

# Section 5

## Precast Reinforced Concrete Manholes

### A. Design Criteria

1. Manholes between gravity sewers shall be placed at all pipe intersections and at intervals not greater than 400 feet (for sewer main 15" and smaller). Manholes shall be placed at all changes in grade, pipe size and alignment. External drop manholes are required if the invert of the incoming pipe is greater than 2'-0" above the invert of the outgoing pipe. However, use of drop manholes shall be avoided wherever possible.
2. Unless otherwise noted, manholes shall be constructed of precast concrete with cast iron frames and covers, as shown on the detail drawings contained herein. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be with a smooth curve of as large a radius as the size of the manhole will permit.
3. In an effort to maintain the integrity of cured-in-place pipe (CIPP) liners installed to rehabilitate existing sanitary sewers, construction of manholes over existing CIPP-lined sewers should be avoided. Wherever possible, new sanitary sewer lines shall be designed to connect into existing manholes.

New manholes to be constructed over CIPP-lined sewers shall be constructed with a cast-in-place concrete base per Detail 16A. The pipe liner shall at all times remain, in effect, one contiguous pipe, and under no circumstances shall the pipe liner be cut completely through the entire circumference into two (or more) separate pieces unless otherwise approved by the engineer. If the existing sanitary sewer line that was CIPP-lined is asbestos-cement material, then all current regulations and protocol for working with that material shall be adhered to in the construction of the new manhole. Existing pipe material shall be confirmed with the Engineer prior to construction.

4. All manholes shall be adjusted to finished grade in paved areas and 12-inches to 18-inches above grade in rights-of-way or unpaved areas or as approved by the Engineer. If a manhole is to be at grade in unpaved areas on residential properties, or at the discretion of the Authority, a watertight manhole frame and cover shall be installed. If the proposed construction includes an existing street or right-of-way in which the existing grade will be changed, the Applicant shall be responsible for adjusting all existing manholes to finished grade. All adjustments required shall be in accordance with methods approved by the Authority. Such approval must be obtained in writing prior to construction.
5. Liftholes in manholes shall not extend through the entire width of the wall.

6. Exterior and interior surfaces of the manholes must be coated or lined, as described in Paragraph B – Materials and Equipment.
7. Manholes shall be constructed in accordance with the standard details noted on the detail drawings contained herein. Shop drawings shall be submitted for approval.
8. Manholes that are installed in field or wooded areas may, at the discretion of the Authority, be required to have a post installed adjacent to the manhole to serve as a marker.

## **B. Materials and Equipment**

1. Precast Reinforced Concrete Manhole Riser and Tops
  - a. Precast reinforced concrete manhole risers and tops shall conform to ASTM Specification C-478 Latest Edition and shall be of watertight construction. Joints between manhole sections shall be provided with preformed plastic joint sealing material conforming to ASTM C990 and shall be Ram-Nek as manufactured by K.T. Snyder Co., MAS-STIK as manufactured by Concrete Products Supply Co., or approved equal. The preformed joint sealer shall be protected by a removable two-piece wrapper and shall be applied in strict accordance with the manufacturer's recommendations. The chemical composition of the sealer shall meet the following requirements: the latest revision of: Bitumen-ASTM D-477, Inert Ash Mineral AASHTO T-11-42, Volatile Matter ASTM D-667. Shop drawings and specifications must be submitted for approval prior to installation.
  - b. Manhole bases may be cast-in-place concrete, and shall have a compressive strength of not less than 4,000 psi after 28 days (tests to be in accordance with ASTM Specification C-39, Latest Revision).
  - c. Precast manhole bases shall have flexible watertight joints at the point of entry of any sewer pipe into the manhole. The rubber materials shall conform to ASTM C443. The gaskets shall be cast into the manhole base to become an integral part of the concrete. The gaskets shall be Press Wedge II as manufactured by Press-Seal Gasket Corporation, Dura-Seal III, or Dura-Seal PSX as manufactured by Dura Tech Inc., and supplied by Monarch, Dallastown, PA, Dual Seal 11 as supplied by Terre Hill Concrete Products, or equivalent.
  - d. Manhole bases with precast outside drop shall conform to ASTM C478, Latest Revision and shall provide a 90-degree elbow cast in monolithically with the base. The riser pipe shall be supported by concrete U-shaped

collars. The collars shall be a minimum vertical height of 12 inches and shall be connected by tongue-and-groove joints.

- e. Precast concrete grade rings with a minimum thickness of 2 inches used for leveling and adjusting to grade shall be of compressive strength as specified above. Precast rings shall be a single piece (no semi-circular pieces). Rubber grade rings are acceptable with a minimum thickness of 0.5 inches and for tapered arrangements, and shall be "Infra-Riser" as manufactured by GNR Technologies. The use of poured concrete grade rings shall be allowed only with prior approval from the Authority. Design of the grade rings must provide for full bearing of manhole frame. Joints between grade rings must be sealed using an approved preformed plastic joint sealing material specified in this section. Cement mortar will not be permitted in any joints.

