require burlap wrapping if the following requirements are met:
1. Dug from marl or heavy soil that adheres to roots and retains shape without shattering.
 2. Moistened material used to cover ball and roots not exposed to wind and sun.
 3. Transport material on vehicles large enough to allow plants not to be crowded. Plants shall be covered to prevent wind damage during transit and shall be kept moist, fresh and protected at all times. Such protection shall encompass the entire period which the plants are in transit, being handled, or are in temporary storage.
- D. All plant material shall not remain on the work site longer than two (2) days prior to being installed.
- E. As specified herein for transplanting.

1.03 MAINTENANCE

- A. Commence to maintain plant life immediately after planting and maintain for a minimum of one growing season, and until plants are well established and exhibit a vigorous growing condition.
- B. In accordance with accepted submittal on care and maintenance of plants and as follows:
 - 1. Maintain by watering, pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers.
 - 2. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required.
 - 3. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.
 - 4. Remove guys, stakes, and other supports at end of maintenance service.
 - 5. Maintenance includes temporary protection fences, barriers, and signs as required for protection.
 - 6. Coordinate watering to provide deep root watering to newly installed trees.

1.04 SCHEDULING AND SEQUENCING

- A. Plant Deliveries: Notify Engineer at least 3 days in advance of each delivery.
- B. Planting Season: Conduct planting during times of year that are normal for such work as determined by accepted local practice.
- C. Plant trees and shrubs after final grades are established and before planting of lawns or grasses.

PART 2 – MATERIALS

2.01 PLANT MATERIALS

- A. Provide quantity, size, genus, species, and variety of trees and shrubs indicated; comply with applicable requirements of ANSI Z60.1.
- B. Nomenclature (Names of Plants): In accordance with “Hortus Third”.
- C. Quality and Size:
 - 1. Nursery-grown, habit of growth normal for species.
 - 2. Sound, healthy, vigorous, and free from insects, diseases, and injuries - Florida #1 quality or better.

3. Equal to or exceeding measurements specified in plant list. Measure plants before pruning with branches in normal position.
 4. Root System of Container-Grown Plants: Well developed and well distributed throughout the container, such that the roots visibly extend to the inside face of the growing container.
 5. Perform necessary pruning at time of planting.
 6. Sizes: Dimensional relationship requirements of ANSI Z60.1 for kind and type of plants required.
 7. Balled and Burlapped Plants: Firm, intact ball of earth encompassing enough of the fibrous and feeding root system to enable full plant recovery.
 - a. Ball Size: ANSI Z60.1.
 8. Container-Grown Plants: Self-established root systems, sufficient to hold earth together after removal from container, without being rootbound.
 - a. Stock: Grown in delivery containers for at least 6 months, but not over 2 years.
 9. Label each tree and shrub of each variety with securely attached waterproof tag, bearing legible designation of botanical and common name.
 10. All trees must have a fully developed fibrous root system, be heavily branched, or in palms, heavily leafed, free from all insects, fungus, and other diseases.
 11. Palms: Wrap the roots of all plants of the palm species before transporting, except if they are container grown plants and ensure that they have an adequate root ball structure, and mass for healthy transplantation as defined in "Florida Grades and Standards for Nursery Plants."
 12. Burlapping is not required if the palm is carefully dug from marl or heavy soil that adheres to the roots and retains its shape without crumbling. During transporting and after arrival, carefully protect root balls of palms from wind and exposure to the sun. Muck grown palms are not allowed. After delivery to the job site, if not planting the palm within 24 hours, cover the root ball with a moist material. Plant all palms within 48 hours of delivery to the site.
 13. Move sabal and coconut palms in accordance with the "Florida Grades and Standards for Nursery Plants."
- D. Replacement Shrubs and Trees: Same species, size, and quality as specified for plant being replaced, except existing trees larger than 4-inch caliper, may be replaced with 4-inch caliper trees to satisfy the caliper inches lost.

2.02 ANTIDESICCANT

- A. Provide transpiration retarding material to be used where any plant material is moved during the growing season.

2.03 GUYING, STAKING, AND WRAPPING MATERIALS

- A. Wood Stake: 2 inches by 2 inches by 8 feet.
- B. Guy Wires: Galvanized, 12-gauge, ductile steel.
- C. Flags:
 - 1. Wood: 1/2-inch by 3 inches by 12 inches, with 3/8-inch hole centered 1-1/2 inches from each end, painted white.
 - 2. Sheet Metal: 1-1/2-inch with clipped corners and both ends punched, painted white.
- D. Hose: Two-ply, reinforced rubber garden hose, not less than 1/2-inch diameter, new or used.
- E. Burlap: Of first quality, minimum 8 ounces in weight, not less than 6 inches nor more than 10 inches in width.

2.04 MULCH

- A. Mulch shall be free from noxious weed seed and foreign material harmful to plant growth and shall be an approved non-native tree bark mulch. It must be uniformly shredded and be free from large pieces of bark, foreign matter, weed seeds and any other organic or inorganic material.
- B. Barkdust: Medium grind, pine; maximum 3/4-inch particle size.

2.05 PLANTING SOIL MIX

- A. Proportion by Weight: 75% approved good quality top soil mixed with 25% approved organic matter as approved by Engineer. The soil must be taken from ground that has never been stripped, with a slight acid reaction (5.5 to 6.5 ph) and without an excess of calcium or carbonate. Soil shall have a loose friable condition.
- B. Special Type: Planting soil for palms shall be a good grade of salt free sand, which is free of all weeds.

2.06 TOPSOIL

- A. General: Uniform mixture of 75 percent good grade of clean, salt free, weed free sand and 25 percent organic material in a loose friable condition, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.
- B. Textural Amendments: Amend as necessary to conform to required composition.
- C. Source: Import topsoil if onsite material fails to meet specified requirements or is insufficient in quantity.
- D. 95% of topsoil shall pass a 1/4 inch sieve.

- E. Organic matter content shall be 4% to 12% of total dry weight.

2.07 SOURCE QUALITY CONTROL

- A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.
- B. Should soil tests prove the topsoil to alkaline or above the accepted minimum for salt content, the topsoil shall be removed and replaced by acceptable material at Contractor's expense.

PART 3 - EXECUTION

3.01 TRANSPLANTING

- A. Remove existing plantings identified for transplant prior to beginning Work in area in accordance with standard nursery practices and as specified herein.
- B. Nondormant Plants: Prior to digging, spray foliage with antidesiccant, as recommended by manufacturer.
- C. Cover balls and containers of plants that cannot be planted immediately, with moist soil or mulch.
- D. Water plants as often as necessary to prevent drying until planted.
- E. Do not remove container-grown stock from containers before time of planting.
- F. Bare-Root Plants:
 - 1. Dig up with least possible injury to fibrous root system.
 - 2. Immediately upon removal from ground, cover roots with thick coating of mud or wrap in wet straw, moss, or other suitable packing material for protection from drying until planted.
 - 3. Plant or heel-in immediately upon relocation to temporary storage. Open and separate bundles of bare-root plants, and eliminate air pockets among roots as they are covered.
- G. Replant each temporarily removed tree, shrub, or other plant only after construction activities are completed and applicable grading and topsoil replacement is completed in its vicinity. Replant trees, shrubs, and other plants in their original positions unless otherwise shown or approved. Plant as specified for new plants.
- H. Maintain transplanted materials in same manner as new trees and shrubs.

3.02 LOCATION OF PLANTS

- A. Locate new planting or stake positions as shown unless obstructions are encountered, in which case notify Engineer.

- B. Locate no planting, except ground cover, closer than 18 inches to pavements, pedestrian pathways, and structures.
- C. Request Engineer observe locations, and adjust as necessary before planting begins.

3.03 PREPARATION

- A. Subsoil Drainage: Furnish for plant pits and beds.
- B. Planting Soil: Delay mixing of amendments and fertilizer if planting will not follow preparation of planting soil within 2 days. For pit and trench type backfill, mix planting soil prior to backfilling and stockpile at site.
- C. Plants: Place on undisturbed existing soil or well-compacted backfill.
- D. Trees and Shrubs:
 - 1. Pits, Beds, and Trenches: Excavate with vertical and scarified sides.
 - 2. B & B Trees and Shrubs: Make excavations at least twice as wide as root ball.
 - 3. Container-Grown Stock: Excavate as specified for B & B stock, adjust for size of container width and depth.
 - 4. Bare-Root Trees: Excavate pits to a width to just accommodate roots fully extended and depth to allow uppermost roots to be below original grade.
 - 5. Fill excavations with water and allow to percolate out prior to planting.
- E. Ground Cover Beds:
 - 1. Mix amendments and fertilizer with top soil prior to placing or apply on surface of top soil and mix thoroughly before planting.
 - 2. Scarify top soil to a depth of 4 to 6 inches.
 - 3. Establish finish grading of soil. Rake areas to smooth and create uniform texture and fill depressions.
 - 4. Moisten.

3.04 PLANTING

- A. Plant trees before planting surrounding smaller shrubs and ground covers. Adjust plants with most desirable side facing toward the prominent view (sidewalk, building, street).
- B. B & B Plants: Place in pit by lifting and carrying by its ball (do not lift by branches or trunk). Lower into pit. Set straight and in pit center with tip of rootball 1 to 2 inches above adjacent finish grade.
- C. Bare-Root Plants: Spread roots and set stock on cushion of planting soil mixture. Set straight in the pit center so that roots, when fully extended, will not touch walls of the

planting pit and the uppermost root is just below finish grade. Cover roots of bare-root plants to the crown.

- D. Container-Grown Plants: Remove containers, slash edges of rootballs from top to bottom at least 1-inch deep. Plant as for B & B plants.
- E. Ground Covers: Dig planting holes through mulch with one of the following: hand trowel, shovel, bulb planter, or hoe. Split biodegradable pots or remove nonbiodegradable pots. Root systems of all potted plants shall be split or crumbled. Plant so roots are surrounded by soil below the mulch. Set potted plants so pot top is even with existing grade.

3.05 BACKFILLING

- A. Backfill with planting soil, except where existing soil is suitable according to top soil analysis.
- B. B & B Plants:
 - 1. Partially backfill pit to support plant. Remove burlap and binding from sides and tops of B & B plants, do not pull burlap from under balls.
 - 2. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill to eliminate air pockets even if it is raining. Finish backfilling pit sides.
 - 3. Never cover top of rootball with soil. Form a saucer above existing grade, completely around the outer rim of the plant pit.
- C. Bare-Root Plants:
 - 1. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers above roots.
 - 2. Set original soil line of plant 1-inch to 2 inches above adjacent finish landscape grades. Spread out roots without tangling or turning up to surface. Cut injured roots cleanly; do not break.
 - 3. Carefully work backfill around roots by hand; puddle with water until backfill layers are completely saturated.

3.06 GUYING AND STAKING

- A. Support trees immediately after planting to maintain plumb position.
- B. Guying: Support all trees over 4 inches in caliper with 3 guys equally.
- C. Special Requirements for Palm Trees: Brace palms which are to be staked with three 2-inch by 4-inch wood braces, toe-nailed to cleats which are securely banded at two points to the palm, at a point one third the height of the trunk. Pad the trunk with five layers of burlap under the cleats. Place braces approximately 120 degrees apart and secure them underground by 2- by 4- by 12-inch stake pads.

3.07 SUBGRADE PREPARATION

- A. The subgrade shall be 4 inches lower than finished grade with 2 inches of topsoil added to sod areas.
- B. Scarify subgrade to minimum depth of 6 inches where topsoil is to be placed.
- C. Remove stones over 2-1/2 inches in any dimension, sticks, roots, rubbish, and other extraneous material.
- D. Limit preparation to areas which will receive topsoil within 2 days after preparation.

3.08 TOPSOIL PLACEMENT

- A. Topsoil Thickness:
 - 1. Sodded Areas: 2 inches.
 - 2. Planting Beds: 6 inches.
 - 3. Planting Beds in Roadways and Parking Lots: All planting areas shall be excavated to a minimum depth of 24" or greater as needed to remove all road base/rock down to native soil prior to backfilling with approved planting soil.
- B. Do not place topsoil when subsoil or topsoil is excessively wet or otherwise detrimental to the Work.
- C. Mix soil amendments with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding.
- D. Uniformly distribute to within 1/2-inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.
- E. Remove stones exceeding 1-1/2 inches, roots, sticks, debris, and foreign matter during and after topsoil placement.
- F. Remove surplus subsoil and topsoil from site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

3.09 MULCHING

- A. Cover planting beds and area of saucer around each plant with 3-inch thick layer of mulch within 2 days after planting. Saturate planting area with water.

3.10 PRUNING AND REPAIR

- A. Prune only after planting and in accordance with standard horticultural practice to preserve natural character of the plant. Perform in presence of Engineer or City's representative. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools. Do not cut lead shoot.
- B. For Existing Trees Impacted by Construction Activities:

1. Maintain a minimum 6-foot clearance from the trunk of all trees except palm trees. Existing trees to remain shall be protected during all construction phases. Protective barriers shall be provided at the drip line of existing trees adjacent to construction operations. Replacement of any trees that are damaged or destroyed due to the Contractor's operations shall be the Contractor's responsibility and shall be replaced at the Contractor's expense
2. Where roots of trees are encountered in the excavation area, use a 24-inch deep saw cut prior to excavation. Roots shall not be torn by excavating equipment. Hand dig around roots. Cut roots do not require coating.
3. Overhead branches not trimmed prior to construction and interfering with construction activities will be pruned and cut as approved by the City Forester and not torn or broken off with excavating equipment.

3.11 WEED CONTROL

- A. Maintain a weed-free condition within planting areas. Apply pre-emergent selective herbicide to mulched beds at manufacturer's recommended rate of application.

3.12 PROTECTION OF INSTALLED WORK

- A. Protect planting areas and plants against damage for duration of maintenance period.

3.13 ROOT BARRIERS

- A. Root barriers shall be installed parallel to all trees (except palms) when there is a sidewalks, roadway or utility adjacent to the planting area. Root barriers will be installed as directed by Engineer.

- END OF SECTION -

SECTION 03100
CONCRETE FORMWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

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

1.02 RESPONSIBILITY

- A. The design and engineering of the formwork as well as safety considerations are the responsibility of the Contractor.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast in Place Concrete
- D. Section 03315 - Grout

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
 - 1. Codes and Standards
 - a. The Building Code, as referenced herein, is the Florida Building Code (FBC).
 - 2. Government Standards
 - a. PS 1U.S. Product Standard for Concrete Forms, Class I.
 - 3. Commercial Standards
 - a. ACI 347 Recommended Practice for Concrete Formwork.
 - b. ACI 318R Building Code Requirements for Reinforced Concrete.
 - c. ACI 350Code Requirements for Environmental Engineering Concrete Structures

1.05 QUALITY ASSURANCE

- A. The variation from established grade or lines shall not exceed 1/4 inch in 10 feet and there shall be no offsets or visible bulges or waviness in the finished surface. All tolerances shall be within the "Suggested Tolerances" specified in ACI 347. The Contractor shall grind smooth all fins and projections between formwork panels as directed by the Engineer.
- B. Curved forms shall be used for curved and circular structures that are cast-in-place. Straight panels will not be acceptable for forming curved structures.

PART 2 – PRODUCTS

2.01 FORM MATERIALS

- 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. All forms shall be smooth surface forms and shall be of the following materials:
 - 1. Footing sides - Construction grade Hem Fir or Douglas Fir
 - 2. Walls - Steel or plywood panel
 - 3. Columns - Steel, plywood or fiber glass
 - 4. Roof and floor Slabs - Plywood
 - 5. All other work - Steel panels, plywood or tongue and groove lumber
- B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
 - 1. Lumber shall be 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 especially for concrete formwork and shall conform to the requirements of PS I for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8 inch thick.

