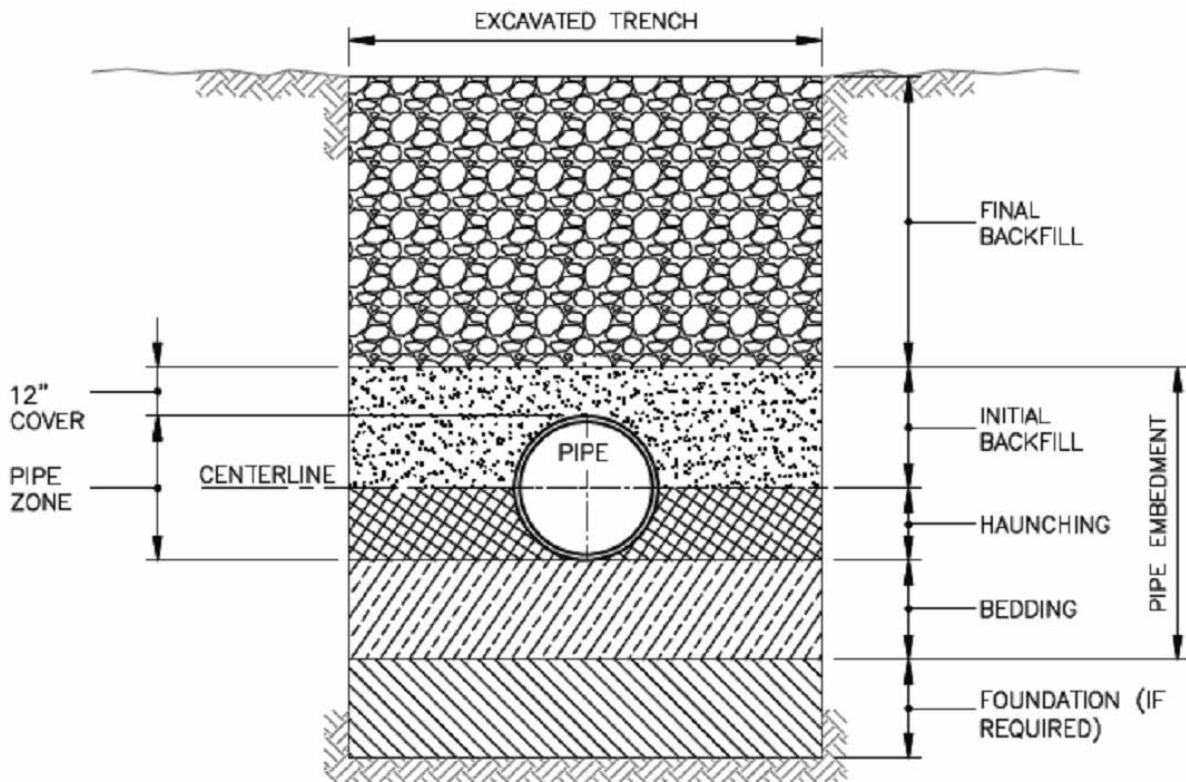


## SECTION 31 23 33

### TRENCHING AND BACKFILLING

#### PART 1: GENERAL

##### 1.01 DEFINITIONS – TRENCH TERMINOLOGY



- A. Foundation – A foundation is necessary only when native soils are unstable. For such conditions, the trench is over-excavated and a layer of supportive material is placed and compacted to provide a firm foundation for the subsequent pipe embedment materials. Must be approved by the Owner prior to over-dig.
- B. Embedment – This zone is the most important in terms of pipe performance. It is divided into the following sub zones:
1. Bedding – Typically six inches of supportive, compacted material. This zone provides even support for the pipe and brings it to grade.
  2. Haunching – Extends from the bottom of the pipe to the centerline of the pipe. It provides the most resistance to pipe deflection. Specifying proper materials and compaction are most important for this zone.
  3. Initial Backfill – Extends from the spring line to a point above the top of the pipe. This zone provides some pipe support and helps to prevent

damage to the pipe during placement of the final backfill. The cover extends from the top of the pipe to the top of the initial backfill. The depth of cover should be as much as necessary to protect the pipe during placement of the final backfill. Twelve inches is a common depth of cover.

