

B/CS
Unified Technical
Specifications



Drainage
2020



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SECTION 33 40 01
STORM DRAINAGE SYSTEM

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2009 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Specification includes the general description of the Storm Drainage System and the components included in that system.
- B. This is a general specification which applies to the furnishing of all plant, labor, equipment, appliances and materials and in performing all operations in connection with the construction of storm drainage systems, together with the inlets, storm drain manholes, headwalls, safety end treatments, cleanout structures and other incidentals, in accordance with the plans and these specifications.

1.2 MEASUREMENT AND PAYMENT

Payment shall be made at the price bid per unit item for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including trenching and backfill, embedment, compaction or tamping, testing, final cleanup, and all other work not otherwise provided for in the Proposal.

A. Pipe

Payments will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including line fittings, trenching, and backfill, embedment, compaction or tamping, and all other work not otherwise provided for in bid proposal. Pipe will be measured (by horizontal distance) from the inside face of the inlet or junction box or end of pipe without adjustment for the slope of the pipe. The length of the inlet or junction box shall not constitute a payable quantity.

B. Manholes/Junction Boxes

Payment will be made at the unit price bid per each for manhole. Manholes will be measured per each.

C. Inlets

Payment will be made at the unit price bid per each for inlet by length and type. Inlets will be measured per each.

D. Headwalls

Payment will be made at the unit price bid per each for headwall by type. Headwalls will be measured per each.

E. Rock Rubble Rip Rap

Rock Rubble Rip Rap shall be measured by area as provided for in the bid proposal form.

F. Channel Grading

Channel Grading shall be measured by area as provided for in the bid proposal form.

1.3 SUBMITTALS

All submittal requirements are listed with the material specifications

PART 2 – PRODUCTS

2.1 MATERIALS

See:

SECTION 31 78 00 - PIPE BORING, JACKING AND TUNNELING
SECTION 31 23 33 - EXCAVATING, TRENCHING, AND BACKFILLING
SECTION 03 30 00 - CONCRETE
SECTION 33 40 02 - REINFORCED CONCRETE PIPE
SECTION 33 40 03 - STANDARD STORM SEWER INLETS
SECTION 33 40 05 - REINFORCED CONCRETE HEADWALLS
SECTION 33 42 16 - PRECAST BOX CULVERTS
SECTION 33 40 04 - REINFORCED CONCRETE RIPRAP
HDPE Storm Drain Pipe (to be specified by design engineer)

2.2 TESTING REQUIREMENTS

T.V. Camera Inspection shall be performed on all installed underground storm drain conduits longer than 20 feet before acceptance. When the Contractor performs the inspection, the City Engineer or his representative shall be notified one working day prior so that he can view the procedure. The inspection shall be in digital video format, saved to a DVD or CD (enclosed within a protective case) and shall be given to the City Engineer or his representative for review and final records.

Conduit shall be cleaned prior to T.V. inspection. All dirt/debris in the line which could cover a defect shall be removed. Jetting of the lines in conjunction with the T.V. Inspection is prohibited. If the line to be televised is discovered to contain foreign material, which prohibits an acceptable T.V. inspection, the line shall be cleaned and televised again.

Select and use closed circuit television equipment that will produce a color digital video that clearly shows pipe and joints, and shall be a self propelled tractor-type system. Produce and use closed circuit television equipment using a panorama tilt, radial viewing, pipe inspection camera that pans plus and minus 75 degrees, rotates 360 degrees, and has optical zoom from 6 or less inches to infinity. The camera must have an accurate footage counter accurate to within 1 foot per 500 foot of pipe. Footage shall be continuously displayed on the video at all times. The camera operator shall stop at each junction box and complete a 360 degree view of the junction box slow enough to identify all defects. Glare shall be avoided and shall not interfere with viewing the pipe segment. Maximum rate of travel for the camera shall be 30 feet per minute. DVDs or CDs shall be continuous between manholes. Provide DVDs or CDs with labels indicating project number, segment number, date televised, date submitted, starting manhole number, ending manhole number, pipe diameter, pipe length and street name.

The T.V. inspection shall be used to identify defective construction such as sags, debris, separated joints, etc. The City Engineer shall make all final determinations if the severity of the defect constitutes failure and subsequent removal of the segment in question.

PART 3 – EXECUTION

3.1 GENERAL

Construction methods for each material are specified in the material specifications.

A. Minimum Cover

The minimum cover for class III storm drain pipe (12” through 60”) (See SECTION 33 40 02 – REINFORCED CONCRETE PIPE) shall be two feet (2’) in areas subject to vehicular loads and one foot in non-vehicular areas as measured from the outside top of pipe vertically to finished ground or pavement surface elevation.

END OF SECTION

SECTION 33 40 02

REINFORCED CONCRETE PIPE

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2009 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This item includes the furnishing of labor, materials, equipment, and supervision in the operations required in the laying and jointing of reinforced concrete pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement shall be made based upon the length of pipe as laid in the field. Length of inlets and junction boxes are not included in this measurement. Pipe shall be paid for at the unit price bid in the Proposal for each size and type of pipe, which price shall be full compensation for trenching and backfilling, furnishing and laying the pipe, and furnishing all equipment, labor, materials, tools and incidentals necessary to complete the work.

1.3 SUBMITTALS

- A. Submit certification from independent testing laboratory at manufacturer expense that the pipe meets the requirements of ASTM C76/C76M and ASTM C497/C497M.

PART 2 – PRODUCTS**2.1 MATERIALS**

The Publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM C76	Standard Specification for Reinforced Concrete Culvert Storm Drain and Sewer Pipe (Latest Revision)
ASTM C443	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Latest Revision)

- A. Reinforced Concrete Pipe
 - 1. Reinforced concrete pipe to meet the requirements of ASTM C76. The pipe shall be Class III unless otherwise shown on PLANS.
 - 2. Joint reinforced for rubber gasket joints to meet the requirements of paragraph 8 of ASTM C76.
 - 3. Joints shall be rubber gasket per ASTM C443 unless otherwise shown on PLANS. Lubricant materials for installation purposes to be per manufacturers recommendations. Mineral lubricants are not to be used.
 - 4. Pipe coating requirements are shown on PLANS if required.

2.2 TESTING REQUIREMENTS

Testing methods for the reinforced concrete pipe shall conform to the latest revision of ASTM C497 (Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile).

REJECTION: The pipe may be rejected for having defects or failure to meet requirements as follows:

- A. Variations in any dimension exceeding the permissible variations prescribed.
- B. A piece broken out of the bell or spigot end of such size that the water-tightness of the joint would be impaired.
- C. Any shattering or flaking of concrete or other conditions indicating an improper concrete mix.
- D. Lack of uniformity in placement of steel which might preclude all joints being typical of those tested.
- E. Cracks sufficient to impair the strength, durability or serviceability of the pipe.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

Shipment of pipe to be in accordance with the manufacturer's recommendations. Pipe to be unloaded and stored in a location where pipe will be protected from damage.

3.2 TRENCH/BACKFILL

Pipe trench excavation and backfill to be in accordance with SECTION 31 23 33 – EXCAVATING, TRENCHING, AND BACKFILLING and/or as shown on Plans or as directed by the City Engineer.

3.3 JOINTING OF PIPE

- A. Lay pipe sections in trench to true alignment and grade. Take exceptional care in placing pipe and making field joints. Avoid bumping of pipe in trench.
- B. Properly lubricate groove end of pipe and rubber gasket with lubricant. Stretch gasket over the spigot end of the pipe. Gasket shall be "equalized" by placing a screwdriver between the gasket and spigot and run around the full joint circumference. Do not twist, roll, cut, crimp, or otherwise injure gaskets or force out of position during closure of joints.
- C. Pull or push "home" pipe for closure of the joint. Correct joint rebound before backfilling of pipe.
- D. Remove foreign matter or dirt from pipe, and keep clean during and after laying.
- E. Any damages in pipe installation or prior to final acceptance is to be repaired or replaced in accordance with ASTM C76 at no additional cost to the City.
- F. Failure to conform with any of the specifications herein set forth or referenced.
- G. Failure of pipe to go completely "home" due to binding of spigot against bell.

END OF SECTION

SECTION 33 40 03

STANDARD STORM SEWER INLETS

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2012 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This item shall include Reinforced Concrete Standard Storm Sewer Inlets, which shall be constructed in true conformity with lines, grades, dimensions and designs as shown on the Plans and Standard Detail Sheet and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

- A. This item shall be measured and payment will be made at the unit price bid for each in the Proposal for each Standard Storm Sewer Inlet based upon length of opening. Such payment shall constitute full compensation for furnishing all labor, materials, equipment and incidentals necessary to complete the work, including excavation, forming, reinforcing steel, furnishing and placing concrete, covers, appurtenances, etc. Payment shall not be made for unauthorized work.

1.3 SUBMITTALS

- A. Manufacturers cut sheet for inlet and covers.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Concrete shall be 3500 psi reinforced concrete.
- B. Manhole Rings and Covers
The standard rings and covers (V-1342-3) and storm plate (V-7001PL2) shall be manufactured by East Jordan Iron Works (or approved equal with approval of City Engineer.)

2.2 TESTING REQUIREMENTS

Concrete test results shall be furnished in accordance with SECTION 03 30 00 – CONCRETE.

PART 3 – EXECUTION**3.1 GENERAL**

- A. This construction of reinforced concrete inlets shall be in accordance with standard procedure and shall conform to the location, line, grade, dimension and detail as shown on the Plans and/or directed by the Engineer. All inlets shall be cast in place unless approved by the City Engineer in writing. All excavation, forming and placing of reinforcing steel shall be approved by the Engineer before any concrete is placed. All backfill for inlets shall be in accordance with the Plans.

END OF SECTION

SECTION 33 40 04

REINFORCED CONCRETE RIPRAP

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall govern the furnishing and placing of riprap of concrete of the type indicated on the plans or specified by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement of acceptable riprap complete in place will be made on the basis of the area actually covered.
- B. Concrete in toe walls will be measured as riprap of the type with which it is placed.
- C. The riprap quantities, measured as provided above, will be paid for at the unit prices bid in the Proposal for Reinforced Concrete Riprap, which price will be full compensation for furnishing, hauling, and placing all materials including reinforcement and for all labor, tools, equipment and incidentals necessary to complete the work.
- D. Payment for excavation of toe wall trenches, all necessary excavation below natural ground or bottom of excavated channel, shaping of slopes, will be included in the unit price bid for riprap.
- E. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- A. Concrete Mix Designs
- B. Certification for cement conformance to specification
- C. Test reports for all required concrete tests

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials for concrete shall conform to the requirements of SECTION 03 30 00 - CONCRETE. Concrete shall be of the class shown on the plans unless otherwise specified by the Engineer.

2.2 TESTING REQUIREMENTS

As specified in SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION

3.1 GENERAL

- A. The slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of riprap. Riprap shall not be placed on embankment slopes

until the embankment has been compacted to ninety-eight (98%) percent of Standard Density as specified in A.S.T.M. Designation D-698 or as shown on the plans.

- B. Concrete for riprap shall be placed in accordance with the details and to the dimensions shown on the plans or as established by the Engineer. Concrete riprap shall be reinforced using #4 steel bars spaced at 12 inches on center. Wire reinforcement will not be allowed.
- C. Reinforcement shall be supported properly throughout the placement to maintain its position equidistant from the top and bottom surface of the slab.
- D. If the slopes and bottom of the trench for toe walls are dry and not consolidated properly, the Engineer may require the entire area to be sprinkled, or sprinkled and consolidated before the concrete is placed. All surfaces shall be moist when concrete is placed.
- E. After the concrete has been placed, compacted and shaped to conform to the dimensions shown on the plans, and after it has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.
- F. Immediately following the finishing operation the riprap shall be cured in accordance with SECTION 03 30 00 - CONCRETE.

END OF SECTION

SECTION 33 40 05

REINFORCED CONCRETE HEADWALLS AND ENDWALLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall include reinforced concrete headwalls and endwalls which shall be constructed as indicated on the Plans in true conformity with the lines, grades, dimensions and designs as shown on the Plans and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

- A. Payment for reinforced concrete headwalls or sloped end treatments will not be considered a separate pay item but shall be considered subsidiary to the price of the drainage pipe.

1.3 SUBMITTALS

- A. Concrete Mix Designs
- B. Certification for cement conformance to specification
- C. Test reports for all required concrete tests

PART 2 – PRODUCTS

2.1 MATERIALS

Concrete shall be reinforced concrete as specified in SECTION 33 40 05 – REINFORCED CONCRETE HEADWALLS.

2.2 TESTING REQUIREMENTS

As specified in SECTION 31 23 33 – EXCAVATING, TRENCHING, AND BACKFILLING and SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION

3.1 GENERAL

- A. The surface of the ground on which the headwalls are to be constructed shall be tamped and compacted to ninety-eight percent (98%) standard proctor density (ASTM D 698) to form the bottom of the headwalls and endwalls. The construction of reinforced concrete headwalls and endwalls shall be in accordance with standard procedure and shall conform to the location, line, grade and dimensions as shown on the Drawings and/or as directed by the Engineer. All excavation, forming and placing of reinforcing steel shall be approved by the Engineer before any concrete is placed.

END OF SECTION

SECTION 33 41 16

DRAINAGE CHANNEL EXCAVATION**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Channel Excavation shall consist of required excavation as shown on the Plans; the removal and proper disposal of all excavated materials; and constructing, shaping, and finishing of all earthwork involved in conformity with the required lines, grades and typical cross sections in accordance with Specification requirements herein outlined.
- B. If no classification is indicated on the Plans, "Unclassified Channel Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed.

1.2 MEASUREMENT AND PAYMENT

- A. All channel excavation shall be measured in its original position and the volume computed in cubic yards by the method of average end areas.
- B. All work performed as required herein and measured as provided in the bid proposal will be paid for at the unit price bid per cubic yard. The price bid shall be full compensation for furnishing all labor, material, tools, equipment, and incidentals to complete the work. This payment is to include any and all clearing, grubbing, removal of trees, stumps, trash and debris necessary to perform the work under "Drainage Channel Excavation". This payment shall also be full compensation for shaping and disposal of all material removed and/or excavated.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION**3.1 GENERAL**

- A. All materials removed from the excavation shall be satisfactorily disposed of as indicated on Plans, or as directed by the Engineer. Completed work shall conform to the established alignment, grades and cross sections. During construction, the channel shall be kept drained and the work shall be prosecuted so that the flow into and through the channel is not impeded. Care shall be taken such that spoils left near the channel are not washed into the channel during rainfall events. The placement of erosion control devices may be necessary to prevent the deposition of the silt into the channel.

END OF SECTION

SECTION 33 42 16.13

PRECAST REINFORCED CONCRETE BOX CULVERTS

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2009 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This specification shall govern for the furnishing and placing of precast reinforced concrete box culverts of the size, type and configuration installed to the lines and grades established by the plans.

1.2 MEASUREMENT AND PAYMENT

- A. All box culverts installed in accordance with the above specifications and accepted by the Engineer shall be considered as a complete installation, in place and paid for by the linear foot as noted in the Bid Proposal complete in place, of the type, size and depth constructed. The unit price bid shall be full compensation for furnishing all material, equipment and labor for all excavation, shaping of trench bottom, jointing, laying, dewatering, sheeting, bracing, bedding, backfilling, and specials necessary to install the box sewers in accordance with this specification and of the size, type and depth as shown on the plans.

1.3 SUBMITTALS

- A. Manufacturer's certification that the Precast Reinforced Concrete Box Sections meets the required ASTM Standards.

PART 2 – PRODUCTS**2.1 MATERIAL**

Precast reinforced concrete box culverts shall be manufactured in accordance with the latest revisions published by the American Society for Testing Materials of the following specifications:

- A. ASTM C1577 – Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains and Sewers, Designed According to AASHTO LRFD.
- B. ASTM C1677 – Joints for Concrete Box Using Rubber Gaskets

Unless otherwise specified, all boxes furnished under this specification shall be fabricated with rubber gasket joints.

PART 3 – EXECUTION**3.1 GENERAL**

- A. Joints in concrete boxes shall be made watertight by the use of rubber gaskets.

3.2 INSTALLATION

- A. Trenches shall be excavated with suitable type equipment such as ladder type trenching machines or trench hoes or other equipment that may be approved by the Engineer. Trenches for precast box sewers shall have a width below the top of the box of not less than the outside width of the box plus 16 inches and shall be wide enough to permit making up the joints.
- B. After the trench has been excavated to the bottom, the trench shall be fine graded to the established sub-grade and re-compacted to a density of at least 90% of maximum as determined using ASTM D 698. Any over excavation of the subgrade shall be filled with 3 sack per cubic yard of cement stabilized sand. Cement stabilized sand shall be in accordance with SECTION 31 23 23.53 – CEMENT STABILIZED SAND BACKFILL. The Contractor shall establish the grade line in the trench from grade stakes. The Contractor shall maintain this grade control a minimum of 100 feet behind and ahead of the box laying operation. The Contractor shall, at his expense, furnish and place in position all necessary stakes, grade and batter boards for locating the work.
- C. The precast box sections shall be so laid in the trench that after the sewer is completely installed, the interior surface shall conform accurately to the grade and alignment as shown on the plans or as established and given by the Engineer. All box sections must be laid in a straight line with the tongue end of the box section pointed downstream entering the grooved end of the previously laid box section, to full depth. Caution shall be taken to not drag cement stabilized sand or earth into the annular space. Box sections shall be fitted together and matched to achieve a finished storm sewer with a smooth and uniform invert.
- D. When the tongue is correctly aligned with the flare of the groove the box section shall be pulled or pushed home with sufficient force and power (backhoe, shovel, chain hoist, ratchet hoist or winch) to fully home the spigot into the bell. Each box section shall be pulled home in a straight line with all parts of the box section on line and grade at all times.
- E. No box sewer shall be laid in a trench in the presence of water. All water shall be removed from the trench sufficiently ahead of the sewer placing operation to insure a dry, firm bed on which to place the sewer, and if necessary, the trench will continue to be dewatered until after the sewer is bedded and backfilled as directed by the Engineer. Removal of water may be accomplished by pumping, or pumping in connection with the well point installation as the particular situation may warrant. The Contractor shall satisfy himself as to the soil conditions to be encountered.
- F. Where necessary, to comply with OSHA Regulation 1926.650, the side of the trench or other excavation shall be braced and rendered secure to the satisfaction of the Engineer. Board sheeting and/or steel sheeting may be utilized as directed by the Engineer. The bracing shall be in accordance with OSHA requirements.
- G. Following compaction of the trench bottom at the established grade, the Contractor shall place a minimum of a 6 inch thickness cement stabilized sand bedding in such a manner that once the box sections are laid, the invert elevation in the box section shall conform to the plan elevations. No voids in the bedding material shall be permitted. Cement stabilized sand shall be composed of a minimum of 3 sacks of cement per cubic yard of sand.
- H. When installing concrete box culverts in an existing channel, ditch or gully, cement stabilized sand shall be placed up to the spring line of the box culvert.

- I. When installing concrete boxes in a trench condition, backfill shall consist of material excavated on the site, and deemed adequate by the Engineer, or materials obtained from a suitable borrow site. Suitable materials shall be CL/CH materials as determined by the Uniform Soil Classification System that are cohesive in nature, free of debris and organic materials and acceptable to the Engineer. Backfill shall be placed in maximum eight (8) inch lifts, sprinkled as required and compacted to a density of 90% standard proctor density (ASTM D 698). Moisture content shall be controlled so that the required density is achieved at a moisture content ranging from optimum moisture to 3 percent above optimum density.
- J. Backfill over box sections will be permitted as installation proceeds. Prior to backfilling, the Contractor shall remove all steel sheeting and/or cut off all timber sheeting a minimum of three (3) feet below finished grade as shown by the plans. Backfill shall consist of material excavated on the site and deemed adequate by the Engineer or materials obtained from a suitable borrow site. Suitable materials shall be CL/CH materials as determined by the Uniform Soil Classification System (ASTM D 2487) and are cohesive in nature, free of debris and organic materials and acceptable to the Engineer. Backfill shall be placed in maximum eight (8) inch lifts, sprinkled as required and compacted to a density of 90% standard proctor density (ASTM D 698). Moisture content shall be controlled so that the required density is achieved at a moisture content ranging from optimum moisture to 3 percent above optimum density.
- K. Where backfill occurs beneath a road surface the material from two (2) feet below subgrade to the established base material shall be compacted to a density of 98% standard proctor density (ASTM D 698).
- L. A seal slab shall be installed, when shown by the drawings. If precast seal slabs are used, the joint of the seal slab shall not coincide with the joint of the box.
- M. Laboratory tests will be performed as the backfill proceeds. All backfill not meeting this specification shall be removed and re-compacted to the satisfaction of the Engineer at no cost to the Owner.
- N. All surplus excavated material shall become the property of the Contractor and shall be disposed of by the Contractor.
- O. The angles in box type sewers shall be built in accordance with the plans and specifications. The cost of making these angles and all cost incidental to them shall be included in the unit price bid for box sewer.
- P. Where junction with other storm sewers are to be made, openings may be left in the walls the size of which shall be the outside dimensions of the connecting sewer. A bond length of each reinforcing bar shall be left in the opening for connecting with the concrete collar or future sewer. Where a stub sewer is to be built, the end of the concrete of the stub sewer at the box sewer shall be at the inside face of the sewer box wall. All openings shall be closed with a 12-inch thick brick bulkhead. The cost of providing bulkheads shall be included in the unit price for the box sewer.

END OF SECTION