2.02 PREFABRICATED FORMS

- A. Form materials shall be metal, wood, plywood, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall be an acceptable type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.03 FORMWORK ACCESSORIES

- A. Exterior corners in concrete members shall be provided with 3/4-inch chamfers. Reentrant corners in concrete members shall not have fillets unless otherwise shown.
- B. Form ties 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.
- C. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. At locations where removable taper ties are acceptable, a preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.
- D. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "Bug Holes" in cast-in-place concrete.

PART 3 – EXECUTION

3.01 EXAMINATION

- 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. 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 and falsework, shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by 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.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantially, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete.
- C. 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 the concrete. 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. Plywood, 5/8 inch 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. Specifically, 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. 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 as acceptable to the Engineer.

- D. Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to 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 affect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

3.02 EARTH FORMS

- A. All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. 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 comparatively 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.

3.03 FOOTINGS, SLAB EDGES AND GRADE BEAMS

- A. Provide wood side forms for all footings, slab edges and grade beams.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.05 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Embedded Form Ties: 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 as specified for in Section 03350 entitled "Concrete Finishes". 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. Ties shall not be removed in such 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. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. 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.

3.06 FORM CLEANING

- A. Forms may be reused only if in good condition and only if acceptable to the Engineer. 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. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.07 FORMWORK TOLERANCES

- A. Formwork shall be constructed to insure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347.
 1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown in the Drawings:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown on the Drawings	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the plum	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls	Minus 1/4 inch; Plus 1/2 inch
Variation in the locations and sizes of slab and wall openings	Plus or minus 1/4 inch

3.08 FORM REMOVAL

- A. Remove top forms on sloping surfaces of concrete as soon as removal operations will not allow the concrete to sag. Perform any needed repairs or treatments required on sloping surfaces at once, and follow immediately with the specified curing.
- B. The Contractor shall be responsible for the removal of forms and shores. Forms or shores shall not be removed before test cylinders have reached the specified minimum 28-day compressive strength for the class of concrete specified in Section 03300 entitled "Cast-in-Place Concrete", nor sooner than listed below:

1. Grade beam side forms..... 3 days
2. Wall forms 3 days
3. Column forms..... 3 days
4. Beam and girder side forms 3 days
5. Beam bottoms and slab forms/shores 14 days

3.09 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. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the Engineer. 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 two 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.

- END OF SECTION -

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, fabricate and place all concrete reinforcing steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories and special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion, all in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
B. Section 03100 - Concrete Formwork
C. Section 03300 - Cast in Place Concrete
D. Section 03315 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications, all Work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. Codes and Standards

- a. The Building Code, as referenced herein, is the Florida Building Code (FBC).

2. Commercial Standards

- | | |
|-------------|---|
| a. ACI 315 | Details and Detailing of Concrete Reinforcement. |
| b. CRSI | Concrete Reinforcing Steel Institute Manual of Standard Practice |
| c. ACI SP66 | ACI Detailing Manual |
| d. ACI 305 | Hot Weather Concreting |
| e. ACI 318 | Building Code Requirements for Reinforced Concrete. |
| f. ACI 350 | Code Requirements for Environmental Engineering Concrete Structures |

- g. WRI Manual of Standard Practice for Welded Wire Fabric.
- h. ASTM A 1064 Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- i. ASTM A 615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

1.04 SUBMITTALS

- A. The Contractor shall furnish shop bending diagrams, placing lists, and Drawings of all reinforcing steel prior to fabrication in accordance with the requirements of the Section 01300 entitled, "Submittals." The Contractor shall submit detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66) for all reinforcing steel. These drawings shall be made to such a scale as to clearly show joint locations, openings, the arrangement, spacing and splicing of the bars. Where opening sizes are dependent on equipment selection the Contractor shall indicate all necessary dimensions to define steel lengths and placing details.
- B. Details of the concrete reinforcing steel and concrete inserts shall be submitted by the Contractor at the earliest possible date after receipt by the Contractor of the Notice to Proceed. Said details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are shown on the Drawings to be used to splice reinforcing steel, the Contractor shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
- E. Proposed supports for each type of reinforcing.
- F. Certification that all installers of dowel adhesives are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.
- G. International Code Council-Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.
- H. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications for Drilled-In Rebar: Drilled-in rebar shall be installed by an Installer with at least three years of experience performing similar installations. Installer

shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:
1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Rebar doweling preparation and installation.
 5. Proof loading/torquing.
- C. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the City in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspection of products and anchor holes prior to injection, installation, and proof testing.

PART 2 – PRODUCTS

2.01 REINFORCEMENT

- A. All reinforcing steel for all reinforced concrete construction shall conform to the following requirements:
1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement, and shall be manufactured in the United States. All reinforcing steel shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on the Drawings.
 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only. All welded wire fabric reinforcement shall be galvanized.
- B. Field welding of reinforcing steel will not be allowed.
- C. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORY MATERIALS

- A. Bolsters, chairs, spacers and other devices for supporting and fastening reinforcing in place shall be plastic protected wire bars supports complying with CRSI recommendations conforming to Class 1 bar supports.
- B. Metal bar supports for reinforcing steel for wastewater structures shall be Class 2, Type B stainless steel protected bar supports (CRSI).
- C. Tie Wire: Galvanized 16-gauge annealed type.
- D. Concrete blocks (dobies), used to support and position reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Concrete blocks shall only be used bottom mat of reinforcing steel for slabs on grade.

2.03 MECHANICAL COUPLERS

- A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.
- C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.
- D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.
- B. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements.
- C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer's instructions with compressed air and a wire brush prior to installation of adhesive and reinforcing bar.
- D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

- E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.
- F. Embedment Depth:
 - 1. The embedment depth of the bar shall be as show on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "SET-XP" by Simpson Strong-Tie Co. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.
 - 2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.
 - 3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long-term temperature of 110 degrees F, and maximum short-term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.
- G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.
- H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete, must comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report. The adhesive system shall be "Epcon System C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Injection Adhesive Anchor System" as manufactured by Hilti, Inc. "SET-XP" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by Powers Fasteners. Fast-set epoxy formulations shall not be acceptable.
- I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

2.05 FABRICATION

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings, and the fabricating details shall be prepared in accordance with ACI 315 and ACII 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1 1/2 inch for No. 3 bars, 2 inch for No. 4 bars, and 2 1/2 inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
- B. The Contractor shall fabricate reinforcing bars for structures in accordance with bending diagrams, placing lists, and placing Drawings. Said Drawings, diagrams, and lists shall be prepared by the Contractor as specified under Section entitled "Submittals," herein.

- C. Fabricating Tolerances: Bars used for concrete reinforcing shall meet the following requirements for fabricating tolerances:
1. Sheared length: + 1 inch
 2. Depth of truss bars: + 0, 1/2 inch
 3. Stirrups and ties: + 1/2 inch
 4. All other bends: + 1 inch

2.06 MINIMUM REINFORCEMENT

- A. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross-sectional area of reinforcing steel in the direction of principal reinforcement shall be 0.0033 times the gross concrete area of all concrete members.
- B. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross-sectional area of temperature reinforcing steel (reinforcing steel perpendicular to the principal reinforcing steel) shall be as follows:
1. 0.0020 times the gross concrete area in slabs of non-water-bearing structures.
 2. 0.0015 times the gross concrete area vertically in walls of non-water-bearing structures.
 3. 0.0025 times the gross concrete area horizontally in walls of non-water-bearing structures.
 4. 0.0050 times the gross concrete area in slabs of water-bearing structures
 5. 0.0030 times the gross concrete area vertically in walls of water-bearing structures.
 6. 0.0050 times the gross concrete area horizontally in walls of water-bearing structures.
 7. Temperature steel shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

PART 3 – EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
- B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

- D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.02 PLACEMENT

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcing steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Bars additional to those shown on the Drawings which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic coated standard type legs as specified in Paragraph B herein. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane shown on the Drawings.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobbies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

- I. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than $1 \frac{1}{3}$ times the maximum size of the coarse aggregate, nor less than one inch.
- J. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.
- K. In columns, the clear distance between longitudinal bars shall be not less than $1 \frac{1}{2}$ times the bar diameter, nor less than $1 \frac{1}{2}$ times the maximum size of the coarse aggregate, nor less than $1 \frac{1}{2}$ inches.
- L. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.
- M. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.
- N. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318, Section 12.15.1 for a class B splice.
- O. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- P. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.
- Q. Reinforcing shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field bent except as shown on the Drawings or specifically permitted by the Engineer.
- R. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.
- S. Adhesive Dowel Testing
 - 1. At all locations where adhesive dowels are shown on the Drawings, at least 5 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is

indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.

2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.
3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State of Florida. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.
4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.
5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.03 CLEANING AND PROTECTION

- A. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary, recleaned.

- END OF SECTION -

SECTION 03290
JOINTS IN CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall construct all joints in concrete at the locations shown on the Drawings. Joints required in concrete structures are of various types and will be permitted only where shown on the Drawings, unless specifically accepted 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 on the Drawings.
- C. Waterstops shall be provided where shown on the Drawings, and in all waterbearing joints in hydraulic structures.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast in Place Concrete.
- D. Section 03315 - Grout
- E. Section 03350 - Concrete Finishes
- F. Section 03370 - Concrete Curing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.
 - 1. Federal Specifications:
 - a. TT S 00227E(3) Sealing Compound, Elastomeric Type, Multi component (For Caulking, Sealing, And Glazing Buildings and Other Structures).
 - 2. U.S. Army Corps of Engineers Standard Specifications
 - a. CRD C572

3. Commercial Standards:

- a. ASTM C 920 Specification for Elastomeric Joint Sealants.
- b. ASTM D 624 Test Method for Rubber Property Tear Resistance.
- c. ASTM D 638 Test Method for Tensile Properties of Plastics.
- d. ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- e. ASTM D 747 Test Method for Apparent Bending Modules of Plastics by Means of a Cantilever Beam.
- f. ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- g. ASTM D 2240 Test Method for Rubber Property Durometer Hardness.

1.04 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called construction joint. Unless noted otherwise, all joints in water bearing structures shall be provided with a waterstop of the shape specified herein or shown on the Drawings.
- B. Contraction Joints: 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 on the Drawings.
- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as detailed on the Drawings. This space is obtained by placing a preformed joint filler against the first pour, which acts as a form for the second pour. Unless noted otherwise, all expansion joints in water bearing members shall be provided with a 9-inch wide waterstop. Preformed joint filler 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. The space so formed shall be filled with a joint sealant material as specified herein. The joint sealant shall be isolated from the filler using a bond breaker.
- D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions shown on the Drawing, is formed or saw cut in the concrete. This groove shall be filled with a joint sealant.

1.05 SUBMITTALS

- A. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such 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 under this contract. The balance of the material to be used under this contract shall not be produced until after the Engineer has reviewed the qualification samples. The samples shall be delivered to a location on site indicated by the Engineer.
- B. Joint Sealant: Prior to ordering the sealant material, the Contractor shall submit to the Engineer for the Engineer's review, sufficient data to show general compliance with the requirements of the Contract Documents.
- C. Contractor shall submit product data sheets of all materials proposed under this section.
- D. Shipping Certification: 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 this project meets or exceeds the physical property requirements of the Contract Documents. Contractor certificates are not acceptable.
- E. The Contractor shall submit placement Shop Drawings showing the location and type of all joints for each structure.

1.06 QUALITY ASSURANCE

- A. Waterstop
 - 1. Review: It is required that all waterstop field joints shall be subject to review inspection, and no such work shall be scheduled or started without having made prior arrangements with the Engineer to provide for the required reviews. Not less than 24 hours' notice shall be provided to the Engineer for scheduling such reviews.
 - 2. All field joints in waterstops will be subject to rigid review 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. All defective joints shall be replaced with material which will pass said review, and all faulty material shall be removed from the site and disposed of by the Contractor at its own expense.
 - 3. The following defects represent a partial list of defects which shall be grounds for rejection:
 - a. Offsets at joints greater than 1/16 inch or 15 percent material thickness, at any point, whichever is less.
 - b. Exterior crack at joint, due to incomplete bond, deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

- c. 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 percent of material thickness at any point, whichever is less.
- d. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
- e. Porosity in the welded joint as evidenced by visual inspection.
- f. Bubbles or inadequate bonding which can be detected with 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.)

1.07 GUARANTEE

- A. The Contractor shall provide a two-year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the City, at no additional cost to the City, any such defective areas which become evident within said two-year guarantee period.

PART 2 – PRODUCTS

2.01 PVC WATERSTOPS

- A. General: Waterstops shall be extruded from an elastomeric polyvinylchloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. 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 meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD C572 and listed in Paragraph C. below.
- B. Multi Rib Waterstops: All PVC waterstops shall be of Multi rib construction. Waterstops for construction joints shall be serrated style 732 by Greenstreak or equal. Waterstops for expansion joints shall be Style 738 by Greenstreak or equal. T type waterstops installed against existing concrete shall be Style 609 by Greenstreak, or equal. Compatible baten bars and anchor bolts shall be supplied by the same manufacturer. Prefabricated joint fittings (90° bends and tees) shall be used at all intersections of the ribbed type waterstops.
- C. Waterstop Testing Requirements: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

(Continued on Next Page)

	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength-min (psi)	1750	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp. Brittleness-Max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
<u>Effect of Alkalies (CRD-C572)</u>		
Ultimate Elongation-min (percent)	300	D 638, Type IV
Change in Weight (percent)	+0.25/-0.10	----
Change in Durometer, Shore A	+5	D 2240
<u>Finish Waterstop</u>		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.02 CHEMICAL RESISTANT WATERSTOPS

- A. **General:** Waterstops shall be manufactured from thermoplastic elastomeric rubber material. The synthetic rubber shall provide a high resistance to acids, bases, alcohols, oils, solvents or chemicals. No reclaimed material shall be used. The Contractor shall obtain from the waterstop manufacturer and 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 meets the physical requirements outlined herein. Waterstop connections shall be heat welded. All waterstop corners, intersections, and directional changes shall be miter cut, heat welded, factory fabricated. Only straight butt splices shall be allowed in the field.
- B. **Multi-Rib Waterstops:** All chemical resistant waterstops shall be of multi-rib construction. Waterstops for expansion joints shall be 9"x3/16" ribbed with a center bulb. Waterstops for construction joints shall be 6"x3/16" ribbed with a center bulb. Chemical resistant waterstops shall be Westec Type TPE-R synthetic rubber, manufactured by Westec Barrier Technologies, St. Louis, MO, or equal.
- C. **Waterstop Physical Properties:** When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength	1800 psi	D-412
Ultimate Elongation	450%	D-412
100% Modulus	1000 psi	D-412
Shore A Hardness	85 units \pm 5 units	D-2240
Brittle Point	-70°F	D-746
Ozone Resistance	450 pphm passed	D-1171

- D. Weathering Performance: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std.</u>
Tensile Strength (% Retention)	87%	D-412
Ultimate Elongation (% Retention)	84%	D-412
Shore A Hardness (units change)	7 units	D-2240

- E. Chemical Resistance Properties: When tested in accordance with ASTM D-471 after 166 hours of full immersion at 73.4oF (23oC), the waterstop material shall meet or exceed the following requirements:

(Continued on Next Page)

<u>Fluid</u>	<u>Physical Property</u>	<u>Value</u>
Sulfuric Acid 98%	Ultimate Elongation	77% Retention
	Ultimate Tensile	82% Retention
	100% Modulus	108% Retention
	Hardness Change Shore A	-1 Unit
	Weight Change	2.1%
Sodium Hydroxide 50%	Ultimate Elongation	101% Retention
	Ultimate Tensile	107% Retention
	100% Modulus	104% Retention
	Hardness Change Shore A	-4 Unit
	Weight Change	-0.1%

2.03 HYDROPHILIC WATERSTOPS

- A. Hydrophilic waterstops shall be designed to expand and seal under hydrostatic conditions. At construction joints, the waterstops shall be Adeka Ultraseal MC 2010 M for wall/slab thickness greater than 9 inches, and Adeka Ultraseal KBA-1510FF for wall/slab thickness less than 9 inches or equal. At expansion joints, the waterstops shall be Adeka Ultraseal KM-3030M or equal.
- B. Plate fabrications used to plug flow channels for future expansion or otherwise to close wall openings shall be caulked using hydrophilic waterstops designed for the application. Caulking agents shall be Adeka Ultraseal P201 or equal.