- C. Final Backfill – This zone extends from the top of the initial backfill to the top of the trench. This zone has little influence on pipe performance, but can be important to the integrity of roads and structures. See specification Section 31 23 23 – Utility Backfill Materials for description of backfill and bedding materials.

## **1.02 SUBMITTALS**

- A. All backfill materials (to be used for backfill, haunching, and bedding), shall be MODOT Type 5 or as approved by Owner prior to placing the materials in the pipe trench. Test all backfill materials, whether obtained from the trench excavation or from an off-site source, as directed by the Owner.
- B. All backfill materials must be approved by the Owner before they are placed in the pipe trench. Submit samples of the materials to an approved testing agency for analysis as required by the Owner. Submit the testing agency's test results and report to the Owner. The report must state that the materials meet the requirements of these Specifications and the Specifications of Federal, State and local authorities (where applicable).

## **1.03 PROFILES AND TOPOGRAPHY**

- A. Contours, topography and profiles of the ground shown on the Drawings are believed to be reasonable approximations and are not guaranteed.
- B. The Contractor accepts the construction site with the conditions that existed at the time of bidding.

# **PART 2: PRODUCTS**

## **2.01 COMMON FILL**

- A. Common Fill shall be earth materials entirely free of: vegetation; trash; lumber; and frozen, soft or organic materials. No stones or rocks larger than the sizes listed below will be permitted in the Common Fill:
  - 1. Common Fill-Type A: No stones or rocks larger than 1-inch
  - 2. Common Fill-Type B: No stones or rocks larger than 4-inches. At the discretion of the Owner and depending upon the quality of the material, stones and rocks up to a maximum of 6 inches may be allowed.
- B. Common fill material may be obtained from the trench excavation provided it has been tested in accordance with the requirements in Section 2.01 above and approved by the Engineer. Furnish the necessary approved common fill materials from an off-site source whenever approved material obtained from the trench excavation is insufficient to complete the backfill.

## 2.02 HAUNCHING FILL

- A. Materials used for haunching around the pipe shall be MODOT Type 5 fill or as approved by OWNER, in accordance with AWWA C151 Type 4 laying condition. The material shall conform to ASTM D 2487 "Standard Method for Classification of Soils for Engineering Purposes" using the "Unified Soil Classification System", except where a higher standard is required elsewhere in the Contract Documents or by rules or regulations of Federal, State or local governmental bodies having jurisdiction over the site of the Work.
  - 1. For Ductile Iron Pipe where Type 5 laying condition is required in accordance with AWWA C151 Table 5 (see Section 33 11.00.15 – Ductile Iron Pipe and Fittings), haunching material shall be of compacted granular fill per AWWA C151 Type 5 laying condition.
- B. The haunching material shall meet the Class II soil type designation. Class II soil types include GW, GP, SW and SP that are described as non-cohesive, well graded and containing some fines. Voids, finer grained soils or movement can allow undesirable migration of haunching material or migration of the trench sidewall material into the haunching material. In such instances place filter fabric, as directed by the Owner, in the trench bottom and sides before placing the haunching material.
- C. Haunching material may be obtained from the trench excavation provided it has been approved by the Owner who may, at his discretion, require testing in accordance with the requirements of Section 2.02 A and B. above. Furnish the necessary approved haunching materials from an off-site source whenever approved material obtained from the trench excavation is insufficient to complete the haunching.

