

## SECTION 02605 – DRAINAGE STRUCTURES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This section covers the furnishing of all labor, materials and equipment required to install drainage structures, frames and covers, access hatches and all appurtenances as shown on the Drawings and as specified herein. All materials and construction shall be in compliance with the latest revision of the standards referenced in this section and Section 2600 of the “KCMO Standard Drawings and Specifications”, except as amended herein.

#### 1.02 SPECIFICATION MODIFICATIONS

- A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements, or as otherwise indicated in the Contract Documents.

#### 1.03 RELATED SECTIONS

- A. Section 01000 – General Project Requirements.
- B. Section 01015 – Specific Project Requirements.
- C. Section 02200 – Earthwork.
- D. Section 02702 – Testing Requirements for Sanitary Sewer: Mains and Manholes.
- E. Section 02940 – GSI Inlets.
- F. Section 02955 – GSI Outlets.
- G. Section 03000 – Miscellaneous Concrete.
- H. Section 03370 – Sanitary Sewer Manhole Construction.
- I. Section 05011 – Stormwater Castings.

#### 1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only
- B. American Concrete Institute (ACI):
  - ACI 350 Code Requirements for Environmental Engineering Concrete Structures.
  - ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures and Commentary.
  - ACI 350.5-12 Specifications for Environmental Concrete Structure.
- C. American Society for Testing and Materials (ASTM):
  - ASTM A48 Standard Specification for Gray Iron Castings.
  - ASTM C150 Standard Specification for Portland Cement.
  - ASTM C443 Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections.

**1.05 INFORMATION PROVIDED BY THE CITY**

- A. As provided in the Contract Documents.

**1.06 SUBMITTALS**

- A. Submit as specified in Section 01300 – Submittals.
- B. Shop Drawings:
  - 1. Base sections, riser sections, eccentric conical top sections, flat slab tops, grade rings, including a certificate indicating compliance with ASTM C478.
  - 2. Pipe connections to precast concrete elements.
  - 3. Manhole frame and cover with certification of compliance with the specified ASTM standard and Class designation.
  - 4. Method of repair for minor damage to precast concrete sections.
- C. Product Data:
  - 1. Precast concrete sections:
    - (a) Sectional plan(s) and elevations showing dimensions and reinforcing steel placement.
    - (b) Concrete design mix.
    - (c) Structural Calculations, including assumptions.
    - (d) Structural design calculations and fabrication drawings shall be prepared and stamped by a professional engineer registered in the State of Missouri.
  - 2. Non-Precast Concrete Drainage Structures including but not limited to FRP, Plastic, or approved equal
- D. Test Reports:
  - 1. Precast concrete boxes:
    - (a) Concrete test cylinder reports from an approved testing laboratory certifying conformance with this Item.
  - 2. Results of leakage tests.

**1.07 QUALITY ASSURANCE**

- A. The Contractor is responsible for the quality assurance and quality control of the Work.
- B. All material shall be new and unused.
- C. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by the City/Design Professional. Inspection may be made at place of manufacture, at the work site following delivery, or both.
- D. Materials will be examined for compliance with this Section and approved manufacturer's drawings.
- E. Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no additional cost to Owner.
- F. Repair minor damage to precast concrete sections by a submitted and approved method, if repair is authorized by the City/Design Professional.

**1.08 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Handle materials and other accessories in such manner as to ensure delivery to the installation location in a sound undamaged condition.

- B. Non-shrink grout: Deliver Materials to the project in manufacturer's original, unopened packaging, with labels clearly identifying product name, manufacturer, and expiration date. Store grout in a cool, dry place and out of the sun.
- C. Precast concrete sections shall not be delivered to the job until the concrete control test cylinders have attained strength of at least 80 percent of the specified minimum.
- D. Precast concrete sections shall be handled carefully and shall not be bumped or dropped. Hooks shall not be permitted to come in contact with joint sections.
- E. Precast concrete sections shall be inspected when delivered. All cracked or otherwise visibly defective units will be rejected. City reserves the right to inspect the production of the units at the manufacturing plant.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.
- C. Provide lifting lugs or holes in each precast section for proper handling.
- D. Cement shall conform to ASTM C150, Type II cement or equal.
- E. Concrete Materials (acceptable mixes, MCIB, KCMMB).
- F. Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained a compressive strength of 3200 psi or 80% of design strength minimum.
- G. Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.