2.04 JOINT SEALANT

- A. Joint sealant shall comply with Section 07920 entitled "Sealants and Caulking".

2.05 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be one of the following types:
 1. Type I – Sponge rubber, conforming to ASTM D1752, Type I
 2. Type II – Cork, conforming to ASTM D1752, Type II
 3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III
 4. Type IV – Bituminous fiber, conforming to ASTM Designation D1752

2.06 BACKER ROD

- A. Backer rod shall comply with Section 07920 entitled "Sealants and Caulking".

2.07 BOND BREAKER

- A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Hunt Process 225 TU as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.08 CONTRACTION JOINT INSERTS

- A. Contraction joint inserts shall be Transverse-Control Joints by Greenstreak Plastic Products or equal.

PART 3 – EXECUTION

3.01 GENERAL

- A. Unless otherwise shown on the Drawings, waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the 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. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on 1 side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 14 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.

3.02 CONSTRUCTION JOINTS

- A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.
- B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

- C. Unless noted otherwise on the Drawings, maximum Maximum1 distance between horizontal joints in slabs and vertical joints in walls shall be 45' 0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25'-0" unless noted otherwise on the Drawings1.
- D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.
- E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.
- F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.03 SPLICES IN PVC WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. 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 percent 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 in waterstop involving more than 2 ends to be joined together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be factory fabricated with not less than 24-inch long strips of material beyond the joint. Upon being inspected and accepted, 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.

3.04 JOINT CONSTRUCTION

- A. Setting PVC Waterstops: In order to eliminate faulty installation that may result in joint leakage, particular 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 PVC 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 on the Drawings. When not shown on the Drawings, maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45-feet, and maximum distance between vertical and horizontal joints for earth or water retaining walls shall be 25-feet, unless noted otherwise. The location of all joints, of any type, shall be submitted for review 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 on the Drawings, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 entitled "Cast in Place Concrete."
- E. 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.
- F. 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 the requirements of Section entitled, "Cast in Place Concrete."
- G. 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.
- H. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- I. 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 doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- J. 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.

3.05 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

- A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.
- B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.
- C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.
- E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.
- F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.
- G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

- END OF SECTION -

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, all in accordance with the requirements of the Contract Documents.
- B. The requirements in this section shall apply to the following types of concrete:
1. Class A1 Concrete: Normal weight concrete used at all non-water-bearing structures, unless otherwise noted.
 2. Class A2 Concrete: Normal weight concrete used at all water-bearing structures and containment structures, unless otherwise noted.
 3. Class A3 Concrete: Normal weight concrete used at all walls of water bearing structures. Class A3 concrete is similar to Class A2 except Class A3 shall contain a mandatory addition of high range water reducer to aid in placement of concrete.
 4. Class B Concrete: Normal weight concrete with pea-rock aggregate. Class B concrete shall be used only at locations indicated on the Drawings.
 5. Class C Concrete: Normal weight concrete used in electrical/instrumentation ductbanks, pipe encasements and sidewalks.
 6. Flowable Fill: Lean concrete proportioned without the use of coarse aggregate primarily for use as pipe backfill. Flowable fill shall be utilized only at locations indicated on the Drawings.
 7. Tremie Concrete: Concrete indicated to be placed underwater.
 8. Grout is specified in Section 03315 entitled "Grout".

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 01400 - Quality Control
- C. Section 03100 - Concrete Formwork
- D. Section 03200 - Concrete Reinforcement
- E. Section 03400 - Precast Concrete, General
- F. Section 03315 - Grout

G. Section 05500 - Metal Fabrications

H. Section 07190 - Vapor Barrier

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code (FBC) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. Codes and Standards

1. The Building Code, as referenced herein, shall be the Florida Building Code.

C. Federal Specifications

1. UU B 790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).

D. Commercial Standards

1. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.
2. ACI 301 Specifications for Structural Concrete for Buildings.
3. ACI 305 Hot Weather Concreting.
4. ACI 306 Cold Weather Concreting.
5. ACI 309 Recommended Practice for Consolidation of Concrete
6. ACI 315 Details and Detailing of Concrete Reinforcement.
7. ACI 318 Building Code Requirements for Reinforced Concrete.
8. ACI 347 Recommended Practice for Concrete Formwork.
9. ACI 350 Environmental Engineering Concrete Structures.
10. ASTM C 31 Methods of Making and Curing Concrete Test Specimens in the Field.
11. ASTM C 33 Specification for Concrete Aggregates.
12. ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C 88 Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.

14. ASTM C 94 Specification for Ready-Mixed Concrete.
15. ASTM C 114 Method for Chemical Analysis of Hydraulic Cement.
16. ASTM C 136 Method for Sieve Analysis of Fine and Coarse Aggregate.
17. ASTM C 143 Test Method for Slump of Portland Cement Concrete.
18. ASTM C 150 Specification for Portland Cement.
19. ASTM C 156 Test Method for Water Retention by concrete Curing Materials.
20. ASTM C 157 Test Method for length Change of Hardened Cement Mortar and Concrete.
21. ASTM C 192 Method of Making and Curing concrete Test Specimens in the Laboratory.
22. ASTM C 227 Standard Test Method for Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar-Bar Method).
23. ASTM C 260 Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C 289 Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
25. ASTM C 494 Specification for Chemical Admixtures For Concrete.
26. ASTM C 586 Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method).
27. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
28. ASTM D 1751 Specification for preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
29. ASTM D 6103 Standard Test Method for Flow Consistency of Controlled Low Strength Material
30. ASTM E11 Specification for Wire-Cloth Sieves for Testing Purposes.
31. ASTM E 119 Method for Fire Tests of Building Construction and Materials.

1.04 SUBMITTALS

- A. The design mixes to be used shall be prepared by qualified persons and submitted for review. The design of the mix is the responsibility of the Contractor subject to the limitations of the specifications. Review processing of this submission will be required only as evidence the mix has been designed by qualified persons and that the minimum requirements of the specifications have been met. Such review will in no way alter the

responsibility of the Contractor to furnish concrete meeting the requirements of the specifications. If in the progress of the work the sources of materials change in characteristics or the Contractor requests a new source in writing, the Contractor shall, at his expense submit new test data and information for the establishment of a new design mix. Submit mix designs for all classes of concrete to be used under this Contract. Mix design submittals shall include the following:

1. Sources of all materials and certifications of compliance with specifications for all sources of each material.
 2. Certified current (less than one year old) chemical analysis of Portland Cement or Blended Cement to be used.
 3. Certified current (less than one year old) chemical analysis of fly ash to be used.
 4. Aggregate test results showing compliance with required standards, i.e. sieve analysis, aggregate soundness tests, etc.
 5. Manufacturer's data on all admixtures stating compliance with required standards and are compatible with one another. Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.
 6. Field experience records and/or trial mix data for the proposed concrete mixes.
- B. Where ready-mix concrete is used, the Contractor shall provide delivery tickets at the time of delivery of each load of concrete. In addition to the information required by ASTM C94, each ticket shall show the mix number, cement content, water/cementitious ratio, and amount of water allowed to be added to truck without exceeding required water/cementitious ratio.
- C. A schedule of all concrete placement with volume of concrete planned to be placed each day.
- D. A layout of all structures with all planned construction joint locations.

1.05 QUALITY ASSURANCE

- A. Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production facilities of the National Ready Mixed Concrete Association and ASTM C 94.
- B. Tests for compressive strength and slump of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
- C. The cost of initial trial mixes and initial laboratory tests to design the mixes including compression tests, sieve analysis, and tests on trial mixes shall be included in the Contract Price.
- D. The cost of all tests during construction will be borne by the City. However, the Contractor shall be charged for the cost of any additional tests and investigation on work

performed which does not meet the Specifications. All test results shall be sent directly to the Engineer. All testing invoices shall be sent directly to the City. The Contractor shall be responsible for coordination of all tests with the testing laboratory.

- E. Concrete for testing shall be supplied by the Contractor at no cost to the City City1, and the Contractor shall provide assistance to the Engineer in obtaining samples. The Contractor shall dispose of and clean up all excess material.
- F. Construction Tolerances
- G. The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 347 and Section 03100 entitled "Concrete Formwork".

1.06 QUALITY CONTROL

A. Compressive Strength

1. Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each placement in excess of five cubic yards, or for each fifty (50) cubic yards of concrete placed, or for each 5000 square feet of surface area for slabs or walls, whichever is greater.
2. Samples of freshly mixed concrete shall be obtained in accordance with ASTM C 172, and compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall consist of at least five 6-inch diameter by 12-inch high cylinders, or eight 4-inch diameter by 8-inch high cylinders. Each cylinder shall be identified by a tag attached to the side of the cylinder.
3. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours
4. Compression test shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at 7 days and 2 at 28 days. For 4x8 cylinders, three test cylinders will be tested at 7 days and three at 28 days. The remaining cylinders will be held to verify test results, if needed.

B. Consistency

1. Consistency of the concrete will be checked by the Engineer by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for delays, material or labor costs due to such eventualities.
2. Slump tests shall be made in accordance with ASTM C 143. Slump tests shall be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

C. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the Engineer in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 215 and ACI 318, Chapter 5 "Concrete Quality Mixing and Placing", and as specified herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor. Additional testing may also be required to verify compressive strength of concrete. Additional testing shall involve extraction and testing of concrete cores in accordance with ASTM C 42. Engineer shall determine locations where concrete cores shall be taken. Nondestructive test methods shall not be used to verify strength of in-place concrete.

1.07 PRE-CONCRETE CONFERENCE

- A. At least 35 days prior to start of the Concrete construction schedule, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction. The Contractor shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference.
- B. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
 1. Contractor's superintendent

2. For the concrete design mix – Laboratory retained for trial batching and tests
 3. For field quality control – Concrete subcontractor, Concrete producer, Admixture Manufacturer(s), Concrete pumping Contractor
- C. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall also be transmitted to the Engineer.
- D. The minutes shall include a statement by the admixture manufacturer(s) indicating that the proposed mix design and placing techniques can produce the concrete quality required by these Specifications.
- E. The Engineer will be present at the conference. The Contractor shall notify the Engineer at least 20 days prior to the scheduled date of the conference.

PART 2 – MATERIALS

2.01 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished and stored for the work shall comply with the requirements of ACI 301, as applicable.
- C. Materials for concrete shall conform to the following requirements:
1. Cement shall be standard brand Portland cement conforming to ASTM C 150 for Type II. Portland cement shall contain no more than 0.60 percent alkalis. The term "alkalis" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114. A single brand of cement shall be used throughout the Work, and prior to its use, the brand shall be acceptable to the Engineer. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these Specifications.
 2. Fly ash shall meet the requirements of ASTM C 618 for Class F, except the loss on ignition shall not exceed 4%. The fly ash constituent shall be maximum 15% of the total weight of the combined Portland cement and fly ash. For concrete to be used in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash in concrete mix is mandatory.
 3. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for

the purposes of this Section only, if it meets the requirements of the local governmental agencies.

4. Aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, and shall conform to the FBC and ASTM C 33. Maximum size of coarse aggregate shall be as specified in Article 2.04, Paragraph B of this Section. Lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size not greater than 1 inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined.
 - b. Fine aggregates shall be manufactured sand that is hard and durable.
 - c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - d. When tested in accordance with "Potential Reactivity of Aggregates (Chemical Method)" (ASTM C 289), the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
 - e. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C 40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - f. When tested in accordance with "Resistance to Abrasion of Small size Coarse Aggregate by Use of the Los Angeles Machine" (ASTM C 131), the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
 - g. When tested in accordance with "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (ASTM C 88), the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.

2.02 ADMIXTURES

- A. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. Air-entraining agent shall be Sika AER by Sika Corp., MB-VR by Master Builders, Darex AEA by Grace, AEA-92S by Euclid Chemical Company, or equal.
- B. Admixtures shall be required at the Engineer's discretion or, if not required, may be added at the Contractor's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the Engineer. Concrete containing an admixture shall be first placed at a location determined by the

Engineer. If the use of an admixture is producing an inferior end result, the Contractor shall discontinue use of the admixture. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be nontoxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are "Eucon Series" by the Euclid Chemical Company, "Pozzolith Series" by BASF, and "Plastocrete Series" by Sika Corporation.
2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The use of high range water reducer is mandatory for Class A2 A3 1 concrete. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are "Eucon 37" or Plastol 5000 by the Euclid Chemical Company, "Rheobuild 1000 or Glenium Series" by BASF, and "Daracem 100 or Advaflo Series" by W.R. Grace.
3. A non-chloride, non-corrosive accelerating admixture shall be used when air temperature at time of placement is expected to be consistently below 40 degrees Fahrenheit as specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.
4. A water reducing retarding admixture shall be used when air temperature at time of placement is expected to be consistently above 90 degrees Fahrenheit as specifically approved by the Engineer. The admixture shall conform to ASTM, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzolith Retarder" by BASF, and "Plastiment" by Sika Corporation.
5. The Contractor shall submit certification from each admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned.
6. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
7. Certification: Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.

2.03 ACCESSORIES

- A. Epoxy adhesives shall be the following products for the applications specified to be used in strict accordance with manufacturer's recommendations.
1. For bonding freshly mixed, plastic concrete to hardened concrete, Sikadur 32 Hi Mod, LPL Epoxy Adhesive, as manufactured by Sika Chemical Corporation; Concessive 1001 LPL, as manufactured by Adhesive Engineering Company; or equal.
 2. For bonding hardened concrete or masonry to steel, Colma Dur Gel, Sikadur Hi Mod Gel, or equal.

2.04 CONCRETE MIX

- A. Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined by the Contractor. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix designs with more than 41 percent of sand of the total weight of fine and coarse aggregate shall not be used for Class A Concrete. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the City. All changes shall be subject to review by the Engineer.
- B. The proportions of cement, aggregates, admixtures and water used in the concrete shall be based on tests of grading and moisture content of materials, slump of concrete mixture, strength of concrete and the following factors:
1. Class A1 Concrete (Normal weight concrete used at all non-water bearing structures, unless noted otherwise).

Minimum cementitious materials content, per cubic yard	611 lbs.
Maximum water-cementitious materials ratio, by weight	0.45
Slump range	3 inches to 4 inches with water reducing admixture
Coarse Aggregate	#57 per ASTM C33
Compressive strength at 28 days – F'c	4,000 psi
Air Content	3% ± 1%

2. Class A2 Concrete (Normal weight concrete used at all water bearing structures and containment structures, unless noted otherwise).

Minimum cementitious materials content, per cubic yard	611 lbs.
Maximum water-cementitious materials ratio, by weight	0.42
Slump range	3 inches to 4 inches with water reducing admixture
Coarse Aggregate	#57 per ASTM C33
Compressive strength at 28 days – F'c	4,500 psi
Air Content	3% ± 1%

3. Class A3 Concrete (Normal weight concrete used at all walls of water bearing structures. Class A3 concrete is similar to Class A2 except class A3 shall contain a mandatory addition of high range water reducer).

Minimum cementitious materials content, per cubic yard	611 lbs.
Maximum water-cementitious materials ratio, by weight	0.42
Slump range	3 inches maximum before addition of high range water reducing admixture 8 inches maximum after addition of high range water reducing admixture
Compressive strength at 28 days - F'c	4,500 psi
Coarse Aggregate	#57 per ASTM C33
Air Content	3% ± 1%

4. Class B Concrete (At locations shown on the Drawings).

Minimum cementitious materials content, per cubic yard	517 lbs.
Maximum water-cementitious materials ratio, by weight	0.50
Slump, maximum	5 inches
Compressive strength at 28 days - F'c	4,000 psi
Coarse Aggregate	Pearock

- | | |
|-------------|-------------|
| Air Content | 3% \pm 1% |
|-------------|-------------|
5. Class C Concrete (Sidewalks, pipe encasements in the dry, thrust blocks and electrical duct banks)
- | | |
|--|------------------|
| Minimum cementitious materials content, per cubic yard | 500 lbs. |
| Maximum water-cementitious materials ratio, by weight | 0.60 |
| Slump, maximum | 5 inches |
| Compressive strength at 28 days - F'c | 3,000 psi |
| Coarse Aggregate | #57 per ASTM C33 |
| Air Content | 3% \pm 1% |
6. Flowable Fill (In lieu of pipe bedding, select backfill)
- | | |
|--|----------------------|
| Minimum cementitious materials content, per cubic yard | 100 lbs. |
| Maximum water-cementitious materials ratio, by weight | 5.0 |
| Flowability, minimum | 8 inches |
| Compressive strength at 28 days - F'c | 50-150 psi |
| Coarse aggregate | none |
| Fine aggregate | limestone screenings |
7. Tremie Concrete (Concrete placed under water)
- | | |
|---|----------|
| Minimum cement content, per cubic yard | 700 lbs. |
| Maximum water-cementitious materials ratio, by weight | 0.45 |
| Slump, maximum | 9 inches |
| Compressive strength lbs. per sq. inch at 28 days - F'c | 4,500 |
- C. All Class A1, A2 and A3 concrete, unless noted otherwise on the Drawings, shall be air entrained concrete. A water reducing admixture may be added to the mix at the Contractor's option.

- D. The mix proportions used shall be changed subject to the limitation specified herein, whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

2.05 CONSISTENCY

- A. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143.

2.06 READY MIXED CONCRETE

- A. Ready mixed concrete shall be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
- B. Ready mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one half hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. Upon delivery from the truck concrete temperature shall not exceed 90 degrees Fahrenheit.
- C. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

PART 3 – EXECUTION

3.01 PROPORTIONING AND MIXING

- A. Proportioning of the concrete mix shall be based on the results of field experience or laboratory trial mixes in conformance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318. When trial mixes are used they shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301; provided, that the maximum slump for any concrete shall not exceed the limits specified in this Section of the Specifications.

- B. When field experience records are inadequate to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318, or when required by the Engineer, an independent testing laboratory designated by the Contractor and acceptable to the Engineer shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the City.
- C. An independent testing laboratory shall observe the preparation of the trial batch, and they shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. _____, Product _____." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the City. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.
- D. Mixing of concrete shall conform to the requirements of Chapter 7 of ACI 301 Specifications.
- E. Retempering of concrete or mortar which has partially hardened will not be permitted.

3.02 PREPARATION

- A. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. A vapor barrier specified in Section 07190 entitled "Vapor Barrier" shall be placed. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. No concrete shall be placed until the reinforcement steel and formwork have been erected in a manner acceptable to the Engineer. The Contractor shall notify the Engineer not less than two working days prior to Concrete Placement, allowing one day for review and any corrective measures which are required.
- C. Joints in Concrete
 - 1. Concrete surfaces upon or against which concrete is to be placed shall be given a roughened surface for good bond and a bonding agent shall be placed. Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete where shown on the drawings.

2. After the surfaces have been prepared all horizontal construction joints shall be covered with a layer of mortar approximately one inch thick. The mortar shall have the same proportions of cement and sand as the regular concrete mixture. The water cement ratio of the mortar in place shall not exceed that of the concrete to be placed upon it, and the consistency of the mortar shall be suitable for placing and working in the manner hereinafter specified. The mortar shall be spread uniformly and shall be worked thoroughly into all irregularities of the surface. Wire brooms shall be used where possible to scrub the mortar into the surface. Concrete shall be placed immediately upon the fresh mortar.

D. Placing Interruptions

1. When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the Engineer. Cold joints will be sufficient cause for rejection of the work.

E. Embedded Items

1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcing steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least four hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
2. All inserts or other embedded items shall conform to the requirements herein.

- F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.

- G. All anchor bolts called for on the drawings shall be cast in place in the concrete. Drilled, impact, adhesive or other types of anchors shall not be substituted for anchor bolts unless otherwise shown on the Drawings. Anchor bolts shall conform to the requirements set forth in Section 05050 entitled "Metal Fastening".

H. Casting New Concrete Against Old

1. Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand blasting (exposing aggregate) prior to the application of an epoxy bonding agent.

- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater, except where shown on the Drawings to be placed by the tremie method, nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any

concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Engineer.

J. Corrosion Protection

1. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
2. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
3. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
4. The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.03 PLACING CONCRETE

- A. Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section.
- B. Non-Conforming Work or Materials
 1. Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the Contractor.
- C. Unauthorized Placement
 1. No concrete shall be placed except in the presence of duly authorized representative of the Engineer. The Contractor shall notify the Engineer at least 24 hours in advance of placement of any concrete.
- D. Placement in Wall Forms
 1. Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies.

2. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.
- E. Casting New Concrete Against Old
1. An epoxy adhesive bonding agent shall be applied to set surfaces of construction joints according to the manufacturer's written recommendations.
- F. Conveyor Belts and Chutes
1. All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- G. Placement in Slabs
1. Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up slope direction.
- H. Temperature of Concrete
1. The temperature of concrete when it is being placed shall be not more than 90 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees Fahrenheit, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements. During summer months concrete pours shall be scheduled in the morning or early part of the day when temperatures are cooler.
- I. Pumping Equipment
1. Pumping equipment and procedures if used shall conform to the recommendations contained in the report of ACI Committee 304 on Placing Concrete by Pumping

Methods, ACI 304.2R. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1-1/2 inches.

- J. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days.
- K. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- L. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- M. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- N. Concrete in walls shall be internally vibrated and at the same time, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.04 CONCRETE FINISHING

- A. Concrete finishes are specified in Section 03350 entitled "Concrete Finishes".

3.05 CURING AND PROTECTION

- A. Curing is specified in Section 03370 entitled "Concrete Curing".

3.06 CONCRETE IN COLD WEATHER

- A. Cold weather concreting procedures shall be in accordance with the requirements of ACI 306.

3.07 CONCRETE IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirement of ACI 305.

3.08 PLACING CONCRETE UNDERWATER (TREMIE CONCRETE)

- A. Placing concrete underwater will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously place concrete from within, displacing water with a minimum disturbance to the surface of the concrete.
- B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

3.09 PLACING CONCRETE UNDER PRESSURE (PUMPING)

- A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- B. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.
- C. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a recognized testing laboratory proving the

proposed mix meets all requirements. In addition, at the Contractor's option, an actual pumping test under field conditions may be performed prior to use of the accepted mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated.

- D. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the Pumping operation and proceed with the placing of concrete using conventional methods.
- E. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
- F. The minimum diameter of the hose (conduits) shall be four inches.
- G. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

3.10 ORDER OF PLACING CONCRETE

- A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall be have cured at least seven days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two adjacent wall panels have cured at least 14 days.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped.

3.11 DEFECTIVE CONCRETE

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until reviewed by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.
- B. Defective surfaces to be repaired as specified in Article 3.11, Paragraph A of this Section, shall be cut back from trueline a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions. The material used for repair proposed shall be approved by the Engineer.

- C. Holes left by tie rod cones shall be repaired in an acceptable manner with dry-packed cement grout or premixed patching material as accepted by the Engineer.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of Article 3.04 or 3.05 of this Section, as applicable, using acceptable methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to backfilling, all cracks that may have developed shall be "vee'd" and filled with sealant conforming to the requirements of Section 07920 entitled, "Sealants and Caulking". This repair method shall be done on the faces of members in contact with fill.

3.12 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the City. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense. This stipulation includes concrete experiencing cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an epoxy injection system approved by the Engineer. Non-structural cracks shall be repaired using a hydrophilic resin pressure injected grout system approved by the Engineer, unless other means or repair are deemed necessary and approved by the Engineer.

3.13 CONCRETE SEALER

- A. Contractor shall apply a sealer to the top surface of all finished concrete floor slabs and equipment pads which are to remain unpainted and not intended to be immersed unless stated otherwise. Sealer shall be as specified in Specification Section 03350 entitled "Concrete Finishes".

- END OF SECTION -

SECTION 03301

REINFORCED CONCRETE

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
 - a. 301, Specifications for Structural Concrete for Buildings.
 - b. 305R, Hot Weather Concreting.
 - c. 306R, Cold Weather Concreting.
 - d. 318/318R, Building Code Requirements for Reinforced Concrete.
 - e. 347, Formwork for Concrete.
2. ASTM International (ASTM):
 - a. A497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - b. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - c. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - d. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - e. C94, Standard Specification for Ready-Mixed Concrete.
 - f. C150, Standard Specification for Portland Cement.
 - g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - h. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - i. C494, Standard Specification for Chemical Admixtures for Concrete.

- j. C618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
 - k. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
3. Concrete Reinforcing Steel Institute (CRSI):
- a. Manual of Standard Practice.
 - b. Recommended Practice for Placing Reinforcing Bars.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Reinforcing steel in accordance with CRSI Manual of Standard Practice.
- 2. Curing compound data.
- 3. Complete data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.

B. Informational Submittals:

- 1. Manufacturer's application instructions for curing compound.
- 2. Ready-mix delivery tickets for each truck in accordance with ASTM C94.

1.03 QUALITY ASSURANCE

- A. Formwork: Unless otherwise specified, follow the recommendations of ACI 347.
- B. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and ACI 318/318R.
- C. Hot Weather Concreting: Conform to ACI 305R.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Do not use curing compound where solvents in the curing compounds are prohibited by state or federal air quality laws. Use only water curing methods.

PART 2 - PRODUCTS

2.01 CONCRETE

- A. Ready-mixed meeting ASTM C94, Option A.

- B. Portland Cement: ASTM C150, Type I or II.
- C. Admixtures:
 - 1. Air-Entraining: ASTM C260.
 - 2. Water-Reducing: ASTM C494, Type A or Type D.
 - 3. Superplasticizers: ASTM C494, Type F or Type G.
 - 4. Fly Ash: ASTM C618, Class C or Class F.
 - 5. Color Pigments: Inert mineral or metaloxide pigments, either natural or synthetic; resistant to lime and other alkalis.
- D. Mix Design:
 - 1. Minimum Allowable 28-day Compressive Field Strength: 3,000 psi when cured and tested in accordance with ASTM C31 and ASTM C39.
 - 2. Water-Cement Ratio: 0.48, maximum.
 - 3. Cement Content: 540 pounds per cubic yard, minimum.
 - 4. Coarse Aggregate Size: 3/4 inch(es) and smaller.
 - 5. Slump Range: 3 inches to 5 inches.
 - 6. Air Entrainment: Between 3 and 6 percent by volume. Use 4 percent minimum for concrete placed under requirements of cold weather concreting.
 - 7. Water Reducers: Use in concrete without plasticizers.
 - 8. Superplasticizers: Use for structures.
- E. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Nonagitating equipment is not allowed.

2.02 REINFORCING STEEL

- A. Deformed Bars: ASTM A615, Grade 60.
- B. Welded Wire Fabric: ASTM A497.

2.03 ANCILLARY MATERIALS

- A. Expansion Joint Filler: ASTM D994, 1/2-inch thick, or as shown.
- B. Nonshrink Grout:
 - 1. Color: To match concrete.

2. Manufacturers and Products:
 - a. Master Builder Co., Cleveland, OH; Master Flow 928.
 - b. Euclid Chemical Co., Cleveland, OH; Hi-flow Grout.
- C. Clear Floor Hardener (Surface-Applied): Colorless, aqueous solution of zinc and magnesium fluosilicate with a minimum 2 pounds of crystals per gallon.
 1. Manufacturers:
 - a. Master Builders, Co., Cleveland, OH.
 - b. Tamms Industries, Inc., Kirkland, IL.
 - c. Sonneborn, Minneapolis, MN.

PART 3 - EXECUTION

3.01 FORMWORK

- A. Form Materials:
 1. Use hard plastic finished plywood for exposed areas, and new shiplap or plywood for unexposed areas.
 2. Earth cuts may be used for forming footings.
- B. Form Ties:
 1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.
 2. Ties shall withstand pressures and limit deflection of forms to acceptable limits.
 3. Wire ties are not acceptable.
- C. Construction:
 1. In accordance with ACI 347.
 2. Make joints tight to prevent escape of mortar and to avoid formation of fins.
 3. Brace as required to prevent distortion during concrete placement.
 4. On exposed surfaces locate form ties in uniform pattern or as shown.
 5. Construct so ties remain embedded in the wall with no metal within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

D. Form Removal:

1. Remove after concrete has attained 28-day strength, or approval is obtained in writing from ENGINEER.
2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. Splices and Laps:

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
2. Horizontal wall bars are considered top bars.
3. Lap top bars 42 diameters or minimum 24 inches.
4. Lap all other bars 30 diameters or minimum 18 inches.
5. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.

C. Before depositing new concrete on old concrete, clean surface using sandblast or bushhammer or other mechanical means to obtain a 1/4-inch rough profile, and pour a cement-sand grout to minimum depth of 1/2 inch over surface. Proportion 1 part cement to 2.5 parts sand by weight.

D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1-1/2 hours after adding cement to mix.

E. Eight feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

3.04 COMPACTION

A. Vibrate concrete as follows:

1. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.
2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
3. Vibrate until concrete becomes uniformly plastic.
4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.05 CONSTRUCTION JOINTS

A. Locate as shown or as approved.

B. Maximum Spacing between Construction Joints: 40 feet.

3.06 FINISHING

A. Floor Slabs and Tops of Walls:

1. Screed surfaces to true level planes.
2. After initial water has been absorbed, float with wood float and trowel with steel trowel to smooth finish free from trowel marks.
3. Do not absorb wet spots with neat cement.

B. Unexposed Slab Surfaces: Screed to true surface, bull float with wood float, and wood trowel to seal surface.

C. Tolerances: Floors shall not vary from level or true plane more than 1/4 inch in 10 feet when measured with a straightedge.

D. Exterior Slabs and Sidewalks:

1. Bull float with wood float, wood trowel, and lightly trowel with steel trowel.
2. Finish with broom to obtain nonskid surface.
3. Finish exposed edges with steel edging tool.
4. Mark walks transversely at 5-foot intervals, or in pattern shown on Drawings, with jointing tool.

3.07 FINISHING AND PATCHING FORMED SURFACES

- A. Cut out honeycombed and defective areas.
- B. Cut edges perpendicular to surface at least 1 inch deep. Do not feather edges. Soak area with water for 24 hours.
- C. Patch with shotcrete or low-pressure mortar as specified in Section 03720, Vertical and Overhead Concrete Surface Repair Systems.
- D. Finish surfaces to match adjacent concrete.
- E. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.
- F. Fill form tie holes with nonshrink grout.

3.08 PROTECTION AND CURING

- A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
- B. Keep concrete slabs continuously wet for a 7-day period. Intermittent wetting is not acceptable.
- C. Use curing compound only where approved by ENGINEER. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.
- D. Remove and replace concrete damaged by freezing.

3.09 FLOOR HARDENER

- A. Use where noted or scheduled.
- B. Follow manufacturer's application instructions.

3.10 FIELD TESTS

- A. Evaluation of Concrete Field Strength: In accordance with ACI 318/318R.

-END OF SECTION-

SECTION 03315

GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials for grout in accordance with the provisions of this Section and shall form, mix place, cure, repair, finish, and do all other Work as required to produce finished grout, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03300 - Cast in Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as specified in Section 03300 entitled "Cast in Place Concrete," and as referred to herein.
- B. Additional Commercial Standards
 - 1. CRD C 621 Corps of Engineers Specification for Nonshrink Grout

1.04 SUBMITTALS

- A. The Contractor shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

PART 2 – PRODUCTS

2.01 PREPACKAGED NON-SHRINK CEMENTITIOUS GROUT

- A. Nonshrink grout shall be a prepackaged, inorganic, non-gas liberating, nonmetallic, cement-based grout requiring only the addition of water. 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 nonshrink grout specified herein shall be that recommended by the manufacturer for the particular application.
- B. Nonshrink grouts shall have a minimum 28 day compressive strength of 5000 psi (ASTM C109, restrained), 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, 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.

- C. Cement based grout shall be Five Star Grout as manufactured by Five Star Products, Inc., Fairfield, Connecticut, or equal.
- D. Cementitious non-shrink grout shall be used at locations where there are no dynamic loads, the grout will not come in contact with wastewater or wastewater gases, and where non-shrink grout is identified on the Drawings. Applications include, but are not limited to, structural steel column base plates, gate frames and guides, and precast concrete to cast-in-place concrete joints.

2.02 PREPACKAGED NON-SHRINK EPOXY GROUT

- A. Epoxy-based non-shrink grout shall be a three component, 100 percent solids, solvent-free system designed for machinery grouting. Applications include, but are not limited to, anchoring, pump and motor bases, and any other equipment imparting dynamic loads to the support system.
- B. When non-shrink grout is identified on the Drawings in submerged (water or wastewater) or under wastewater gas environment, epoxy-based non-shrink grouts shall be used.
- C. The epoxy grout shall be delivered to site as prepackaged, three-component systems composing of the resin, hardener, and specially blended aggregates. The components shall be stored as recommended by the manufacturer until use.
- D. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Fairfield, Connecticut, or equal.

2.03 CEMENT GROUT

- A. Cement grout shall be composed of Portland cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland cement shall be mixed with Portland cement as required to match color of adjacent concrete.
- B. The minimum compressive strength at 28 days shall be 4000 psi.
- C. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
- D. Sand shall conform to the requirements of ASTM C144.

2.04 DOWEL/ANCHOR BOLT ADHESIVE SYSTEM

- A. When rebar or anchor bolts are specified to be drilled in and grouted on the Drawings, an adhesive system specified in Section 03200 entitled "Concrete Reinforcement" shall be used for dowels and an adhesive system specified in Section 05050 entitled "Metal Fastening" shall be used for anchor bolts.

2.05 CURING MATERIALS

- A. Curing materials shall be as recommended by the manufacturer.

2.06 CONSISTENCY

- A. The consistency of grouts shall be that 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 called for in the Contract Documents, it shall mean a grout of the above described consistency; the type of grout to be used shall be as specified herein for the particular application.

2.07 MEASUREMENT OF INGREDIENTS

- A. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 – EXECUTION

3.01 GENERAL

- A. All curing, and protection of cement grout shall be as specified in Section 03370 entitled "Concrete Curing" (Methods 1 and 2); or as recommended by manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

3.02 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 03350
CONCRETE FINISHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 03400 - Precast Concrete, General
- D. Section 03315 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 -Specifications for Structural Concrete for Buildings
 - 2. ACI 318 - Building Code Requirements for Reinforced Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 entitled "Submittals".
 - 1. Manufacturer's literature on all products specified herein.

PART 2 – PRODUCTS

2.01 CONCRETE FLOOR SEALER

- A. Floor sealer shall be Diamond Clear VOX or Super Diamond VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

- A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant,

non-yellowing silicate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is silicate. Acceptable products are Diamond Hard by the Euclid Chemical Company, Seal Hard by L&M Construction Chemicals and MasterKure HD 210 by BASF Master Builder Solutions.

2.03 NON-METALLIC FLOOR HARDENER

- A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. Acceptable products shall be "Surflex" by the Euclid Chemical Company, "Harcol" by Sonneborn, "Maximent" by BASF, and "Mastercon" by BASF.

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

- A. Non-oxidizing heavy-duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or Masterplate by BASF Construction Chemicals.

2.05 NON-SLIP FLOORING ADDITIVE

- A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be Frictex NS by BASF Construction Chemicals, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

PART 3 – EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

- A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.05 of this Section entitled "Concrete Finish Schedule". Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.
 - 1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than 1/4-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than 1/4-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three

parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been pre-dampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.
3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

- A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 of this Section entitled "Concrete Finish Schedule". The Engineer shall be the sole judge of acceptability of all such finish work.
 1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2-inch minimum deep grooves prior to final set.
 2. Type "B" - Wood Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood float until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and other irregularities.
 3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.
5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.
6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03315 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations of the equipment manufacturer.
7. Type "G" - Hardened Finish: This finish shall be applied after completion of a Type "B" or Type "C" finish and prior to application of a Type "D" finish. Hardeners shall be applied in strict accordance with the manufacturer's requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising of 2/3 of the total amount. Type "D" finish shall be applied following completion of application of hardener.
 - a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft².
 - b. Non-oxidizing heavy-duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft².
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.
9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of +/-1/4 inch.

3.03 CONCRETE SEALERS

- A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.
- B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer’s requirements.
- C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.
- D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.
- E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

- A. Formed surfaces of equipment pads shall receive a Type III finish.
- B. Top surfaces of equipment pads, except those surfaces subsequently required to receive non-shrink grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Concrete surfaces indicated to receive textured coating	I
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 3 feet below water surface to bottom of wall	I*
From top of wall to 3 feet below water surface	II*
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
All interior exposed concrete vertical surfaces in buildings	III
Interior exposed ceiling, including beams	III

Item	Type of Finish
Floors of process equipment tanks or basins, and slabs to receive roofing material or waterproof membranes	B
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	D
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Floors to receive tile, resilient flooring, or carpeting	D
Concrete in flow channels	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Floors of process equipment tanks indicated on Drawings to receive grout topping	F
Garage and storage area floors	G
Precast concrete form panels, hollow core planks, double tees	J

** Finish shall be acceptable to the coating applicator and manufacturer. See Section 09900 entitled "Painting"*

- END OF SECTION -

SECTION 03370
CONCRETE CURING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall protect all freshly deposited concrete from premature drying and excessively hot or cold temperatures, and maintain with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Framework
B. Section 03300 - Cast-in-Place Concrete
C. Section 03315 - Grout
D. Section 03350 - Concrete Finishes

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the Section entitled "Submittals", the contractor shall submit the following:
1. Proposed procedures for protection of concrete under wet weather placement conditions.
 2. Proposed normal procedures for protection and curing of concrete.
 3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
 4. Proposed method of measuring concrete surface temperature changes.
 5. Manufacturer's literature and material certification for proposed curing compounds.

1.04 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
1. ACI 301 Specifications for Structural Concrete for buildings
 2. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete

3. ACI 305 Hot Weather Concreting
4. ACI 306 Cold Weather Concreting
5. ACI 308 Standard Practice for Curing Concrete
6. ASTM C171 Specifications for Sheet Materials for Curing Concrete
7. ASTM C309 Specification for Liquid Membrane - Forming Compounds for Curing Concrete
8. ASTM C1315 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.05 QUALITY ASSURANCE

- A. Curing compound shall not be used on any surface where concrete, coatings, or other material will be bonded unless the manufacturer certifies that the curing compound will not prevent bond or indicates measures to be taken to completely remove the curing compound from areas to receive bonded applications, and specifically approved by the Engineer.
- B. Care shall be taken to ensure that curing compounds are compatible with all finish concrete castings.
- C. Curing compounds shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

PART 2 – PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

- A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m² when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, MasteKure CC 300 SB by BASF Master Builder Solutions, and Cure & Seal 30 Plus by Symons Corporation.
- B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

- A. Evaporation reducer shall be BASF, "MasterKure ER 50", or Euclid Chemical "Euco-Bar".

2.03 BURLAP MATS

- A. Burlap mats shall conform to AASHTO M-182.

PART 3 – EXECUTION

3.01 PROTECTION AND CURING

- A. All freshly placed concrete work shall be protected from the elements, flowing water and from defacement of any nature during construction operations.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 7-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.
- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.
- D. After placing and finishing, use one or more of the following methods to preserve moisture in concrete:
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150 degrees Fahrenheit).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the Engineer, application of a curing compound in accordance with Article 3.05. Apply the compound in accordance with the manufacturer's recommendation on after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.
- E. Keep absorbent forms wet until they are removed. After form removal, cure concrete by one of the methods in paragraph D.
- F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

- A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Article 3.02 herein. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.

- B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.
- C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.
- D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

- A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.
- B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.
- C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.
- D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least four (4) additional days using one of the methods listed in paragraph 3.01D.
- E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

- A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall not be used on surfaces to receive subsequent coatings. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

- B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.
- C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 300 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

- A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:
 - 1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.
 - 2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

- END OF SECTION -

SECTION 03400
PRECAST CONCRETE, GENERAL

PART 1 – GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 – Concrete Reinforcement
- B. Section 03300 – Cast-in-Place Concrete
- C. Section 03350 – Concrete Finishes
- D. Section 03370 – Concrete Curing
- E. Section 03315 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.
 - 1. Florida Building Code
 - 2. ACI 318-Building Code Requirements for Reinforced Concrete
 - 3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
 - 4. PCI Design Handbook

1.04 SUBMITTALS

- A. The Contractor shall submit the following for review in accordance with Section 01300 entitled "Submittals".
 - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.
 - 2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the State of Florida.
4. Certified reports for all lifting inserts, indicating allowable design loads.
5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

- A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, checks, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the City.
- B. Manufacturer qualifications:
 1. The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double T members, etc.
 2. In lieu of such certification, the manufacturer shall, at his expense, meet the following requirements:
 - a. Retain independent testing or consulting firm approved by the architect/engineer and/or City.
 - b. The basis of inspection shall be the Prestressed Concrete Institute Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products, MNL-116.
 - c. This firm shall inspect the precast plant at two-week intervals during production and issue a report, certified by a registered engineer verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and MNL-116. If the report indicates to the contrary, the engineer, at the precaster's expense, will inspect and may reject any or all products produced during the period of non-compliance with the above requirements.
- C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five (5) years' experience in precast concrete work.

PART 2 – PRODUCTS

2.01 CONCRETE

- A. Concrete materials including Portland cement, aggregates, water, and admixtures shall conform to Section 03300 entitled "Cast-in-Place Concrete".
- B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi.
- C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4,000 psi unless otherwise specified.

2.02 GROUT

- A. Grout for joints between panels shall be a non-shrink, non-metallic grout in conformance with Section 03315 entitled "Grout".
- B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

- A. Reinforcing steel used for precast concrete construction shall conform to Section 03200 entitled "Concrete Reinforcement".

2.04 PRESTRESSING STRANDS

- A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K.

2.05 STEEL INSERTS

- A. Steel inserts shall be in accordance with Section 05500 entitled "Metal Fabrications".
- B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05035 entitled "Galvanizing".

2.06 WELDING

- A. Welding shall conform to Section 05500 entitled "Metal Fabrications".

2.07 BEARING PADS

- A. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 – EXECUTION

3.01 FABRICATION AND CASTING

- A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.
- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.
- D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- E. Concrete shall be finished in accordance with Section 03350 entitled "Concrete Finishes". All recesses due to cut tendons shall be grouted.
- F. Curing of precast members shall be in accordance with Section 03370 entitled "Concrete Curing".
- G. The manufacturer shall provide lifting inserts.

3.02 HANDLING, TRANSPORTING AND STORING

- A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28-day compressive strength and a period of at least five (5) days has elapsed since casting, unless otherwise permitted by the Engineer.
- B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.
- C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.
- D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.
- E. Precast concrete members shall not be used as storage areas for other materials or equipment.
- F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

- A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools and materials required for proper execution of the work.
- B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.
- C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.
- D. Connections which require welding shall be properly made in accordance with Section 05050 entitled "Metal Fastening".
- E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.
- F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).
- G. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.
- H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

- END OF SECTION -

SECTION 03480

PRECAST CONCRETE MANHOLES, HANDHOLES AND VAULTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03400 – Precast Concrete, General

1.03 QUALITY CONTROL

- A. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code (FBC) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this section:

- 1. ASTM C478 Specification for Precast Reinforced Concrete Manhole Sections.
- 2. ACI 318 Building Code Requirements for Reinforced Concrete.

1.04 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Specification Section 01300 – Submittals.
- B. In addition to the items listed in Section 03400 – Precast Concrete, General, Shop Drawings shall include, but not be limited to:
 - 1. Piping and conduit sheets
 - 2. Complete layout and installation Drawings and schedules with clearly marked dimensions.

PART 2 – PRODUCTS

2.01 PRECAST CONCRETE MANHOLES, VAULTS, AND METER BOXES

- A. Precast concrete manholes, vaults, and meter boxes, shall conform to ASTM C478 except as modified herein, and shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Reinforcement, if shown, shall be as shown on the Drawings. Tapered top sections shall be supplied where they are shown on the drawings, or where they are otherwise indicated to be necessary.

1. The design and manufacture of the sections shall be based on H-20 traffic loading.
2. Reinforcement shall conform to the requirements of the Section 03200 entitled "Concrete Reinforcement".
3. Minimum wall thickness shall be eight inches.
4. Cement shall be ASTM C150, Type II.
5. The date and name of manufacturer shall be marked inside each precast section.
6. Joints between manhole riser sections and at base slabs shall be groove type. Joints shall be sealed with two (2) individual self-sealing butyl rubber gaskets conforming to Federal Specification No. SS-5-00210. The gasket material shall be Kent Seal.

2.02 PIPE CONNECTIONS

- A. The precast reinforced concrete manhole base shall be provided with circular openings at the locations and elevations for the proper connection of all pipes. The pipe connections shall be sealed with either a flexible manhole seal assembly or with mortar.
- B. When a flexible manhole seal assembly is used to seal the pipe connection, the seal assembly shall be installed in accordance with the recommendations of the seal assembly manufacturer and shall conform to ASTM C923.
- C. Flexible manhole seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.
- D. The flexible manhole seal assembly shall be manufactured by Interpace Corp (Lock Joint Flexible Manhole Sleeve), National Pollution Control Systems, Inc. (Kor-N-Seal) or Press-Seal Gasket Corp. Manhole seal assemblies produced by other manufacturers will be considered for use by Engineer if submitted by the Contractor. Such manhole seal assemblies shall be acceptable only if the Shop Drawings are approved.
- E. Short lengths of sewer pipe shall be installed entering and leaving the precast manhole base. These short lengths of pipe shall have a maximum length of 3'3". A concrete cradle shall be placed under the short length of pipe in accordance with the dimensions shown on the Drawings.
- F. The concrete cradle is not necessary when a flexible manhole seal assembly is used.

2.03 MANHOLE LADDERS

- A. Manhole ladders shall conform to Section 06610, Glass Fiber and Resin Fabrications.

2.04 SITE-CAST ITEMS

- A. Where removable concrete slabs are required by the drawings, they shall conform to the requirements set forth in Section 03300 entitled "Cast-in-Place Concrete." All thicknesses, reinforcing, and edge clearances shall be as shown on the drawings.

2.05 MORTAR

- A. Mortar used between the sections of precast concrete manholes and vaults shall be as recommended by the section manufacturer, subject to the requirements of Division 4.

2.06 NON-SHRINK GROUT

- A. Non-shrink grout shall be as specified in Section 03315 entitled "Grout".

PART 3 – EXECUTION

3.01 MANUFACTURED ITEMS

A. Precast Concrete Manhole Sections

- 1. Precast concrete manhole sections shall be set so as to be vertical, with sections in true alignment. The joint of the previously set section shall be covered with mortar and preformed joint sealant before the next section is placed. Before the mortar is set, joints shall be pointed, and exterior joints shall be thoroughly tooled so as to be slightly concave with a hard-polished surface, free of cracks. Interior joints shall be tooled flush in a similar manner.

B. Miscellaneous Precast Vaults

- 1. All pull boxes, electrical manholes, vaults, meter boxes and other miscellaneous precast concrete boxes shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the drawings.

3.02 SITE CAST ITEMS

- A. Where removable concrete slabs are required by the drawings, they shall be fabricated in accordance with Section 03300 entitled "Cast-in-Place Concrete".
- B. Sealant, as specified in the Section 07920 entitled "Sealants and Caulking" shall be provided all around the panels.

- END OF SECTION -

SECTION 04220

CONCRETE BLOCK MASONRY

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall construct all concrete masonry Work for the project, complete, including furnishing, fabricating, and placing of required reinforcing steel and the furnishing and setting of embedded items and all other appurtenant work, all in accordance with the requirements of the Contract Documents. The Contractor is responsible for coordinating the Work of this section with that of other trades.
- B. All concrete block masonry that contains empty cells after installation shall be provided with a foamed-in-place insulation specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03300 - Cast in Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of the Florida Building Code (FBC) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
- B. Products and their installation shall be in accordance with the following trade standards, as applicable:
 - 1. Masonry Design Manual (MDM) shall mean the Masonry Design Manual published by the Masonry Industry Advancement Committee.
 - 2. Manufacturer's published recommendations and specifications.
 - 3. Federal Specifications (FS) as reference herein.
 - 4. American Society for Testing and Materials (ASTM) Specifications, as referenced herein.
 - 5. "Specifications for the Design and Construction of Load Bearing Concrete Masonry" published by the National Concrete Masonry Assoc., P.O. Box 9185, Rosslyn Station, Arlington, VA.
 - 6. "Building Code Requirements for Concrete Masonry Structures" (ACI 530/ASCE 5).
 - 7. "Specifications for Masonry Structures" (ACI 530.1/ASCE 6).

1.04 CONTRACTOR SUBMITTALS

- A. If requested, samples of concrete masonry unit (CMU) color ranges for each texture, as specified under products, shall be submitted to the Engineer for selection of color. Full size samples of the blocks selected shall be submitted for final review by the Engineer after color selection.
- B. Submit compressive test reports of concrete block units satisfying the design strength requirements noted on the drawings and a notarized affidavit that the block units conform to the requirements of this Section.
- C. Samples of mortar colors shall be submitted for color selection by the Engineer.
- D. Submit manufacturer's product data and installer's detailed descriptive plans for installing the foamed-in-place wall insulation. The insulation shall be installed by installers certified by the manufacturer. Submit manufacturer certification of the installer contracted to perform the work.
- E. Manufacturer's literature indicating mortar strength and composition.
- F. Submit shop drawings for precast concrete lintels.
- G. Mortar mix and water repellent admixture.
- H. Reinforcements.
- I. Ties.
- J. Control joint filler (with manufacturer's literature).
- K. Grout mix design - Quantities listed in the mix design shall be listed both by weight and by bulk volume for each component.
- L. Accessories.
- M. The Contractor through the manufacturer of the concrete masonry units shall furnish certificates, in triplicate, prior to delivery of any units to the jobsite. Each certificate shall be signed by an authorized officer of the manufacturing company and shall contain the name and address of the Contractor, the project location, the quantities, and date or dates of shipment and delivery to which the certificate applies. Units shall be certified for conformance with these Specifications.
- N. Cold and/or hot weather construction procedures in accordance with ACI 530.1/ASCE 6 sections 2.3.2.2. and 2.3.2.3.
- O. Cleaning procedures and cleaner for each masonry type.
- P. Shop Drawings, Reinforced Unit Masonry: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Shop drawings shall comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Shop drawings shall include bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcing for unit masonry work.

1.05 QUALITY ASSURANCE

- A. Before any masonry is laid, a sample panel shall be constructed for approval by the Engineer. The sample panel shall be 6 feet wide by 4 feet high, showing the CMU face, reinforcement, grouting, and type, color and tooling of mortar and bond. The approved wall sample panel shall remain in place for the duration of all masonry work, to serve as the standard of reference for all masonry. The sample panel shall be removed by the Contractor at the completion of the project.
- B. The City reserves the right to test materials for compliance with these specifications. Sampling and testing will be done in accordance with ASTM standards by an independent testing agency employed by the City. Materials that fail to meet requirements are considered defective. Subsequent tests to establish compliance (of the same or new materials) shall be paid for by the Contractor.
 - 1. Mortar testing shall be performed in accordance with ASTM C 109.
 - 2. Masonry grout testing shall be performed in accordance with ASTM C 1019.

1.06 SHIPPING, HANDLING, AND STORAGE

- A. All mortar materials shall be delivered, stored, and handled so as to prevent damage, deterioration, or contamination. All materials shall be stored under cover in a dry place and in the original packaging.
- B. All concrete masonry units shall be stored under cover, in a dry place and in a manner to prevent damage, breakage, or staining. Blocks shall be delivered to the site dry, in conformance with the specification limitation for moisture content, and kept dry by storing off the ground and under cover. Blocks which have become wet shall be removed from the site by the Contractor.
- C. All accessories shall be delivered to the site and stored in the manufacturers' original packaging. All materials shall be stored above ground and under weathertight cover.

PART 2 – PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. General
 - 1. All concrete masonry units shall be load bearing blocks conforming to ASTM C 90. Units shall be normal weight units unless shown or specified otherwise. Block shall be smooth finish block. Net area compressive strength of concrete masonry units shall be a minimum of 1,900 psi when tested in accordance with ASTM C 140. Compressive strength F'm shall be minimum of 1500 psi in accordance with ACI 530.1 when these units are tested with the mortar specified, unless otherwise indicated on the structural drawings. Reinforced wall units shall be 2 cell end blocks with cells aligned vertically when constructed.
 - 2. All units shall be obtained from one manufacturer to ensure even color and texture throughout.

3. Nominal face dimensions shall be 8-inch by 8-inch by 16-inch, 12-inch by 8-inch by 16-inch, or "U" shaped CMU as indicated on the Drawings.
4. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped nonstructural blocks may be constructed by sawcutting. Color and texture shall match that of the adjacent units.

B. Sound Absorptive Concrete Masonry Units

1. Sound absorptive concrete masonry units shall be used to construct walls or partitions as indicated on the Drawings.
2. Sound absorptive concrete masonry units shall be Soundblox made on standard block machines using molds furnished by the Proudfoot Company, Inc., Greenwich, Connecticut; or equal. Units shall meet the requirements of ASTM C 90.
3. Soundblox units shall be 8-inch by 8-inch by 16-inch (nominal), and Type RSC as shown on the Drawings.
4. The filler elements shall be installed at the block plant and be fabricated of noncombustible fibrous material. The fillers shall have metal septa laminated to one side of the fibrous material and shall be installed with the septa facing away from the slots. The filler and the septa shall be cut accurately to size, and installed as recommended.

- C. Fire-Rated Units: Masonry units for fire-rated walls shall comply with the requirements of Paragraph 2.01, A above and Underwriter's Laboratory requirements for fire rating as shown on the Drawings.

2.02 MORTAR AND GROUT

- A. Mortar shall be Type "M" mortar with average compressive strength at 28 days of 2,500 psi; in accordance with ASTM C 270.
- B. The mortar shall be dry mixed to laboratory established proportions with only as much water added as required to produce a workable mix.
- C. Hydrated lime shall conform to the requirements of ASTM C 207, Type "S", domestic manufactured.
- D. Sand shall be clean, durable particles, free from injurious amounts of organic matter. The sand shall conform to the requirements of ASTM C 144.
- E. Water shall be from a potable source, suitable for domestic consumption.
- F. Admixture for the mortar shall be Master Builders "Omicron Mortarproofing"; Sika Chemical Company "Sika Red Label"; or equal. The admixture shall not be detrimental to the bonding of the mortar.
- G. Masonry Grout shall conform to the requirements of ASTM C 476 and ACI 530.1. Grout shall be plant batched peagravel 3000 psi 28-day compressive strength.

- H. Sand for grout shall conform to ASTM C 404 or ASTM C 33, as required.
- I. Admixture for grout shall be Sika Chemical Company "Sika Grout Aid", Type II; Master Builders "Pozzolith", normal; or equal.

2.03 MASONRY ACCESSORIES

- A. The following list of companies manufacture products that are acceptable for this section, subject to conformance with the specified requirements: Dur O Wall Products, A.A. Wire Products; Hohman Barnard, Keystone Steel and Wire Company, or equal.

B. Masonry Joint Reinforcement

1. All masonry joint reinforcement shall be fabricated from cold drawn steel wire, conforming to ASTM A 82.
2. Reinforcement shall consist of two parallel longitudinal deformed wires, not less than 8-gauge, weld connected with cross-wires, not less than 9 gauge, in a triangular pattern. For vertically reinforced walls, cross wires shall be of a rectangular pattern.
3. Out to out spacing of the longitudinal wires shall be 2 inches less than the nominal width of the wall.
4. The distance between the welded contacts of cross wires with each longitudinal wire shall not exceed 16 inches, staggered.
5. Cross wires shall be in the same plane with the longitudinal wires.
6. Reinforcement shall be provided in minimum 10-foot sections. All corners and tees shall be provided prefabricated, of the same materials as the joint reinforcement.
7. Reinforcing bars shall conform to "Specifications for Deformed Billet Steel Bars for Concrete Reinforcement" (ASTM A 615), grade 60, except 1/4" diameter smooth bars which shall be grade 40.

C. Anchor and Ties

1. Anchors and ties shall be hot dip galvanized ferrous metals.
2. Wire mesh ties shall be minimum 16-gauge, 1/2-inch mesh of steel wire. Ties shall be a minimum of 12 inches in length, and 1 inch less in width than the wall in which they are placed.
3. Rigid steel anchors shall be 1 1/2 inch by 1/4 inch with ends turned up 1/4 inch at the outer end.
4. Dovetail anchors shall be minimum 16-gauge, 1 inch wide, and turned up 1/4 inch at the outer end.
5. Corrugated or crimped metal ties shall be made of steel sheet not less than 7/8 inch wide, 22 gauge in thickness, 6 inches in length.

2.04 FOAMED-IN-PLACE MASONRY WALL INSULATION

- A. Insulation shall be a two-component, foamed-in-place thermal insulation comprising of an amino-plast resin and a catalyst foaming agent surfactant that when injected into open cavities of block will flow and completely fill the open cells.
- B. Foamed-in-place insulation shall conform to the requirements of Core-Fill 500 as manufactured by Tailored Chemical Products, Hickory, NC, or approved equal. Tailored Foam of Florida, Inc., Sanford, Florida is an approved applicator of Core-Fill 500 foam insulation.
- C. Insulation shall be non-combustible, Class A building material.
- D. Insulation shall have an R value of 4.9 per inch at 32 degrees Fahrenheit per ASTM C-177.

PART 3 – EXECUTION

3.01 GENERAL

- A. All Work shall be performed in accordance with the provisions of the FBC for concrete hollow unit masonry.
- B. All masonry shall be laid plumb and true to line. Bond shall be maintained such that the horizontal or vertical alignment of the foundation shall not be more than 1 inch out of plumb.
- C. The Contractor shall set or embed in the Work all anchors, bolts, reglets, sleeves, conduits, and other items as required. Where bolts or other items are anchored into the masonry, those cells shall be grouted solid after the embedded items are in place.
- D. No construction support shall be attached to the wall except where specifically permitted by the Engineer.
- E. All masonry slots, chases, or openings required for the proper installation of the Work of other Sections shall be constructed as indicated on the Drawings, or in accordance with information furnished, prior to starting Work in those areas. No chase shall be cut into any constructed hollow unit masonry wall, except as directed or reviewed by the Engineer.
- F. Surfaces shall be brushed as Work progresses, and maintained as clean as is practicable. Unfinished Work shall be raked back where possible, and toothed only where absolutely necessary.
- G. All fresh or unfinished Work shall be fully covered and protected against rain and wind. Before continuing work, all previously laid Work shall be swept clean. The tops of walls or other unfinished Work shall be protected against all damage by means of waterproof paper, tarpaulins, boards, or other means satisfactory to the Engineer.
- H. Anchors and ties shall be placed a minimum of 16 inches vertically and 24 inches horizontally, unless otherwise indicated. Anchors and ties for masonry shall be provided into adjacent concrete walls, columns, or beams at the above specified spacings.

- I. Over plumbing and pounding shall be avoided, at corners and jambs, for fitting stretcher units after they are set in position. Where adjustment must be made after mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.
- J. Concrete brick shall be used to course out walls which are concealed in the finished work.
- K. Masonry units shall be cut straight, and true, using power masonry saws.
- L. Cold and hot weather construction
 - 1. No masonry shall be erected when ambient temperature has dropped below 45⁰ F unless it is rising and at no time when it has dropped below 40⁰ F. Provisions shall be made for heating and drying of materials, and the complete work shall be protected in accordance with ACI 530.1 section 1.8C. Masonry shall not be laid with ice or frost on its surfaces, and no masonry shall be laid on frozen work. Any work which freezes before the mortar has set shall be removed and replaced at the Contractor's own expense. Do not use any admixtures or antifreeze in the mortar.
 - 2. When temperature is above 100⁰ F or 90⁰ F with a wind velocity greater than 8 MPH, mortar beds shall be spread no more than 4 feet ahead of masonry and masonry shall be set within one minute of spreading mortar.

3.02 LAYOUTS

- A. The Contractor shall lay out the coursing horizontally and vertically, as shown on the Drawings.
- B. Block cuts less than 4 inches wide shall be avoided.
- C. Vertical coursing shall be 8 inches, with 3/8-inch-thick mortar joints.
- D. Bed joints shall be indicated to receive masonry joint reinforcing, ties, and/or anchors.

3.03 REINFORCING

- A. All reinforced horizontal joints shall be reinforced continuously with ends lapped 8 inches, and laps staggered vertically. Horizontal reinforcing shall have a vertical spacing of 16 inches on center unless noted otherwise. Prefabricated corners and tees shall be provided at all horizontal wall intersections.
- B. Reinforcing shall be provided in the bed joints immediately above and below all masonry openings.
- C. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire.
- D. Where knock out openings are indicated on the Drawings, no steel or joint reinforcement shall run continuously through the openings.
- E. Prior to placing metal reinforcing, anchors, and ties, all loose rust, tie wires, tags and all other foreign matter that may reduce bond shall be removed.

- F. Reinforcing shall be placed as indicated on the Drawings and general notes. Place a minimum of two No. 5 bars in each bond beam or lintel, and a minimum of one No. 5 bar at all jambs, corners, intersections and wall ends of concrete blockwalls, whether indicated or not. Lintels shall extend 8 inches past the openings. Lap reinforcing bars 48 diameters or 30 inches minimum at splices. All cells containing reinforcing shall be filled solid with grout.
- G. When a dowel does not line up with a vertical core, it shall not be sloped more than 1 horizontal in 6 vertical. Dowels shall be grouted into a core in vertical alignment, even though they are in adjacent cell to the vertical wall reinforcing.

3.04 BOND AND JOINTS

- A. All masonry units shall be laid in running bond by lapping units in successive courses a distance of one-half unit.
- B. The starting joint of foundations and floor slab shall be laid with full mortar coverage on the bed except that the area where grout occurs shall be kept free from mortar so that the grout will bond (contact) with concrete already placed.
- C. All courses shall be level, with joints of uniform width. Units shall have full mortar coverage of the face shells in both the horizontal and vertical joints. Reinforced cells shall have mortar coverage on cross webs also to prevent grout leakage to adjacent cells.
- D. All joints shall be pointed solid with mortar on both sides and wall of block. Joints in exposed Work shall be finished concave with finishing tool, to create a dense surface. Interior and exterior joints in nonexposed or plaster covered masonry shall be flush.
- E. All sound absorptive concrete masonry units shall be laid in stack bond with the open ends of the cavities facing downward, and shall be seated in a full bed of mortar.
- F. Slots shall be provided to expose the areas where sound absorption is desired, as indicated on the Drawings. Care shall be taken to ensure that the slots are kept free of mortar or debris above mortar joints.

3.05 CONTROL JOINTS

- A. Control joints shall be installed as detailed and where shown on the Drawings or needed.
- B. The maximum horizontal distance between vertical control joints shall be 30 feet, but joints shall be located only as reviewed by the Engineer or as shown.
- C. Joints shall be equal in width to the standard mortar joints.
- D. Horizontal joint reinforcing shall be discontinuous at control joints.

3.06 MORTAR AND GROUT

- A. All equipment used in placing, moving, and storing mortar shall be thoroughly cleaned at the end of each day's work.

- B. Mortar that, in the opinion of the Engineer, has begun to set shall not be used.
- C. All courses shall be laid in full mortar beds. All units shall be laid with mortar applied to the face shells of blocks previously laid, as well as to blocks being laid, to ensure well filled joints.
- D. Where new masonry is joined to existing or partially set work, loose mortar and joints shall first be cleaned. When it is necessary to stop a horizontal run, rack back one-half block length in each course; toothing shall not be permitted.
- E. Hollow metal frames, mullions, and spaces around built in items shall be filled solidly with grout.
- F. Proportioning and Mixing of Mortar
 - 1. Measurement of materials shall be such that the specified proportions are controlled and accurately maintained.
 - 2. Workability of consistency of the mortar on the board shall be sufficiently wet to be worked under the trowel. Water for tempering shall be available on the scaffold at all times. Mortar which has begun to set after initial mixing shall be discarded. Mortar which has stiffened due to evaporation shall be retempered to restore its workability. Retempering the mortar at the mixer shall not be permitted.
 - 3. Mortar shall be machine mixed in a type of mortar mixer which is acceptable to the Engineer, and in which the quantity of water can be accurately and uniformly controlled.
 - 4. The mixing time shall not be less than 5 minutes, approximately 2 minutes of which shall be for mixing the dry materials, and not less than 3 minutes for continuing the mixing after the water has been added.
 - 5. Where hydrated lime is used for mortar requiring a lime content, the Contractor has the option of using the dry mix method or first converting the lime into a putty. Where the dry mix method is employed, the materials for each batch shall be well turned over together until the even color of the mixed, dry materials indicates that the cementitious materials have been thoroughly distributed throughout the mass. After this point, the water shall be gradually added.
- G. Mortar and grout drippings shall be cleaned from exposed masonry and adjacent surfaces immediately, to prevent surfaces from being permanently stained. Drippings and smears shall be removed before mortar and/or grout sets or hardens. Mortar extruded beyond faces of walls or partitions shall be removed.
- H. Grouting
 - 1. Grouting shall not be started until walls have cured a minimum of 24 hours.
 - 2. Reinforcing steel shall be secured in place and inspected before grouting starts. Inform Engineer for inspection.
 - 3. Mortar drippings shall be kept out of the grout space.

4. Vertical cells to be filled shall have vertical alignment to maintain a continuous unobstructed cell area not less than 2 inches by 3 inches.
 5. All cells to be grouted including those with reinforcing shall be solidly filled with grout. Consolidate at time of pouring by puddling (rodding) or vibrating with mechanical vibrators and reconsolidate again after 5 to 10 minutes and no later than 20 minutes to allow water absorption by concrete block.
 6. Grout shall be consolidated by puddling or mechanical vibrating during g placement, and reconsolidated after excess moisture has been absorbed, but before plasticity is lost.
 7. All anchor bolts and other embedded items shall be securely held in place during the grouting operation.
 8. Grouting shall be done in pours no exceeding 10 feet and lifts of a maximum of 5 feet. Provide pre-cut full block height clean out holes at the first course of all cores containing vertical reinforcement. As successive masonry lifts are laid, remove mortar dripping from the grout space and off the reinforcing steel. Prior to grouting and boarding the cleanout opening, remove all leftover mortar drippings and loose materials and flush out the reinforced cell with water. Board up the opening only after Engineer's inspection and approval.
- I. Installation of all masonry accessories shall be in strict accordance with manufacturer's recommendations for the particular product. In the event that no specific installation instructions are provided by the manufacturer, accepted industry standard shall be adhered to.

3.07 INSULATION

- A. Install foamed-in-place insulation in ungrouted cells of masonry units where shown and/or noted on the drawings.
- B. The foamed-in-place insulation shall be pressure injected through a series of 5/8-inch to 7/8-inch holes drilled into every vertical column of block cells beginning at an approximate height of four feet from the finished floor level. Holes shall be patched with mortar and scored to resemble existing surface.
- C. Foamed-in-place insulation shall be placed prior to installation of interior finish work, after all masonry and structural concrete work is in place, and once moisture content of in-place CMU is acceptable to the manufacturer. Installation shall comply with manufacturer's instructions.
- D. Remove excess materials and debris promptly. Remove mortar drippings from masonry and adjacent work before final set.
- E. All holes and openings in the wall through which insulation can escape shall be permanently sealed or caulked prior to installation of the insulation. Copper, galvanized steel, or fiber glass screening shall be used in all weep holes.

3.08 BUILT-IN WORK

- A. Furnish and install all anchor bolts, access doors and frames, and all metal work to be built into masonry which is not specified to be furnished under any other heading of the Specifications.
- B. The masonry Contractor shall thoroughly familiarize himself with all the requirements of the structural steel and reinforced concrete work and specifications, and he must make his own work conform to the requirements therein illustrated or described. He shall build in all the structural steel and miscellaneous iron work of every description.
- C. Thoroughly tie in all anchors and secure masonry work to the concrete work in a careful manner. All pockets and openings must be filled solidly with mortar so as to leave no air space or pockets to collect moisture. No iron work shall be covered or built-in unless thoroughly painted by the Contractor setting it.
- D. The masonry Contractor shall build-in items furnished by others.
- E. The masonry Contractor shall coordinate his work with mechanical and electrical trades in order to accommodate all built-in pipes and conduits.

3.09 LINTELS

- A. Furnish and install precast reinforced concrete lintel at all openings in masonry walls not having poured lintel or tie beam at top. Provide 8" minimum bearing either side of opening. Bottom flange of precast lintels shall be pre-cut at bearing to allow passage of reinforcing and grout.

3.10 CLEANING AND POINTING

- A. All masonry to be left exposed shall be cleaned thoroughly with 5 percent muriatic acid solution using stiff brush and rinse thoroughly with clear water.
- B. Point all holes and chipped areas in exposed masonry. Cut out defective joints and tuck pointed solidly with like mortar.
- C. Remove all loose and excess mortar prior to cleaning.

3.11 PARGING

- A. Parge masonry walls where shown or indicated on the drawings in two uniform coats of mortar. Maintain 3/4-inch total thickness.
- B. Dampen masonry walls prior to application.
- C. Scarify base coat to ensure full bond to subsequent coat.
- D. Steel trowel surface smooth and flat.

- END OF SECTION -

SECTION 15000

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. All piping located outside the face of structures or building foundations and all piping embedded in concrete within a structure or foundation shall be considered exterior piping.
- B. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.
- C. The work shall include, but not be limited to, the following:
 - 1. Connections to existing pipelines.
 - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
 - 3. Installation of all new pipe and materials required for a complete installation.
 - 4. Cleaning, testing and disinfecting as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1 – General Requirements
- B. Division 2 – Sitework
- C. Division 9 – Finishes

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish to the City (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- B. Shop Drawings for major piping (2 inches in diameter and greater) shall be prepared and submitted in accordance with the Section entitled "Submittals." In addition to the requirements of the Section entitled "Submittals," the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.
- C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in the Section entitled "Pipeline Testing and Disinfection".
- C. All buried exterior piping shall have restrained joints for thrust protection unless otherwise specified or shown on the drawings.
- D. The Contractor shall verify existing buried piping tie-in connections before fabricating new piping assemblies. The Contractor shall verify size, type, and location of all existing buried piping and appurtenances by excavating test pits as required of all buried connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 SOLID SLEEVE COUPLINGS

- A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All piping shall be installed by skilled workers and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at their own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work.

- B. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.
- C. All excavation required by this contract shall be unclassified. No additional payment will be made for rock excavation required for the installation of pipe or structures shown on the drawings.
- D. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- E. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.
- F. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately 100 feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.
- G. Joint deflection shall not exceed 75 percent of the manufacturers recommended deflection. Excavation and backfilling shall conform to the requirements of Division 2, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings
- H. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall any of the materials be dropped or dumped into the trench.
- I. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.
- J. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

- K. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at their own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
 - L. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.
 - M. At the close of each work day the end of the pipeline shall be tightly sealed with a cap or plug so that no water, dirt, or other foreign substance may enter the pipeline, and this plug shall be kept in place until pipe laying is resumed.
 - N. During the laying of pipe, each pipe manufacturer shall provide their own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.
 - O. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at maintenance holes and areas where joint deflection is required.
 - P. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each maintenance hole and any adjustments will be coordinated and approved by the Engineer.
 - Q. All piping shall have type "a" bedding as shown on the drawings, unless otherwise specified herein or indicated on the drawings.
- 3.02 REINFORCED CONCRETE PIPE, CONCRETE CULVERT, AND DRAIN PIPE
- A. The laying of reinforced concrete pipe shall conform to the applicable sections of the Concrete Pipe Handbook as published by the American Concrete Pipe Association.
- 3.03 DUCTILE IRON PIPE
- A. Ductile iron pipe (DIP) shall be installed in accordance with the requirements of the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association, and AWWA C600.
 - B. Where it is necessary to cut ductile iron pipe in the field, such cuts shall be made carefully in a neat professional manner using approved methods to produce a clean square cut. The outside of the cut end shall be conditioned for use by filing or grinding a small taper, at an angle of approximately 30 degrees.
 - C. Unless otherwise approved by the Engineer, field welding of ductile iron will not be permitted.

3.04 PVC/CPVC AND HDPE PIPE

- A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High-Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.
- B. Plastic piping shall not be installed when the temperature is less than 60 degrees F except as otherwise recommended by the manufacturer and approved by the Engineer.

3.05 JOINTS IN PIPING

- A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.
- B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed and the condition corrected.
- C. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.
- D. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

- END OF SECTION -

SECTION 15006
DUCTILE IRON PIPE

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install ductile iron pipe and all appurtenant Work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. All applicable sections of the Contract Documents

1.03 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:

AWWA C104 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.

AWWA C110 Ductile-iron and Gray-Iron Fittings.

AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

AWWA C150 Thickness design of ductile iron pipe.

AWWA C151 Ductile-iron Pipe, Centrifugally Cast, For Water.

AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.04 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit Shop Drawings of pipe and fittings in accordance with the requirements set forth in the Sections entitled "Basic Mechanical Requirements" and "Submittals."
- B. Contractor shall submit certification that all materials coming in contact with potable water comply with the requirements of NSF 61.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pipe shall be centrifugally cast in metal molds or sand lined molds in accordance with AWWA C151 of grade 60-42-10 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from three inches up to and including sixty-four inches in diameter. Working pressure shall be as specified herein.

B. Wall Thickness

1. Buried Pipe:
 - a. 30-inch diameter and greater shall be Pressure Class 300.
 - b. 24-inch diameter and smaller shall be Pressure Class 350.
2. Flanged Pipe: Pipe wall thickness of threaded pipe for a flanged pipe end shall be minimum special thickness Class 53 from 4-inch to 54-inch and/or minimum Pressure Class 350 for 60-inch to 64-inch diameter pipe in accordance with AWWA C115.
3. Grooved Pipe: Grooved coupling pipe shall be special thickness Class 54, or greater if required by pipe manufacturer. Pipe groove dimensions shall be for rigid joints unless otherwise indicated on the drawings.

C. Joints

1. Ductile iron pipe above grade shall be flanged.
2. All pipe and fittings below grade shall be restrained joint type.
3. Mechanical and push-on type joints shall be in accordance with AWWA C111.
4. Flanges for flanged pipe shall be in accordance with AWWA C115, shall be ductile iron, shall be rated at 250 psi maximum working pressure, and shall be similar to flange Class 125 per ASME B16.1. Where shown on the Drawings, pipe and fittings shall be furnished with flanges similar to flange Class 250 per ASME B16.1. Fittings shall be provided with flanges having a bolt circle and bolt pattern the same as the adjacent pipe and/or mechanical devices. Joint materials shall be ANSI sized and approved and shall consist of hot dip galvanized carbon steel bolts and nuts and full faced gaskets, unless otherwise specified.
5. No raised face flanges shall be used. The raised faces shall be milled flat.
6. Flange gaskets shall be full face Toruseal gaskets by American Cast Iron Pipe Co., or FLANGE-TYTE gaskets by U.S. Pipe, or equal. Gaskets shall be nominal 1/8" thick SBR rubber.

D. Restrained Joints

1. All ductile iron pipe and fittings below grade shall be restrained joint.
2. Manufactured Proprietary Restrained Joint Piping: Restrained joint pipe shall be as specified in the City of Fort Lauderdale Department of Sustainable Development Engineering Division Shop Drawing Submittals and Approved Utility Product List provided in Appendix B.
3. Restrained Mechanical Joint Fittings: All mechanical joint fittings, valves and appurtenances shall be restrained as described herein. Restrained joint fittings shall be mechanical joint fittings with restraint assemblies such as Stargrip by Star Pipe

Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, or approved equal. Manufacturers and model numbers shall be as specified in the City of Fort Lauderdale Department of Sustainable Development Engineering Division Shop Drawing Submittals and Approved Utility Product List provided in Appendix B. Use of this restraining system shall be approved by the Engineer for each application.

E. Fittings

1. General: Fittings shall be manufactured in accordance with AWWA C110 or the manufacturer's standard. Fittings shall be as specified in the City of Fort Lauderdale Department of Sustainable Development Engineering Division Shop Drawing Submittals and Approved Utility Product List provided in Appendix B.
2. Pressure Rating: 350 psi minimum working pressure for 4- to 24-inch fittings and 250 psi minimum working pressure for 30- to 64-inch fittings.
3. Materials: Fittings shall be ductile iron.
4. Joints - General: Fittings shall be either flanged, mechanical joint or manufactured proprietary restrained joint type as indicated on the Drawings and specified herein.
5. Flanged Joint Fittings: Above ground fittings shall be flanged.
6. Manufacturer Proprietary Restrained Joint Fittings: Unless otherwise indicated on the Drawings or specified herein, all below ground fittings 30 inches in diameter and greater shall be manufacturer proprietary restrained joint type.
7. Mechanical Joint Fittings: Underground ductile iron fittings 24 inches in diameter and less shall be mechanical joint type fittings.

F. Pipe Lining and Coating General: Pipe linings and coatings shall be as follows:

1. Buried Service: The piping manufacturer's standard asphaltic coating shall be applied prior to shipment to the exterior wall of buried pipe and fittings in accordance with AWWA C151.
2. Above Ground Piping and Exposed Piping within Underground Vaults: A coating of rust inhibitive primer, compatible with the coating system specified in the Section entitled "Painting," shall be applied to the pipe exterior prior to shipment for piping that is above ground and exposed piping within vaults. Primer for pipe used for potable water main applications shall be compliant with NSF Standard 61.
3. Cement-Mortar Lining: Pipe and fittings for potable water service shall be cement-lined and seal-coated in accordance with AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
4. Protecto 401 Ceramic Epoxy Lining: The interior of all ductile iron pipe and fittings for wastewater services shall be lined with an epoxy lining. The epoxy lining shall be Protecto 401 Ceramic Epoxy as manufactured by the Protecto Division of Vulcan Painters, Inc, or equal. All pipe and fittings shall be lined with a minimum dry film thickness of 40 mils, except for the gasket groove and spigot end up to six inches

back from the end of the spigot which shall be lined with ten mils of the material. All ductile iron pipe and fittings shall be checked for dry film thickness in accordance with the SSPC-PA2. Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date. The pipe supplier shall furnish a certificate stating that lining applicator has complied with all specification requirements relative to the material, its application and inspection. Surface preparation, number of coats, application of the lining material and field touch-up shall be in strict accordance with the lining material manufacturer's recommendations. During the installation of the pipe, the lining material manufacturer shall provide the services of a field engineer to instruct and demonstrate to the Contractor's personnel, the procedure for the field touch-up of lining where field cuts and taps were required. Holiday inspection shall be conducted using test equipment described in American Water Works Association Standard, AWWA C210, Section 5.3.3.1. In accordance with coating manufacturer's recommendation, holiday testing may be conducted any time after the coating has reached sufficient cure.

5. Polyethylene Encasement: All ductile iron pipe, fittings and valves installed underground shall be encased with polyethylene film in accordance with ANSI Standard A21.5, Method A or B at the Contractor's option. Encasement shall terminate 3-inches to 6-inches above ground where pipe is exposed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading in accordance with Division 2 - Sitework.
- B. Unless otherwise directed, ductile iron pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.
- C. Thrust restrained and mechanical joints shall be made in accordance with the manufacturer's standards except as otherwise specified herein. Joints between mechanical joint pipe and/or fittings shall be made in accordance with AWWA C600, except that deflection at joints shall not exceed one-half of the manufacturer's recommended allowable deflection, or one-half of the allowable deflection specified in AWWA C600, whichever is the lesser amount.
- D. Before laying thrust restrained and mechanical joint pipe and fittings, all lumps, blisters and excess bituminous coating shall be removed from the bell and spigot ends. The outside of each spigot and the inside of each bell shall be wire brushed, and wiped clean and dry. The entire gasket groove area shall be free of bumps or any foreign matter which might displace the gasket. The cleaned spigot and gasket shall not be allowed to touch the trench walls or trench bottom at any time. Vegetable soap lubricant shall be applied in accordance with the pipe manufacturer's recommendations, to aid in making the joint. The Contractor shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Deflections shall only be made after the joint has been assembled.

- E. Prior to making up flanged joints in ductile iron pipe and fittings, the back of each flange under the bolt heads and the face of each flange shall have all lumps, blisters and excess bituminous coating removed and shall be wire brushed and wiped clean and dry. Flange faces shall be kept clean and dry when making up the joint, and the Contractor shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Bolts and nuts shall be tightened by opposites in order to keep flange faces square with each other, and to ensure that bolt stresses are evenly distributed.
- F. Bolts and nuts in thrust restrained, mechanical and flanged joints shall be tightened in accordance with the recommendations of the pipe manufacturer for a leak-free joint. The mechanics shall exercise caution to prevent overstress. Torque wrenches shall be used until, in the opinion of the Engineer, the mechanics have become accustomed to the proper amount of pressure to apply on standard wrenches.
- G. Cutting of the ductile iron pipe for inserting valves, fittings, etc., shall be done by the Contractor in a neat and professional manner without damage to the pipe, the lining, or the coating. Pipe 16 inches and larger in diameter shall be cut with a mechanical pipe saw. After cutting the pipe, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.
- H. Areas of loose or damaged lining associated with field cutting shall be repaired or replaced as recommended by the pipe manufacturer and required by the Engineer. Repair methods shall be as recommended by the manufacturer and shall be submitted to the Engineer for review.
- I. Any work within the pipe shall be performed with care to prevent damage to the lining. No cable, lifting arms or other devices shall be inserted into the pipe. All lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe barrel.
- J. Homing the pipe shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise accepted by the Engineer. No pipe shall be driven or struck in order to seat it home.
- K. Cleaning: Cleaning methods shall be acceptable to the Engineer, and must be sufficient to remove silt, rocks, or other debris which may have entered the pipeline during its installation and shall also follow the requirements of the Section entitled "Pipeline Testing and Disinfection."

- END OF SECTION -

SECTION 15007

PVC C900 PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install 4-inch to 48-inch polyvinyl chloride (PVC) pressure pipeline, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

All applicable sections of the Contract Documents

1.03 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
ANSI/AWWA C110/A21	Ductile Iron and Gray Iron Fittings 3-inch through 48-inch for Water and other Liquids
ANSI/AWWA C111/A2	Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
ANSI/AWWA C600	Installation of Ductile Iron Water Mains and Appurtenances
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe for Water
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins
PPI Technical Report	Policies and Procedures for Developing
TR ¾	Recommended Hydrostatic Design Stresses for Thermoplastic
AWWA Manual M23	PVC Pipe – Design and Installation

1.04 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit Shop Drawings of pipe and fittings and appurtenances in accordance with the requirements in the Section entitled “Submittals”.
- B. Certifications
- The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards.

2. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.

1.05 QUALITY ASSURANCE

- A. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this Section of the Specifications, as specified in the referenced standards, as applicable.
- B. In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the City. The additional samples shall be furnished at no additional cost to the City.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Approved PVC pipe manufacturers are:
 1. Diamond Plastic
 2. Freedom Plastic
 3. Griffico
 4. JM Eagle
 5. IPEX
 6. National
 7. Napco
 8. Or Equal
- B. PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 and subject to additional requirements specified herein.

2.02 PIPE

- A. The pipe shall be of the diameter and pressure class specified or shown, shall be furnished complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA.
- B. Unless otherwise provided in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the Engineer, the additive and filter content shall be determined using the prolysis method as specified in ASTM D 2584.

- C. Joints: All joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors. Where required, restrained joint retainer glands shall be used and shall be cast from 60-42-10 ductile iron and shall have a sufficient number of ductile tie bolts to restrain working and test pressures as required. The retainer clamp shall be of two-piece construction with serrations on the I.D. sufficient to hold the required pressures with a safety factor of 2:1. The retainers shall be Series 1500 or 6500 as manufactured by EBAA, Iron, Inc.
- D. Joint Deflection: Deflection at the joint shall not exceed 1.5 degrees or one half the maximum deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints which are overbelled or not belled to the stop mark.

2.03 FITTINGS

- A. Fittings in the pipe shall be ductile iron and shall conform to the requirements of AWWA C110, Class 250. PVC pipe fittings shall be restrained joint.
- B. All fittings shall be lined and coated in accordance with the requirements of Section entitled "Ductile Iron Pipe" and "Piping, General".
- C. Each fitting shall be clearly labeled to identify its size and pressure class.
- D. Mechanical joint restraint shall be incorporated in the design of the follower gland. The restraint mechanism shall consist of a plurality of individually activated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell conforming to ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153 of latest revision. Twist-off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of restraining devices. The restraining glands shall have a pressure rating equal to that of the PVC pipe on which it is used and shall be Megalug Series 2000 PV or 2000SV as manufactured by EBAA, Iron Inc., or equal.

PART 3 – EXECUTION

3.01 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to acceptance by the Engineer. All material found during the progress to have defects will be rejected and the Contractor shall promptly remove such defective materials from the site of the work.
- B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.02 HANDLING AND STORAGE

A. Handling

1. Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

B. Storage

1. Pipe should be stored, if possible, at the job site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to bell ends of pipe. Pipe should be stored in such a way as to prevent sagging or bending and protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, in the original packaging.

3.03 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Division 2 and as specified herein.

3.04 INSTALLATION

- A. Bell and spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.
- B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints and couplings. Anchors and supports shall be provided where necessary and where indicated on the Drawings for fastening work into place. Fittings shall be independently supported.
- C. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.
- D. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

- E. Pipe shall be cut by means of saws, power driven abrasive wheels or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander or abrasive disc.

3.05 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection of water mains shall conform to the requirements of Section entitled "Pipeline Testing and Disinfection".

3.06 TRACER WIRE

- A. All non-ferrous pipe (PVC AND HDPE) shall be furnished and installed with tracer wire. Special care in handling shall be exercised during delivery, distribution, and storage of tracer wire to avoid damage and unnecessary stresses. Damaged tracer wire will be rejected and shall be replaced at the Contractor's expense. The tracer wire shall have water-blocking characteristics, be corrosive resistant, and have UV protection. The tracer wire shall be copper or copper clad steel with polyethylene insulation and core material of woven polyester and water blocking polyester yarns. The wire shall have an outer jacket of high-density polyethylene. The wire shall be HDD-CCS PE45 as manufactured by Pro Trace; or Soloshot EHS by Copperhead Industries. Manufacturer/distributor furnished water-blocking connectors and locate clip shall be used as needed.

- END OF SECTION -

SECTION 15008

PVC NON-PRESSURE PIPE

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all 6- to 15-inch underground PVC non-pressure pipe for gravity sewer replacement and all appurtenant work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

All applicable sections of the Contract Documents

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM D 1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
ASTM D 2241	Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
ASTM D 2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
ASTM D 3034	Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.04 SUBMITTALS

- A. Samples: The Contractor shall submit to the City for review, samples of all the materials proposed for use on the Work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions. All sample submittals shall conform to the requirements for "Samples" in Section 01300, "Submittals".
- B. Shop Drawings: The Contractor shall submit shop drawings and laying diagrams of all Pipe, joints, bends, special fittings, and piping appurtenances in accordance with Section 01300, "Submittals".
- C. Certificates: The Contractor shall provide manufacturer's certificates for all materials indicating conformance to the Contract Documents.

1.05 QUALITY ASSURANCE

- A. Testing: All materials testing will be based upon applicable ASTM Test Methods and AWWA Standards referenced herein for the materials specified.

- B. Certificates: Manufacturer's notarized certificates of compliance shall be furnished by the Contractor.
- C. The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests, and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.

1.06 CLEANUP

- A. In addition to the requirements of Section 01700, "Project Closeout", the Contractor, upon completion of backfilling and grading over trenches shall remove all excess materials and equipment from the site.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and pressure rating in psi.
- B. The Contractor shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

2.02 PIPE

- A. All PVC pipe shall be joined by compression joints unless otherwise shown or specified in the Piping Schedule, and shall conform to the following requirements:
 - 1. Polyvinylchloride pipe (PVC) shall conform to the requirements of ASTM D 3034, Class SDR 26. Material for PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein.
 - 2. Flexible rubber rings for compression type joints for PVC pipe and fittings shall conform to the requirements of ASTM D 1869.

2.03 FITTINGS

- A. All fittings for PVC pipe shall conform to the requirements of ASTM D 2241. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible with cast-iron or ductile iron pipe fittings.
- B. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

2.04 BEDDING MATERIAL

- A. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements for "Embedment materials" as specified in ASTM D 2321.

PART 3 - EXECUTION

3.01 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the City, and shall be subject to his approval before acceptance. All material found during the progress to have defects will be rejected and the Contractor shall promptly remove such defective materials from the site of the Work.
- B. Installation shall conform to the requirements of ASTM D 2321 and to the supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the requirements of ASTM D 2321 are in conflict, the more stringent provision shall apply.

3.02 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of the Section entitled "Excavation and Backfill for Utilities", and as specified herein.
- B. Unless otherwise specified or shown, the maximum width of trenches shall be as specified in said ASTM D 2321.

3.03 LAYING PIPE

- A. The pipe shall be installed in accordance with the requirements of ASTM D 2321 and as specified herein and shown and the sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for joining, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the Work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of backhoe, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.
- D. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the Work shall be furnished by the Contractor.

- F. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with owners of such utility structures.

3.04 HANDLING

- A. Handling of the PVC pipe shall be done with care to ensure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.
- B. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and immediately removed from the working area.

3.05 FIELD JOINTING

- A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. At this time a thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.
- C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer of the coupling.
- D. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the City, the trench conditions or weather are unsuitable for such Work.

3.06 INSTALLATION OF BENDS, TEES, AND REDUCERS

- A. Cast-iron and PVC fittings shall be installed Utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

3.07 PIPE-TO-PIPE CONNECTIONS

- A. Pipe-to-pipe connections shall be made by using flexible banded, sheer reinforced couplings or adapter couplings, each with compression joints, in compliance with ASTM C 425.

3.08 PIPE-TO-PIPE MANHOLE CONNECTIONS

- A. When a sound pipe stub-out exists at a manhole to which connection is to be made, a pipe-to-pipe connection shall be made as described above. If a stub-out is not present or is

faulty, an opening shall be cut in the manhole wall and the connection made. The connection shall consist of a pipe stub-out with elastomeric waterstop grouted into the opening with non-shrink grout. A flexible band coupling, as shown on the details for new manholes, shall join the pipe stub-out to the replacement pipe. The invert or floor inside the manhole shall be cut and reshaped as necessary.

3.09 GRAVITY SEWER SERVICE LATERALS

- A. Lateral sewers shall be installed in accordance with all the applicable requirement for pipe installation. Branch fittings shall be installed in the main line sewer as it is constructed, in the locations and configuration of the original laterals or as designated by the City.
- B. The existing laterals shall be hand excavated to a joint, saw cut, clean and square and the appropriate adapter installed to connect the replacement laterals. Care shall be taken to maintain the slopes of the existing laterals. The laterals shall be removed and replaced from the main line to a point along the existing lateral as determined by the City to be in acceptable condition.
- C. The Contractor shall not excavate trenches for laterals on both sides of the street at the same time unless written permission has been secured in advance to close the street.

3.10 TESTING

- A. Field testing of gravity sewer pipe shall conform to the requirements of the City of Fort Lauderdale and AHJ standards.

- END OF SECTION -

SECTION 15177

INLINE CHECK VALVES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install inline check valves, complete and operable, as shown and specified herein, including appurtenances and accessories, all in accordance with the requirements of the Contract Documents.
- B. The requirements of the section entitled "Basis Mechanical Requirements" apply to the work of this section.

1.02 SUBMITTALS

- A. Shop Drawings: Submit shop drawings in accordance with the section entitled "Submittals". The shop drawings shall include but not limited to:
 - 1. Manufacturer's standard literature including head loss, flow data, pressure ratings, and vertical and horizontal opening pressures
 - 2. Dimension drawings for all valves to be supplied
 - 3. Valve manufacture's recommended installation instructions
- B. Operation and Maintenance Manuals: Submit operation and maintenance manuals in accordance with the section entitled "Submittals".
- C. Field Test Reports: Submit field test reports as required by this Section.

1.03 QUALITY ASSURANCE

- A. Documented head loss tests are to be provided by the manufacturer. These are to be third party tests performed by a hydraulic testing institute and shall show head loss in open air and submerged conditions. Vertical opening pressure shall be tested and documented.

1.04 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. The Contractor shall furnish the services of a qualified manufacturer's technical representative as described below. If multiple inline check valves are required for the Work, the times and trips apply to each size of inline check valve installed.
 - 1. At least one trip of one day to check and supervise the equipment installation
 - 2. At least one trip of one day to supervise testing and adjustments of the equipment

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Inline check valves shall be WASTOP by WAPRO Inc., OR APPROVED EQUAL

2.02 INLINE CHECK VALVES

- A. Inline check valves shall be installed where shown in the Contract Documents. Inline check valves shall be designed to operate in installations using flanges, flat irons, slide muffs, joint couplings, or custom-made mounting tabs/brackets. If required, mounting tables shall be custom extended lengths as required to accommodate installation conditions. Inline check valves shall be designed to operate on an inlet, an outlet, vertically, horizontally, inside pipes, or between two pipes. The housing of the valve should be stainless steel.
- B. The membrane should be conical and should be attached to the housing along the top of the membrane, and the outlet side of the housing allowing maximum flow through the membrane. Unless noted otherwise, opening and closing pressures shall conform to the "Standard" valve configuration.
- C. Body lengths shall be standard or short body as required by the individual installation. Body length shall take into consideration operation and maintenance activities, including access for future replacement. Valves installed or accessed through manholes shall be short body length.
- D. Each inline check valve shall be labeled with flow direction and unique serial number.
- E. Materials of construction shall be as follows:

Housing / Tube	316 SS
Membrane	Polyurethane
Sealing/Gasket	EPDM
Collar Plate	316 SS
Whale Tail	Polyethylene
Bracket	316 SS
Nuts, Bolts, Washers	316 SS
Mounting Tabs	316 SS
Seal/Gasket	CR, EPDM
Flanges (when used)	316 SS