## 2.03 BEDDING FILL

- A. ¾ inch clean granular fill material shall meet the sieve analysis requirements of AASHTO as follows 1" sieve passing 100%, ½" sieve passing 0-5% and sieve size No 4 passing 0-1% or approved equal as approved by the Owner. This material may be wrapped in filter fabric (trench bottom, side, and over top of clean granular fill), as directed by the Owner, to prevent the migration of finer grained soils into this material or the migration of this material into the trench bottom or sidewall.
- B. ¾ inch Minus granular fill material contains additional fine material and may be used as noted in specific pipe specifications. Material shall meet the sieve analysis requirements of AASHTO as follows 1" sieve passing 100%, ¾" sieve passing 80-90%, No 4 sieve passing 25-50%, No 10 sieve passing 0-20% No 200 passing sieve 0-5% or approved equal as approved by the Owner.
- C. For Ductile Iron Pipe:
  - 1. Where depths allow a Type 4 laying condition in accordance with AWWA C151, material shall be coarse to fine, sandy natural soil material with maximum stone size of 1-inch and shall meet ASTM D 2487 "Standard

Method for Classification of Soils for Engineering Purposes". Scarify soil 2" deep before placing pipe.

2. Where depths require a Type 5 laying condition in accordance with AWWA C151, material shall be of compacted granular fill per AWWA C151 Type 5 laying condition. Scarify soil 2" deep before placing pipe.

## **2.04 FILTER FABRIC**

- A. Filter fabric shall be non-woven, synthetic fiber material with sieve design to prevent the select material in the pipe bedding and haunching from migrating into the surrounding soils. The material shall have a minimum: thickness of 15 mils, tensile strength of 130 lbs, elongation at break of 64%, and trapezoidal tear strength of 70 lbs.

## **PART 3: EXECUTION**

### **3.01 CONSTRUCTION EQUIPMENT**

- A. All backfilling and materials handling equipment shall have rubber tires when mains are located in or adjacent to pavements. Crawler equipment shall be permitted when there is no danger of damaging pavement. It is the Contractor's responsibility, to repair, at their expense, any damages due to the use of any equipment to complete the work.

### **3.02 NOISE, DUST AND ODOR CONTROL**

- A. Conduct all construction activities so as to eliminate all unnecessary noise, dust and odors.

### **3.03 PROTECTION OF TREES**

- A. Take special care to avoid damage to trees and their root system. Open trenching shall not be used for established trees in areas marked on the plans and designated 'Root Protection Zone'. In these areas, methods to be used include tunneling or boring. In other areas where established trees are to remain with roots in the path of the trench line, the Owner shall direct acceptable means to install pipe through tree roots. In these areas, methods to be used careful cutting (not ripping or tearing) of larger tree roots. In all cases, operate equipment within the limb spread in a manner which will not injure trees, trunks, branches or their roots. Pay particular attention when employing booms, storing materials, and handling excavated materials.

### **3.04 TRENCH SUPPORT**

- A. Support open cut excavation for mains where trenching may cause danger to life, unnecessary damage to street pavement, trees, structures, poles, utilities, or other private or public property. Support the sides of the excavation by adequate and suitable sheeting, shoring, bracing or other approved means in accordance with all applicable Federal, State, County, Municipal and OSHA rules and regulations during the progress of the work, whenever and wherever it is necessary. Maintain the trench support materials and equipment in place until

backfilling operations have progressed to the point where the supports may be withdrawn without endangering life or property.

### **3.05 TRENCH EXCAVATION AND BOTTOM PREPARATION**

#### **A. General Excavation**

1. General excavation shall consist of the satisfactory removal and disposal of all material taken from within the limits of the Work contracted, meaning the material lying between the original ground line and the finished ground line as shown on the Drawings regardless of whether the original ground line is exposed to air or is covered by water. Excavation below existing ground line to enable any required construction or removals is included. It is distinctly understood that any reference to earth, rock, silt, debris or other materials on the Drawings or in the Specifications is solely for the Owner's information and shall not be taken as an indication of classified excavation or the quantity of earth, rock, silt, debris or other material encountered.
2. Excavation to the lines and grades indicated on the Drawings or established in the field by the Owner. Backfill over-excavated areas with approved fill material. All labor and materials shall be furnished at the Contractor's expense.
3. Keep all excavations free from water. Maintain groundwater a minimum of 6 inches below excavations. Remove soil which is disturbed by pressure or flow of groundwater and replace with free draining material.
4. Remove pavement over excavations made in paved roadways by saw cutting, milling, or removal by a trench machine. Cut the full depth of the pavement with straight lines and squared edges.
5. Dispose of excess excavated materials and excavated materials unsuitable for backfilling off site. Furnish the Owner with satisfactory evidence that an appropriate disposal site was used.

#### **B. Rock Excavation**

1. If the Contract includes a unit price for rock excavation, it includes the removal, hauling, stockpiling and/or proper disposal the rock per the specification section 01 00 02 Basis of Payment. Rock is defined as:
  - a. Boulders or loose rock having a volume of one cubic yard or more;
  - b. Material which cannot be loosened or broken down by ripping with a hydraulic ripper or other Owner approved devices and equipment designed to remove rock; or
  - c. Material that requires systematic blasting, barring, backhoe ramming or wedging for removal.

2. Notify the Owner promptly upon encountering rock. The Owner's determination as to whether the material meets the definition of rock and Owner's measurement of the volume of rock removal for which the Contractor is entitled to payment will be final and conclusive. No payment will be made for rock removed without Owner's approval.
3. Strip rock for measurements as directed by the Owner. No payment will be made for rock excavated or loosened before measurement. Only rock actually removed will be paid for, and in no case will payment be made for rock removal beyond the payment limits shown for a standard trench or more than 12" beyond the edge of a pipeline or 6" below its bottom for pipes of nominal OD 24 inches and less, unless such rock has been removed at the direction of Owner.

C. Blasting Rock

1. Blasting is not allowed unless expressly permitted by the Owner. Notify the Owner in advance of blasting. Provide evidence to the Owner that the proposed blasting will comply fully with Laws or Regulations.
2. Do not blast where limited or prohibited by any Federal, State or local laws or regulations, or in violation of any limitation or restriction contained in any right-of-way, or wherever specifically prohibited in any Drawing or other Contract Document. Do not blast within forty (40) feet of any pipe or structure without specific permission from the Owner. Properly cover blasts and protect the pipe or structure. Warn all persons in the vicinity. Blasting shall be at the risk of the Contractor who shall be liable for all damages to persons or property. Secure and pay for all necessary permits. Perform whatever pre-blast surveys and investigations that may be required by the circumstances and/or by Federal, State or local laws.
3. Prepare a blasting plan and submit it to the Owner for approval prior to commencing any blasting work. The plan shall state all procedures and methods which will be used to monitor and mitigate the effect or impact of the proposed blasting work.
4. Employ an experienced blaster holding a blasting license issued by the applicable State to carry out the blasting work. Use, handle, and store explosives as prescribed by the applicable state and federal regulations. Keep all explosives in a safe place at a sufficient distance from the Work so that, in case of accident, no damage will occur to any part of the Work. Contractor shall be held responsible for and shall pay for all damage caused by blasting operations or accidental explosion.

D. Trench Width – Widths of trenches shall be held to a minimum to accommodate the pipe and appurtenances. The trench width shall be measured at the top of the pipe barrel and shall conform to the following limits:

1. Earth
  - a. Minimum: Outside diameter of the pipe barrel plus 8 inches, i.e., 4 inches each side.



- b. Maximum: Nominal pipe diameter plus 24 inches.
- 2. Rock
  - a. Minimum: Outside diameter of the pipe barrel plus 24 inches, i.e., 12 inches each side.
  - b. Maximum: Normal pipe diameter plus 30 inches. (Contractor will only be compensated for the minimum described above.)
- E. Excessive Trench Width – Provide additional backfill, haunching, and bedding material, as specified in Sections 2.01, 2.02, and 2.03 as approved by the Owner to fill any trench excavation that exceeds the maximum trench width defined in Section 3.05.D. Dispose of excess excavated materials off site at no cost to the Owner. Furnish the Owner with satisfactory evidence that an appropriate disposal site was used.
- F. Trench Depth
  - 1. General Provide 42 inches of cover from the top of the pipe barrel to the top of the finished grade of the roadway, unless otherwise authorized by the Owner, or as shown on the plans.
  - 2. Earth Excavate to the depth required, so as to provide a uniform and continuous bearing and support for the pipe barrel on solid and undisturbed ground at every point between joints. It will be permissible to disturb the finished trench bottom over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. Provide bell holes and prepare the finished trench bottom accurately using hand tools.
  - 3. Rock Excavate trenches in rock or boulders 6-inches below the pipe barrel for pipe 24-inches or less in diameter. Remove all loose material from the trench bottom. Prepare a pipe bed using bedding material (3/4" Clean Granular Fill) as specified in Section 2.03.
  - 4. Unsuitable Bottom Notify the Owner whenever unsuitable material is found below subgrade. Remove the material over the area and to the depth determined by the Owner. Provide compacted bedding material (3/4" Clean Granular Fill) as specified in Section 2.03 to restore the trench bottom to the required grade in these areas.
- G. Open Trench Length – The length or size of excavation shall be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by Owner. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, Owner may require special construction procedures such as limiting the length of the open trench or prohibiting stacking excavated material in the street. Take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which could be dangerous to the public, shall be well lighted.

### 3.06 TRENCH BACKFILLING - OPEN TERRAIN

All trench backfilling shall be compacted so that no settlement occurs and is stable with surrounding soil that also shall not have settled.

#### A. Ductile Iron Pipe

##### 1. Bedding:

- a. In Suitable Soil See Section 2.03(c) for definition of soil and means of bedding.
- b. In Rock or Unsuitable Soil When encountering rock or unsuitable material, prepare pipe bedding immediately before pipe is laid. In this instance, compact  $\frac{3}{4}$ " Clean Granular Fill as described in Section 2.03 from 6" below the pipe to the bottom of the pipe.

##### 2. Haunching:

- a. Place haunching from the bottom of the pipe barrel to the centerline (springline) of the pipe barrel with Haunching Fill (Section 2.02) or  $\frac{3}{4}$ " Clean Granular Fill as described in Sections 2.02 and 2.03.
- b. Take care to avoid injuring or moving the pipe. Place the material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints.

##### 3. Initial Trench Backfill:

- a. Where depths allow a Type 4 laying condition in accordance with AWWA C151, backfill from the centerline (springline) of the pipe barrel to 12 inches above the pipe with Common Fill-Type A, as described in Section 2.01.
- b. Where depths require a Type 5 laying condition in accordance with AWWA C151, material shall be of compacted granular fill per AWWA C151 Type 5 laying condition. Backfill from the centerline (springline) of the pipe barrel to 12 inches above the pipe with  $\frac{3}{4}$ " Clean Granular Fill, as described in Section 2.03.
- c. See Specification 33 05 19.03 (Ductile Iron Utility Pipe WasteWater) for determining required laying conditions in accordance with ASTM C151.
- d. Mechanical equipment may be used to place the backfill. Place the material in such a manner that the material does not free fall, but rather flows onto the previously placed material. Consolidate the backfill in such a manner as will ensure the minimum possible settlement and the least interference with traffic.
- e. Do not compact the backfill with mechanical equipment, such as wheeled vehicles, unless sufficient cover is provided over the pipe to prevent damage to the pipe.



4. Final Trench Backfill:

- a. Backfill from 12 inches above the pipe to final grade with Common Fill-Type B, as described in Section 2.01. Mechanical equipment may be used to place the backfill.
- b. Place the material in such a manner that the material does not free fall, but rather flows onto the previously placed material. Consolidate the backfill in such a manner as will ensure the minimum possible settlement and the least interference with traffic.
- c. Do not compact the backfill with mechanical equipment, such as wheeled vehicles, unless sufficient cover is provided over the pipe to prevent damage to the pipe.

5. Surface Conditions:

- a. Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out.
- b. Maintain the trench surface in a safe condition that does not interfere with natural drainage.

6. Deficiency of Backfill:

- a. Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

B. PVC and HDPE Pipe

1. Bedding:

- a. Prepare pipe bedding immediately before pipe is laid. Compact  $\frac{3}{4}$ " Clean Granular Fill as described in Section 2.03 from 6" below the pipe to the bottom of the pipe.
- b. Clay or impermeable soil type water stops shall be installed approximately 2 feet wide from the bottom of the bedding to the ground elevation every 50 to 100 feet to promote water to migrate to the surface unless approved by the Owner.

2. Haunching and Initial Backfill:

- a. Place haunching and initial backfill from the bottom of the pipe barrel to 12 inches above the top of the pipe barrel with  $\frac{3}{4}$ " Clean Granular Fill as described in Section 2.03. When material with high void ratios (e.g.  $\frac{3}{4}$  inch clean granular fill) are used for embedment, it is possible for fines in the trench walls to migrate into the voids. This can cause some loss of support. An alternative method is to install filter fabric in the boundary between the trench and the fill to prevent migration.
- b. Place the clean granular material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints. Another alternative is to use materials containing fines, (e.g.  $\frac{3}{4}$  inch minus).

3. Remaining Trench Backfill:

- a. Backfill from 12 inches above the pipe to finished grade with Common Fill-Type B, as described in Section 2.01. Mechanical equipment may be used to place the backfill.
- b. Place the material in such a manner that the material does not free fall, but rather flows onto the previously placed material. Consolidate the backfill in such a manner as will ensure the minimum possible settlement and the least interference with traffic.
- c. Do not compact the backfill with mechanical equipment, such as wheeled vehicles, unless sufficient cover is provided over the pipe to prevent damage to the pipe.

4. Surface Conditions:

- a. Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out.
- b. Maintain the trench surface in a safe condition that does not interfere with natural drainage.

5. Deficiency of Backfill:

- a. Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

**3.07 TRENCH BACKFILLING – Within 3 feet of Driveways, Roads, and Parking Areas**

- A. Bedding – Install bedding for selected pipe material in accordance with Section 3.06.
- B. Haunching and Backfill – Haunch around the pipe and fill the remainder of the excavation using  $\frac{3}{4}$ " Clean Granular Fill, as described in Section 2.03. Place the material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints. Take care to avoid injuring or moving the pipe.
- C. Surface Conditions – Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage.
- D. Deficiency of Backfill – Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

### **3.08 SPECIAL BACKFILLING (Under Roads – option to the Contractor)**

- A. Bedding – Install bedding for selected pipe material in accordance with Section 3.06.
- B. Haunching and Backfill – Place haunching and initial backfill from the bottom of the pipe barrel to 12 inches above the top of the pipe barrel with  $\frac{3}{4}$ " Clean Granular Fill as described in Section 2.03. When material with high void ratios (e.g.  $\frac{3}{4}$  inch clean granular fill) are used for embedment, it is possible for fines in the trench walls to migrate into the voids. This can cause some loss of support. An alternative method is to install filter fabric in the boundary between the trench and the fill to prevent migration. Place the clean granular material in uniform 6 to 12 inch loose layers and compact each layer so as to eliminate the possibility of settlement, pipe misalignment, or damage of joints. Another alternative is to use materials containing fines, (e.g.  $\frac{3}{4}$  inch minus). Vibratory compaction and moisture addition is required to obtain maximum compaction.
- C. Surface Conditions – Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage.
- D. Deficiency of Backfill – Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

### **3.09 QUALITY ASSURANCE TESTING**

- A. The Owner reserves the right to have the Contractor provide Independent Quality Assurance Testing for the backfill material, at the Contractor's expense.

### **3.10 TRENCH MAINTENANCE**

- A. Assume full responsibility for the condition of the trenches for a period of one (1) year from the date of the final acceptance of the Contractor's work, or as required by state, county or local authorities, and any materials required for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at their expense.

**--END OF SECTION 31 23 33--**