Section 402. STORM SEWERS

402.01. Description. This work consists of constructing storm sewers of the size and class required, including excavation, bedding, and backfill.

402.02. Materials. Provide materials in accordance with the following:

- Concrete, Grade S3 ................................................................. 701
- Mortar, Type R-2 ..................................................................... 702
- Granular Material Class II, III, IIIA ....................................... 902
- Aggregate 6A, 17A, 34R ......................................................... 902
- Sewer Pipe ............................................................................. 909
- Sealers for Sewer Joints ......................................................... 909
- Steel Pipe (for jacking in place) ............................................. 909
- Geosynthetics ....................................................................... 910

Select pipe with watertight joint systems from the Qualified Products List.

Storm sewers are divided into five classes, as specified in Table 402-1. If the contract only specifies the size and class of sewer, provide an alternate allowed in Table 402-1.

For types of sewer material required, but not included in Table 402-1, the contract will specify the type and size of sewer material.

The Contractor may substitute a higher strength or greater thickness of sewer for the minimum sewer strength or minimum thickness required.
<table>
<thead>
<tr>
<th>Type of Pipe/Depth of Cover in feet (a)</th>
<th>Class A Sewer 0–10 (k)</th>
<th>Class B Sewer &gt;10–16</th>
<th>Class C Sewer &gt;16–23</th>
<th>Class D Sewer &gt;23–33 (l)</th>
<th>Class E Sewer 0–3 (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced Concrete Pipe (c)</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>V</td>
<td>IV</td>
</tr>
<tr>
<td>Nonreinforced Concrete Pipe (d)</td>
<td>1</td>
<td>3</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Corrugated and Spiral Ribbed Al-Alloy Pipe (e)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Corrugated and Spiral Ribbed Steel Pipe (f)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Smooth-Lined Corrugated Plastic Pipe (CPE) (g)</td>
<td>Yes (h)</td>
<td>Yes (i)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Corrugated Polyvinyl Chloride Pipe (CPV) (j)</td>
<td>Yes (h)</td>
<td>Yes (i)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

a. Cover, including the pavement structure is defined as the height of fill above the top of the pipe measured to final grade.
b. Class E Sewer applies when the sewer is beneath the influence of proposed pavement and the depth of cover is no greater than 3 ft.
c. Roman numerals refer to class of reinforced concrete pipe, AASHTO M 170.
d. Arabic numerals refer to the class of nonreinforced concrete pipe, AASHTO M 86.
e. Allowed for 12 in to 66 in spiral ribbed and 12 in to 18 in helically corrugated 2½ in × ½ in aluminum alloy pipe only.
f. Allowed for 12 in to 84 in spiral ribbed and 12 in to 18 in helically corrugated 2½ in × ½ in steel pipe only.
g. CPE shall conform to AASHTO M 294, Type S Polyethylene pipe.
h. Allowed only for 36 in diameter pipe and under for CPE and CPV pipes. At least 3 ft of cover.
i. Allowed only for 12 in to 24 in diameter CPE and CPV pipes. Refer to the Class B Plastic Pipe Qualified Products List for approved manufacturers and products.
j. CPV must conform to AASHTO M 304.
k. Class A sewer applies when the sewer is outside the influence of proposed pavement or is beneath the influence of proposed pavement and the depth of cover is greater than 3 ft but less than or equal to 10 ft.
l. Special design is required for depths of cover greater than 33 ft.
402.03. Construction.

A. **Excavation, Trench Construction, and Sewer Bedding.** Perform trench construction using methods meeting the health and safety requirements specified in subsection 104.07.

Begin the trench excavation at the downstream end of the sewer. Excavate the trench as shown on the plans, or as determined by the Engineer. Construct the trench width to at least the minimum width shown on the Standard Plans, but wide enough to provide free working space and to allow compaction of the backfill around the pipe. Shape the bottom of the trench to support the pipe uniformly. Backfill and compact with granular material Class II to the required elevation.

If unstable soil conditions, or obstructions other than rock, require excavation of the sewer trench below the elevation shown on the plans, undercut, backfill, and compact the trench as directed by the Engineer. Use 6A, 17A, or 34R aggregate to backfill trench undercutting due to unstable soil conditions.

Take possession and dispose of surplus material from sewer excavation in accordance with subsection 205.03.P.

During sewer construction, maintain and protect existing live utilities. Minimize service interruptions and coordinate with the local municipality or utility company. Immediately repair or replace utilities, interrupted during sewer construction, as directed by the Engineer.

B. **Repair of Damaged Coated Surfaces.** Repair, at no additional cost to the Department, coated pipe surfaces damaged during pipe transportation, handling, or installation. Complete repair of galvanized pipe surfaces in accordance with subsection 716.03.E. Repair other coated sewer pipe surfaces as directed by the Engineer.

C. **Laying and Jointing Pipe.** Lay storm sewers as shown on the plans, with bells or grooves upgrade, and ends closely jointed. Provide a full, firm bearing along the length of each pipe section. Wrap pipe joints, with a diameter greater than 24 inches, using geotextile fabric. Use geotextile at least 22 inches wide, centered on the joint.

Remove and replace pipe damaged by Contractor operations. Mandrel test replaced CPE and CPV pipe. Remove and re-lay sewer sections that the Engineer determines, show signs of settlement or poor alignment at no additional cost to the Department.
1. **Corrugated Plastic Pipe (CPE and CPV).** During field installation, align pipe sections with homing marks on CPE and CPV pipe sections and joint material. After trench backfill and compaction is complete, the Engineer will select at least 50 percent of the installed length of each size of CPE and CPV for the Contractor to mandrel test for deformation. Unless otherwise approved by the Engineer, perform the mandrel test from 5 to 10 working days before pavement surfacing or completion of final grade. Provide the labor and equipment required to complete testing. Use a nine-point mandrel with a diameter equal to 95 percent of the nominal pipe diameter. Provide the Engineer with a proving-ring to verify the mandrel size. Pull the mandrel through the pipe by hand, with no mechanical advantage, and without damaging the pipe. Remove and reinstall, or replace, pipe with nominal diameter reduced by more than 5 percent at no additional cost to the Department. Only reinstall undamaged pipe. Do not reinstall pipe without the Engineer's prior approval. The Contractor is responsible for all expenses and delays caused by reinstallation or replacement of pipe.

2. **Concrete Pipe.** Install reinforced concrete elliptical pipe with the longer axis placed horizontally, unless otherwise required. Install Type HE elliptical pipe with the longer axis within 5 degrees of horizontal. Install Type VE elliptical pipe with the longer axis within 5 degrees of vertical. Install circular concrete pipe with elliptical reinforcement so the lift holes or manufacturer's marks are on top of the pipe. Place pipe so the lift holes or manufacturer's marks, designating the top and bottom of the pipe, are no more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. After installing the pipe, seal the lift holes with concrete plugs and waterproof.

D. **Sewer Taps.** Make connections to county, municipality, or drain commission-owned storm sewers in accordance with the regulations of the owner and as required by the contract. If a conflict exists between the owner's regulations and these specifications, the owner's regulations will take precedence.
For existing storm sewers with plugs or bulkheads, remove plugs or bulkheads without damaging the existing sewer and make watertight joint connections. Take possession and dispose of the removed material in accordance with subsection 204.03.B.

If tapping an existing pipe, cut an opening in the receiving pipe at least 6 inches larger than the outside diameter of the inlet pipe. Insert the inlet pipe and cut flush with the inner wall of the receiving pipe. Pack a layer of mortar at least 3 inches thick around the inlet pipe and strike smooth with the inner wall of the receiving pipe. Encase the inlet pipe on the outside of the connection with concrete to provide bearing under the pipe. Repair or replace existing pipe damaged by Contractor tapping operations at no additional cost to the Department.

Do not direct tap sewer inlet pipes with outside diameters greater than half the inside diameter of the trunk sewer. Construct a manhole structure for these taps in accordance with section 403. Obtain the Engineer’s approval before using other methods for tapping existing sewers.

E. **Sewer Bulkheads.** Construct sewer bulkheads using Grade S3 concrete or brick or block masonry. Extend the bulkhead at least 1 foot into the pipe from the inner wall of the drainage structure. Construct masonry bulkheads in accordance with subsection 403.03.

F. **Backfilling.** Backfill in accordance with subsection 401.03.D.

G. **Corrugated Steel Sewer.** In a single line of pipe, do not use dissimilar base metals or coatings on steel.

H. **Sewer Jacked in Place.** Jack sewers in place in accordance with subsection 401.03.G.

I. **Disposal of Surplus Material.** Take possession and dispose of surplus material in accordance with subsection 205.03.P.

J. **Cleanout.** Maintain storm sewers installed on the project. Ensure installed sewers are free of silt, debris, and other deleterious material at the time of final acceptance.

K. **Video Inspection of Sewer Pipe.** Use closed circuit television to inspect required storm sewers. Dewater or divert flow in sewers for inspection. Video inspection is not required for extensions of existing catch basin leads less than 20 feet.

After backfilling and compacting the trench, and from 5 to 10 working days before pavement surfacing or completion of final grade, conduct the
402.03

inspection of sewers under pavement, unless otherwise approved by the Engineer.

For sewers not under pavement, conduct the inspection as close to project completion as possible, but allow time for corrective action determined by the video inspection and directed by the Engineer.

1. Traffic Control. Obtain the Engineer’s approval of traffic control measures at least 5 days before beginning work. Propose a traffic control plan in accordance with the Michigan Manual of Uniform Traffic Control Devices.

Unless otherwise approved by the Engineer, keep traffic lanes open. For necessary lane or shoulder closures, use traffic control measures in accordance with the traffic control plan.

2. Equipment. Use a camera designed and constructed for inspecting sewers, equipped with the following features:

   a. A pan and tilt head external to the main body of the camera to allow inspection of the sewer joints and cracks or other defects;
   b. Lighting to allow a clear picture of the perimeter of the pipe; and
   c. Underwater operation, capable of producing a picture quality satisfactory to the Engineer.

   If the Engineer determines the video quality is not satisfactory, re-inspect the pipes to obtain acceptable results, at no additional cost to the Department.

   Use continuous running video capable of recording audio and video information. Include the date, the month, day and year, and camera location. Provide a continuous record of the sewer section, from manhole to manhole or from end to end. Use high quality, color, DVD format at a standard play speed. Obtain the Engineer’s approval before using other recording media.

3. Sewer Flow Control. Provide flow control to bring the depth of flow in the sewer pipe within the range specified in subsection 402.03.K.3.a for video inspection. Submit to the Engineer for approval, the proposed method of sewer flow control before starting work.

   a. Depth of Flow. Lower the depth of flow in the sewer during the videotaping operation to less than 2 inches. Reduce flow by plugging or blocking the flow, or by pumping the flow and bypassing the pipe section during inspection, as approved by the Engineer.
b. **Plugging or Blocking.** Insert a sewer line plug into the line upstream of the section undergoing inspection. Use a plug designed to allow the release of portions of the flow. During video inspection, reduce the flow depth to 2 inches. Restore normal flow after completing the work. Meter flow discharge to prevent erosion.

c. **Pumping and Bypassing.** For pumping and bypassing, supply the pumps, conduits, and other equipment to divert the flow around the sewer section undergoing inspection. Provide a bypass system with a capacity to handle existing flow plus additional flow that may occur during a rain event. Provide the labor and supervision required to set up and operate the pumping and bypassing system.

d. **Flow Control Precautions.** If the flow in a sewer line is plugged, blocked, or bypassed, protect the sewer lines from damage that may result from sewer surcharging. Ensure sewer flow control operations do not cause flooding or damage to public or private property.

4. **Procedure.** Move the camera through the line at a rate no greater than 0.5 feet per second, stopping as required to document the joint and pipe conditions. Use winches, cable, powered rewinds, or other devices that do not obstruct the camera view or interfere with proper documentation of the pipe conditions.

   Adjust the camera to travel above the level of the flow in the pipe. If the camera encounters a dip in the pipe such that the water rises above the springline of the pipe, or if the camera lens becomes submerged, withdraw the camera and re-insert it from the other end as far as possible. Do not back the camera into a pipe undergoing inspection.

   Measure the distance to the location of defects above ground using a meter device. The Engineer will not allow marking defect locations on the cable to measure the distance to defects. Provide a distance meter with an accuracy within 1 foot and check using a walking meter, roll-a-tape, or other device.

5. **Documentation.** After completing the video inspection, provide two copies of the video to the Engineer. Include a written log of damages or installation defects, including pipe deformation, cracking, joint separation, corrosion, perforation or other features identified in the video. Provide two copies of the log to the Engineer. Locate the damage or defect by meter marking of the video in the inspection
log. Label the videos to describe the reaches of sewer or culverts contained in the videos, including street location and manhole numbers. If manhole numbers are not provided, assign a numbering system to allow identification in the inspection report and video.

402.04. Measurement and Payment.

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer, Cl, __ inch, Tr Det __</td>
<td>Foot</td>
</tr>
<tr>
<td>Sewer, Reinf Conc Ellip, Cl, (rise) by (span) inch, Tr Det</td>
<td>Foot</td>
</tr>
<tr>
<td>Sewer, Cl, (type), __ inch, Jacked in Place</td>
<td>Foot</td>
</tr>
<tr>
<td>Sewer Tap, __ inch</td>
<td>Each</td>
</tr>
<tr>
<td>Sewer Bulkhead, __ inch</td>
<td>Each</td>
</tr>
<tr>
<td>Trench Undercut and Backfill</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>Dewatering System, Trench</td>
<td>Foot</td>
</tr>
<tr>
<td>Video Taping Sewer and Culv Pipe</td>
<td>Foot</td>
</tr>
</tbody>
</table>

A. **Sewer and Sewer, Reinforced Concrete Elliptical.** The Engineer will measure Sewer and Sewer, Reinf Conc, Ellip, of the size, class, and trench detail required, in place from center to center of manholes, catch basins, or inlets. The unit price for Sewer and Sewer, Reinf Conc, Ellip includes the cost of excavation, backfill, geotextile fabric and mandrel testing.

B. **Sewer, Jacked in Place.** The Engineer will measure Sewer, Jacked in Place, of the size and class required, by multiplying the number of units jacked by the commercial laying length. The unit price for Sewer, Jacked in Place includes excavating the pit; providing and installing sheeting, bracing, and other safety devices; providing jacking equipment; drainage and dewatering; and other items associated with the operation.

C. **Sewer Tap.** The Engineer will measure Sewer Tap, based on the inlet pipe size required, by each tap into an existing system. If tapping an existing sewer line using a drainage structure, the Department will pay for one sewer tap in addition to the drainage structure.

D. **Sewer Bulkhead.** The Engineer will only measure sewer bulkheads for storm sewers with a diameter larger than 12 inches. The cost of constructing sewer bulkheads for pipes with a diameter less than or equal to 12 inches, or constructed as part of abandoning or removing drainage structures as shown on the plans, is included in the unit prices for related pay items.

The Department will pay separately for bulkheading pipes greater than 12 inches.
E. **Trench Undercut and Backfill.** The Engineer will measure *Trench Undercut and Backfill* by calculating the volume from the length, depth, and width of undercut authorized by the Engineer and shown on the plans. The Engineer will not make allowance for sloping the sides of the trench. The unit price for *Trench Undercut and Backfill* includes the cost of excavation and disposal of material; and providing, placing, and compacting 6A, 17A, or 34R aggregate to the bottom of trench elevation shown on the plans.

F. **Rock Excavation.** The Engineer will measure and the Department will pay separately for rock excavation in accordance with subsection 205.04.

G. **Dewatering System, Trench.** If the contract does not include a pay item for *Dewatering System, Trench* and the Contractor uses a dewatering system, the Department will not pay separately for the system, but will consider the cost to be included in the unit prices for related pay items.

H. **Tunneling.** The Engineer may authorize tunneling, in place of open-cut construction methods. The Department will delete, or proportionally reduce pay item quantities required for corresponding open-cut construction from the contract if the Engineer authorizes tunneling. The Department will not make an adjustment in the pay items of *Minor Traffic Devices* or *Flag Control*.

If the contract does not include a unit price for tunneling of the proposed pipe size, the Department will pay for tunneling as Extra Work at an agreed upon price. Payment for the work performed by tunneling methods will not exceed the unit price bid for the open-cut method.

I. **Video Taping Sewer and Culvert Pipe.** The unit price for *Video Taping Sewer and Culv Pipe* includes the cost of dewatering, flow control, video inspection, and documentation.

The Department will pay separately for traffic maintenance and control in accordance with subsection 812.04.