### 2.02 DESIGN CRITERIA

- A. Precast concrete:
  - 1. Minimum compressive strength shall be 4000 psi at 28 days.
  - 2. Maximum water-to-cement ratio shall be 0.45 by weight.
  - 3. Minimum cement content shall be 564 lbs. of cement per cubic yard of concrete.
  - 4. For Precast Manhole Sections, design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-25 truck loading applied at finished grade.
- B. Design of Manufactured products (Precast Concrete or approved equal):
  - 1. Analyze walls and slabs using accepted engineering principals. Design walls for internal fluid pressures and external soil pressures independently.
  - 2. When "fy" exceeds 60,000 psi, "z" (per ACI 350-01, Chapter 10) shall not exceed 95 kips/in, and "fs" shall be computed and shall not exceed 50 percent of "fy".
  - 3. Design products to support their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO HS-25 truck loading applied to top slab.
  - 4. Design walls of the precast boxes for the governing case from the following load conditions:
    - (a) An external lateral pressure based on an equivalent fluid with a unit weight of 90 pounds per cubic foot (pcf). Originate the pressure diagram at the finished ground surface or top of pavement surface, as applicable. When designing by the Strength Design Method, environmental durability factors,

as defined in ACI 350-01, need not be included for this load condition. When designing by the Alternate Design Method (Service Loads), allowable stresses may be increased by one-third for this load condition.

- (b) An external lateral pressure based on an equivalent fluid with a unit weight of 60 pcf. Include a live load surcharge pressure equal to 2 feet of earth above the finished ground surface or top of pavement surface, as applicable.
  - (c) An internal lateral pressure based on a fluid with a unit weight of 63 pcf. Assume internal fluid to the bottom surface of the top slab, unless otherwise noted or shown. Design of walls shall account for effects of tension due to internal fluid pressure.
- 5. Locate access openings, wall sleeves and pipe penetrations as shown on Drawings or as recommended by manufacturer and approved by Design Professional.
  - 6. Locate horizontal wall joints 8-in minimum from edge of wall openings unless otherwise approved by the City/Design Professional.
  - 7. Consider discontinuities in structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.

### 2.03 PRECAST CONCRETE MANHOLE SECTIONS

- A. Precast manholes shall be in accordance with City Standards (<https://www.kcmo.gov/city-hall/departments/public-works/standard-drawings>), except as modified herein.
- B. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and shall meet the following requirements or the KCMO City Standards whichever is more stringent:
  - 1. Bottom slab thickness shall be no less than the riser wall thickness.
  - 2. Construct precast concrete bases as shown on the Drawings.
  - 3. Base, riser and transition top sections shall have tongue and groove joints.
  - 4. Top section shall be a flat slab where cover over top of pipe is 4-ft or less.
  - 5. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Drawings. Knock-out panels shall have no steel reinforcing.

### 2.04 PRECAST CONCRETE BOX STRUCTURES

- A. Precast concrete box structures shall conform to the requirements of ACI 350 and the following additional requirements:
  - 1. Minimum reinforcing bar size shall be No. 5, and shall be Grade 60 or higher.
  - 2. Maximum spacing of reinforcing bars shall be 12 inches, center to center.
- B. Structural design calculations and fabrication drawings shall be prepared and stamped by a professional engineer registered in the State of Missouri.