## 2. Frame and Cover

Manhole frame and cover shall be of cast iron, 24-inch diameter and equal in design to Model #1032, as manufactured by the Bridgestate Foundry Company, Berlin, NJ or equal machined and having the letters "SLSA" cast approximately in the center of the cover. All manhole cover frames shall be securely attached to the manhole by use of anchor bolts. The joint between the frame and the precast manhole section shall be provided with preformed plastic joint sealing material equal to Ram-Nek as manufactured by K.T. Snyder Company, Inc. of Houston, TX, and shall be of self-sealing design with a continuous rubber gasket supplied in a machined groove in the surface upon which the cover rests.

## 3. Watertight Manhole Frame and Cover

Watertight manhole frames shall be 24-inch diameter of cast iron similar in design to Model #1032 as manufactured by the Bridgestate Foundry Company, Berlin, NJ or equal, and having the letters "SLSA" cast approximately in the center of the cover. Watertight frames shall be securely attached to the manhole by use of anchor bolts. The joint between the frame and the precast manhole section shall be provided with preformed plastic joint sealing material equal to Ram-Nek as manufactured by K.T. Snyder Company, Inc. of Houston TX. All joints shall be watertight. Manhole covers shall be bolted to the frames using four 4 1/2-inch stainless steel bolts. Watertight designs using bowl inserts or locking bars shall not be acceptable. Shop drawings for this type of cover must be submitted for approval before installation.

## 4. Manhole Steps

- a. Manhole steps shall be composed of a ½-inch Grade 60, ASTM A615 steel reinforcing bar completely encapsulated in Grade 49108, ASTM D2146 polypropylene copolymer compound, as manufactured by M.A. Industries Inc., Peachtree City, GA or equal. The Authority reserves the right to have steps tested according to the latest revision of ASTM Specification C-478 at the extendor's cost.
- b. Manhole steps shall be positioned to form a continuous ladder with 12-inch intermediate spacing in the manhole in such a manner to permit easy access to the manhole and not conflict with either influent or effluent lines. The first step shall be no further than 24-inches from the top of the manhole, and the bottom step shall be no higher than 16-inches from the bench.

5. Protective Coatings and Linings

a. Exterior Coating

All exterior surfaces shall be coated with dampproofing. Dampproofing shall be coal tar waterproofing pitch; Pro-Mastic 900 by Pro-Guard Coatings; Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn Inc.; Meadows Trowel Mastic (Type 3) or approved equal.

b. Interior Coating (hydrogen sulfide corrosion protection)

(1) New manholes with an internal drop of less than 2 feet shall have a white epoxy coating (Propoxy 2228 by ProGuard Coatings or approved equal) applied to all interior surfaces at the manhole manufacturer's facility before delivery to the site. Surface preparation and application shall be as recommended by coating manufacturer.

(2) New manholes with a drop of 2 feet or greater or force main terminal manholes shall have one of the following liners:

(a) A High Density Polyethylene (HDPE) liner to provide an impermeable lining on the interior concrete surfaces shall be AGRU Sure Grip HDPE of polypropylene random copolymer as furnished and installed by Terre Hill Concrete Products, Terre Hill, PA. The Sure Grip liner shall have a minimum thickness of 2 mm. The minimum anchor stud density shall be 39 studs per square foot. The anchoring studs shall not be welded or mechanically attached to the liner. All joints shall be sealed by thermal welding performed by AGRU certified welders. The interior surfaces to be protected shall include the wall, ceiling, pipe entries and structure chimney.

- (b) A Polyvinyl Chloride (PVC) resin liner to provide an impermeable lining on the interior concrete surfaces shall be Dura Plate 100 as manufactured by A-Lok Products, Inc. Tullytown, PA. The Dura Plate liner shall have a minimum thickness of 1.65 mm. The PVC liner, channel joints, H-joints, and corner joints shall be manufactured from PVC and shall be white in color. A combination of standing ribs and dovetails shall be used to secure the liner panels to the wall of the structure and shall be spaced a maximum of 6 inches apart. Liner panels for 48" through 60" diameter manholes shall be a minimum of 0.50 inches high and shall be 0.75 inches high for 72" and larger diameter manholes. Liner panels shall be formed to the correct radius and have a PVC return into the joint of 0.50 inch. The fabricated liner panels shall be joined together by a slotted strip of EPDM rubber meeting the manufacturer's specifications. Sections of lined concrete structure shall be joined together by an approved butyl rubber strip as manufactured by A-Lok Products, Inc., designed to produce sufficient squeeze-out between PVC returns. Manhole steps, if required, shall be polypropylene drive-in step. Pipe penetrations through the wall shall be afforded protection by applying 0.125-inch cementitious corrosion resistant material, Forsroc Epoxy Liner, to the unlined exposed areas within the openings and shall overlap the liner wall a minimum of 1.50 inches. The manhole chimney shall be protected by installing a telescoping PVC connector, Water-Lok, as manufactured by A-Lok. The interior surfaces to be protected shall include the wall, ceiling, pipe entries and structure chimney.
- (c) Manholes to receive a PVC or HDPE liner shall also have a fiberglass reinforced plastic (FRP)-lined base. The FRP base liner shall be by GU International. The liner shall be of one-piece construction of unlayered, homogenous composite. Minimum thickness shall be 0.12" - 0.20" (3 mm - 5 mm) and shall be in lengths and nominal inside diameters corresponding to the precast concrete base section. The prefabricated FRP base liner shall include full flow channels with side walls to the crown of the pipe; inner surface of the bench shall have an anti-skid pattern; watertight gasketed pipe bell connections of FRP/PVC boot hole sleeves to suit specific pipe types, grade and alignment, shall be monolithically attached to prefabricated FRP base liners to extend to the outside profile of the precast concrete structure. The outer surface of the liner shall be aggregate-coated and shall have steel spirals/lattice bonded to the FRP to ensure adequate anchoring to concrete base sections to pass vacuum test with 10" of negative pressure.

- (3) Existing manholes receiving a new drop connection of 2 feet or greater or a new force main connection shall be lined with an epoxy or urethane resin applied monolithic liner system that will provide corrosion protection from hydrogen sulfides and other corrosive materials typically found in sanitary sewer systems. Acceptable liner systems are: SprayWall by Sprayroq, Raven 405 by Raven Lining Systems, S-301/M-301 by Warren Environmental, NPR-5300 by NeoPoxy, Epoxytec Lining Systems by Epoxytec, or equal. The installation of the liner system shall be in accordance with the manufacturer's specifications, and the contractor installing the liner system shall be certified by the manufacturer as a trained applicator of the selected lining process. Prior to installing the liner system the manhole's walls and bench shall be thoroughly cleaned using a pressure water spray. The use of acid for cleaning purposes will not be allowed. All damaged concrete shall be patched and repaired as necessary. The contractor shall fill voids, rough surfaces, and other surface defects which may affect the performance or adhesion of the liner product using resurfacing products recommended by the liner system manufacturer. All liners shall be applied so that they result in a monolithic liner covering the invert, walls and corbelled top up to the cast iron manhole frame.

If the Authority determines that an existing manhole receiving a new drop connection of 2 feet or greater or a new force main connection is in poor condition and cannot be rehabilitated using an interior coating, a new manhole will be required and the interior shall be as described in paragraph B.5.b.(2) above.

## **C. Installation**

### 1. General

The relevant parts of Section 2 - Gravity Sewers shall apply regarding earthwork.

### 2. Precast Concrete Bases

#### a. Bedding

Install bases on a 6-inch deep compacted layer of aggregate meeting requirements of pipe bedding as specified previously in Section 2 - Gravity Sewers.

- b. When using prefabricated pipe opening seals (i.e., Press Wedge II, Dura-Seal, etc.) for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall pipe openings after pipe

connection is made, fill such annular spaces with non-shrink grout. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.3. Concrete Channel Fill

- a. The following criteria shall apply to both field and factory formed bases:
  - (1) Form inverts directly in concrete channel fill. Concrete fill shall be a minimum depth of 3 inches.
  - (2) Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
  - (3) Make changes in size and grade gradually.
  - (4) Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.
  - (5) Make slopes gradual outside the invert channels. Provide a minimum slope of 1"/foot and a maximum slope of 2"/foot.
- b. Use 3000 psi concrete unless indicated otherwise on the detail drawings.
- c. Channels shall be full pipe height; PVC channels may be used for invert section.

#### 4. Manhole Wall Erection

##### a. Precast Components

Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.

- b. Install two rings of preformed plastic sealing compound between sections in accordance with manufacturer's recommendations and as shown on the detail drawings, and join sections in accordance with written instructions of manhole component manufacturer.
  - (1) Prime joint surfaces if required by preformed sealing compound manufacturer.
  - (2) If sealing compound is installed in advance of section joining, leave exposed half of two piece protective wrapper in place until just prior to section joining.

- (3) Use preformed sealing compound as the sole element used in sealing section joints from internal and external hydrostatic pressure.
- (4) Following manhole section installation, trim any excess sealing compound to provide a smooth surface that is flush with interior face of manhole.
- (5) Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

5. Frame and Cover Installation

- a. Adjust frames using grade rings. Set grade rings in preformed plastic joint sealing material specified in this section.
- b. Bolt manhole frames in place on manhole top section, or on grade rings, if required, after installing ½-inch thick preformed plastic sealing compound on bearing surface of manhole frame and between grade rings. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.
- c. Use bolts of sufficient length to properly pass through concrete grade rings, if any; engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer.

6. Drop Manholes

Construct as depicted on the detail drawings.

7. Cast-in-Place Concrete Base (New Manhole Over Existing CIPP-Lined Sewer)

a. Proposed Pipe Elevation

In an effort to maintain the integrity of the existing CIPP-lined pipe by minimizing the cutting of the liner, the proposed pipe shall be designed such that the invert of the proposed pipe shall match (or be higher than) the crown of the existing pipe.

In the event that the above criteria cannot be met and approval is granted by the Authority to allow the invert of the proposed pipe to match the invert of the existing CIPP-lined pipe, removal of a section of the CIPP-lined pipe to achieve this shall only be done using a cut-off machine. Cutting of the CIPP-lined pipe with a reciprocating saw shall not be permitted.



b. Finish

Upon completion of manhole construction, the top of the existing CIPP-lined pipe shall be cut off at the springline and removed. All cutting shall be done with a cut-off machine. The annular space between the CIPP liner and the host pipe that was exposed as a result of cutting the sewer shall be sealed with a two-part, 100% solids, epoxy-based patching compound (Splash Zone A-788 by Carbolite Company, or an approved equal). A concrete bench shall be formed around the existing CIPP-lined pipe and a channel shall be formed to convey sewage flow from the new pipe into the main channel of the manhole.

## **D. Testing and Inspection**

1. Notification

It is incumbent upon the applicant to notify the Authority a minimum of 24 hours in advance of when the work will be ready for inspection.

2. All manholes shall be tested for water infiltration. The Extendor shall furnish all labor, materials, water, tools, equipment and accessories necessary to perform the required tests. All tests shall be made in the presence of and to the complete satisfaction of the Authority.
3. The manhole shall be thoroughly cleaned and all openings sealed to the satisfaction of the Authority. All pipe openings in the base and the walls shall be plugged with plugs properly designed to provide a watertight and airtight seal. All excess joint sealing material protruding into the manhole shall be removed.
4. There shall be no groundwater around the outside of the manhole during the vacuum test. If there is groundwater around the manhole during the vacuum test and any water is found in the manhole at the conclusion of the test, it shall be deemed to have failed the test.
5. The manhole shall be tested using the vacuum testing method (ASTM C1244)
  - a. An inflatable circular rubberized seal shall be placed in the manhole cover frame, and a vacuum of 10-inches (mercury) shall be applied to the manhole. The time lapse shall be measured for the vacuum to drop from 10 inches to 9 inches. The vacuum drop shall be measured by a vacuum gauge graduated between 0 and 20 inches (mercury).
  - b. If the time lapse is greater than 60 seconds, the manhole is considered to have passed the test.

- c. If any manhole fails to meet the testing requirements, the Extendor shall determine at his expense the source or sources of leakage. The Extendor shall repair or replace all defective material and/or workmanship and shall conduct such additional tests as required to demonstrate that the manhole meets the requirements, at his expense. All materials and methods used to repair the manholes shall meet with the approval of the Authority.
6. Cast-in-Place Concrete Base (New Manhole Over Existing CIPP-Lined Sewer)
    - a. A reasonable effort, as determined by the Authority's Engineer, shall be made to successfully vacuum test the manhole in accordance with the specifications described herein. If a successful vacuum test cannot be achieved and, in the opinion of the Authority's Engineer, the Extendor has exhausted all reasonable efforts to do so, the Extendor may request that this requirement be waived.
    - b. In cases where approval is granted to waive the vacuum testing requirement for a manhole that has been constructed over an existing CIPP-lined sewer, the Extendor shall provide a final sealing of the annular space between the CIPP liner and the host pipe that was exposed as a result of cutting the sewer with a two-part, 100% solids, epoxy-based patching compound (Splash Zone A-788 by Carboline Company, or an approved equal).

## **E. Detail Drawings**

Relevant detail drawings are:

- 13 Precast Concrete Manhole
- 14 Cast-in-Place Drop Connection to Manhole
- 15 Precast Drop Connection to Manhole
- 16 Cast-in-Place Base - New Manhole Over Existing Sewer
- 17 New Sewer to Existing Manhole Connection
- 18 Force Main Connection to Manhole
- 19 Manhole Location Post
- 16A Cast-in-Place Base - New Manhole Over Existing CIPP-Lined Sewer

END OF SECTION