### 2.05 PIPE CONNECTIONS

- A. Connect pipe to precast structure using one of the following methods:
  - 1. Grout in place - Precast section shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink and waterproof equal to Hallemite, Waterplug or Embecco. Plastic pipe shall have a water stop gasket secured to pipe with a stainless steel clamp.
  - 2. Flexible sleeve – An integrally cast sleeve in precast section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion.

Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

3. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok or equal.

## 2.06 MANHOLE FRAME AND COVER

- A. Manhole frames and covers shall be per Section 05011 – Stormwater Castings.

## 2.07 JOINTING PRECAST SECTIONS

- A. Seal tongue and groove joints of precast sections with either rubber O-ring gasket or preformed flexible joint sealant. O-ring rubber gaskets shall conform to ASTM C443. Preformed flexible joint sealant shall conform to ASTM C990 and shall be Kent Seal No. 2 by Hamilton-Kent; Ram-Nek by K.T. Snyder Company or equal.
- B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. All Drainage Structures shall be provided, installed and constructed at the location shown on the Drawings.
- B. Manhole and Precast Box Installation:
  1. Manholes and precast boxes shall be constructed to the dimensions shown on the Drawings and as specified herein. Construct cast-in-place bases in accordance with the requirements of the contract documents and KCMO Standard details.
  2. Place base on a bed of 8-in structural fill as shown on the Drawings. Set base grade so that a maximum grade adjustment of 8-in is required to bring the structure to final grade.
    - (a) Use precast concrete grade rings to adjust manhole frame and cover to final grade.
  3. Set precast concrete sections plumb with a 1/4-in maximum out of plumb tolerance allowed. Seal joints of precast sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finish flush with the adjoining surfaces. Caulk the inside of any leaking joints with lead wool or non-shrink grout to the satisfaction of the City/Design Professional.
  4. Allow joints to set for 14 hours before backfilling, unless a shorter period is specifically approved by the City/Design Professional.
  5. Plug holes in the concrete sections required for handling with a non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside.
  6. Cut holes in precast sections to accommodate pipes prior to setting precast sections in place to prevent jarring that may loosen the mortar joints.
  7. Backfill carefully and evenly around manholes and precast boxes.
- C. Pipe Connections:
  1. Construct pipe connections, including pipe stubs, as specified above in section 2.05. Close or seal pipe stubs for future connections with a gasketed watertight plug.

D. Setting Manhole Frame and Cover:

1. Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, a maximum of 8-in thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

3.02 LEAKAGE TESTS

- A. Test each liquid-containing structure for leakage. City/Design Professional shall observe each test. Perform exfiltration test as described below.
- B. Assemble structure in place; fill and point all lifting holes and exterior joints within 6-ft of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert and before filling and pointing the horizontal joints below 6-ft of depth. Lower ground water table below bottom of the structure for the duration of the test. Plug all pipes and other openings into the structure and brace to prevent blow out.
- C. Fill structure with water to the top of the structure. If the excavation has not been backfilled and no water is observed moving down the surface of the structure, the structure is satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the City/Design Professional, or if the structure excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill structure to the top of the structure, if necessary and allow at least 8 hours to pass. At the end of the test period, refill the structure to the top of the structure again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each structure shall not exceed one gallon per vertical foot for a 24-hour period. If the structure fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the City/Design Professional. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the structure shall be rejected. Uncover the rejected structure as necessary and to disassemble, reconstruct or replace it as directed by the City/Design Professional. Retest the structure and, if satisfactory, fill and point the interior joints.
- D. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.
- E. An infiltration test may be substituted for an exfiltration test if the ground water table is above the highest joint in the structure. If there is no leakage into the structure as determined by the City/Design Professional, the structure will be considered water-tight. If the City/Design Professional is not satisfied, testing shall be performed as previously described.
- F. Regardless of whether leakage testing is required, visible leaks which occur after backfilling shall be sealed by approved means.

3.03 CLEANING

- A. Thoroughly clean all new manholes, precast boxes and drainage structures of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION