

## SECTION 2100 - TRENCHING AND TUNNELING

### PART 1- GENERAL

- 1.01 SCOPE:** This Section covers excavation, fill, and compaction of earth and rock for utility trenches in public right-of-way and in sewer easements. Topics include acceptable materials, imported materials, topsoil stripping, dewatering, disposal of excess material, cleanup, placement of fill, preparation of pavement subgrade, plating, and compaction requirements.
- 1.02 RELATED WORK:** Refer to the following sections for related work:
- |                            |  |
|----------------------------|--|
| Photographic Record        | Section 1000-General Requirements                                |
| Construction Fence         | Section 1200-Incidental Construction                             |
| Embankment Construction    | Section 2000-Earthwork   |
| Final Surface Preparation  | Section 2000-Earthwork   |
| Flowable Fill              | Section 4000-Concrete Materials and Methods                      |
| Filter Fabric              | Section 2000-Earthwork   |
| Trench Width, Pipe Bedding | Section 5100-Sanitary Sewer Main and<br>Section 5200-Storm Sewer |
| Topsoil Placement          | Section 7000-Seeding, Sodding, and Mulching                      |
- 1.03 OSHA STANDARD:** Contractor is notified that the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) has standards for excavations and trenches that affect the work covered by this Section.
- 1.04 TUNNELER'S QUALIFICATIONS:** Installation of casing and carrier pipe and fill mixture shall be by an installer with at least three successful installations of similar scope.
- 1.05 SUBMITTALS:** Submit the following for review:
- A. Soil samples for moisture-density tests. One sample required for each soil type encountered.
  - B. Tunneler's references.
- 1.06 DEFINITIONS:** In this Section, the following words shall have the meanings specified:
- A. Rock: Rock ledges 6 inches or more in thickness with interbedded seams of soft materials less than 12 inches thick, or detached boulders 1-1/2 cubic yards or greater in volume.
  - B. Overexcavation: Excavation beyond the normal trench limits as defined by the appropriate utility specification. Overexcavation will be considered authorized when directed by Engineer to remove unsuitable material. All other overexcavation, including unsuitable material removed without Engineer's direction, shall be considered unauthorized. Payment shall not be made for unauthorized excavation or its repair.
- 1.07 PERMITS:** Contractor shall obtain a haul permit from the Unified Government if operations require on-street transportation of earth or excavated rock.

- 1.08 PHOTOGRAPHIC RECORD:** Whenever excavation will be closer to an existing improvement to remain than a plane descending at 1.5 Horizontal to 1 Vertical from a point on the original ground line at the existing improvement, Contractor shall make a photographic record of the existing improvement.

## PART 2 - PRODUCTS

- 2.01 ACCEPTABLE FILL MATERIAL:** On-site or imported material free of muck, frozen material, excess moisture, organic material, topsoil, rubbish, construction debris, and rock or brick larger than 8 inches. Excavated trench material generally meets this standard.
- 2.02 BACKFILL UNDER PAVEMENT:** KDOT Standard Specifications Subsection 1105, AB-3, aggregate for aggregate base construction. For convenience the following graduation is reprinted from the KDOT standard:

<u>Sieve Size</u>	<u>Percent Retained</u>
1½ inch	0 - 5
¾ inch	5 - 30
No. 4	35 - 60
No. 8	45 - 70
No. 40	70 - 84
No. 80	80 - 92

- 2.03 SURGE ROCK:** Stone for Aggregate Ditch Lining,  $D_{50} = 5$  inches, KDOT Standard Specifications Subsection 1116.
- 2.04 CASING PIPE:** Casing pipe for small diameter tunneling shall conform to ASTM A139, and wall thickness shall be as listed below.

<u>Diameter (in)</u>	<u>Under Railroads (in)</u>	<u>Other Locations (in)</u>
Less than 14	0.188	0.188
14 to 18	0.250	0.219
20 to 24	0.344	0.281
26 to 30	0.406	0.312
32 to 36	0.469	0.344

Waterproof caps shall be provided for each end. A 17-pound magnesium anode shall be installed at each end of the casing.

- 2.05 TUNNEL LINER:** Where segmented tunnel liner system is used, it shall be designed and stamped by a professional engineer. The minimum factors of safety shall be as follows:

<u>Critical element</u>	<u>F.S.</u>
Seam strength	3.0

Wall buckling	2.0
Installation stiffness	3.0

**2.06 SAND - CEMENT FILL:** Fill between carrier and casing pipe shall be a dry mixture of 10 parts clean sand and 1 part portland cement, unless otherwise required on drawings or in Special Conditions.

**2.07 SKIDS:** Furnish skids for pipe alignment guides as indicated for all carrier pipe to be installed in casing.

- A. Minimum spacing of skids shall be 10 feet or every pipe joint, whichever is the lesser.
- B. Size to fit outside diameter of carrier pipe and inside diameter of casing pipe.
- C. Skids to be size slightly larger than carrier pipe's outside joint diameter.

Provide the following:

- A. Stainless steel casing spacers with plastic runners, Cascade Waterworks Style CCS or Engineer-approved equal.

**2.08 PLATES FOR TEMPORARY TRAFFIC SUPPORT:** Plates shall be ASTM A36 structural steel, minimum 3/4-inch thick and of sufficient length to provide adequate bearing surface on solid pavement.

### PART 3 - EXECUTION

**3.01 TRENCHING:** The following requirements apply to all trenching:

- A. Avoid embankment loading of exposed pipe: If the elevation of the ground at time of the trenching would be result in less than 2 foot of cover over the top of the pipe, then construct a platform of compacted fill to the dimensions shown in the standard detail. Proceed to trench into the compacted platform for pipe installation.
- B. Exposed Trench / Public Protection: No more than 175 feet of trench shall be excavated in advance of the laying crew. Except as approved by Engineer, trench shall be filled or plated when workers are not present. Excavations left overnight and all excavations in areas of high pedestrian traffic shall be surrounded by high visibility construction fence. Excavations left overnight in areas subject to vehicular traffic shall be further marked by reflectorized drums or barricades.
- C. Trench Width: Refer to the bedding instructions for the specific utility. See reference in Part 1, this Section.
- D. Cutting Roots: When excavating within a distance of 6 times the diameter at chest height of a tree to remain, cut roots by either of the following methods:

1. Expose large roots without tugging, hacking, or scraping on root. Cut with sharp axe or saw.
2. Prior to excavation, make a narrow vertical cut at limits of excavation using a utility trencher. Cut shall be at least 3 feet deep.

This requirement does not apply to small roots that are severed with the first advance of the excavator bucket.

- E. Dewatering: Water shall be prevented from entering or standing in the trench or tunnel. Dewatering methods may include pumping, sheeting and shoring, and control of runoff by ditching and berming as appropriate to the site conditions.
- F. Unsuitable Foundation: No pipe or fill shall be placed in water or on frozen, unstable, or otherwise unsuitable subgrade. If material encountered at the trench subgrade cannot support the pipe, Engineer shall be called for identification and directions. Engineer's directions to remedy unsuitable foundations shall be followed. Remediation directed by Engineer may be overexcavation and replacement with surge rock or concrete cradle for rigid pipe, or concrete encasement for flexible pipe.
- G. Overexcavation: All overexcavation in trenches shall be filled with stone fill material.
- H. Rock: If rock is encountered, Contractor shall inform Engineer and shall not commence excavation of rock until the upper limits of the rock strata have been defined. Contractor shall follow individual utility specification for overexcavation. A blasting permit is required for use of explosives on a construction site.
- I. Disposal: Excess material shall be disposed of on site only as permitted by the drawings or as directed by Engineer; such directions shall control the location, shape, method of placement, and types of material disposed. If on-site disposal is not permitted, Contractor shall make his own arrangements for off-site disposal.
- J. Bedding: Pipe shall be bedded and initial backfill placed according to the pipe bedding requirements of the specific utility.
- K. Backfill and Compaction: Thickness of lifts shall be compatible to the compaction equipment used. Backfill material and compaction requirements above the initial bedding zone shall be:
1. In areas not under proposed pavement, backfill shall be acceptable fill material compacted to 90 percent of standard density as determined by ASTM D698.
  2. In areas to receive pavement or within 4 foot horizontal of proposed pavement, backfill shall be aggregate base course compacted to 95 percent of standard density as determined by ASTM D698.

3. Where the trench width allows the effective use of embankment compaction techniques, follow the requirements for embankment construction. Examples of this condition are:
    - i. A deep trench where a sufficiently wide bench is cut at least 2 feet above the proposed top of pipe.
    - ii. Where trenching is done prior to mass grading the trench shall be backfilled per 1 or 2 above; however the fill above the existing ground at the time of the pipe installation may be placed as embankment.
  4. Excavations with maximum horizontal dimension of 4 feet or less may be filled with flowable fill at Contractor's option.
- L. Preparation of Final Surface: Surface elevation shall match adjacent surfaces and shall not form a depression. Unless subsequent surface improvements are called for in the work, restore surface to match or exceed previously existing condition. See reference in Part 1 for additional requirements for preparation of pavement subgrade in paved areas and topsoil placement in nonpaved areas.
- M. Maintenance of Traffic Flow: Except where work zone is completely closed to traffic, plates or temporary surfacing shall be used to maintain traffic flow.

**3.02 TUNNELLING:** Tunnelling shall be completed prior to open trench installation of upstream and downstream reaches. Tunnelling shall be used where required on the drawings. Contractor may, at his option, substitute tunnelling for open trench excavation. Payment for optional tunnelling shall be at the unit price for the trench, backfill, and surface restoration of the depth and type for which the substitution was made.

- A. Casing Pipe: Casing pipe shall be installed by augering or jacking. Auger shall be sized to leave no voids outside the installed casing pipe. Alignment and grade shall permit the carrier pipe to be installed to the line and grade proposed on the drawings. Field welds shall conform to American Water Works Association (AWWA) Standard C206.
- B. Carrier Pipe: A minimum of 2 sets of skids shall be used for each length of carrier pipe. Thickness of skids shall be adjusted to bring installed carrier pipe to proposed line and grade. Carrier pipe shall be pulled or pushed through so as to not disturb the integrity of the joints.
- C. Sand - Cement Fill: Required tightness tests shall be completed before filling the casing void. Sand - cement fill mixture shall be blown or pumped to fill the annular space between carrier pipe and casing pipe. Both ends of casing shall be closed with common brick and mortar.
- D. Tolerances: Unless otherwise stated in the drawings, the installation shall be true to design line and grade to within 0.1 diameter of the carrier pipe.
- E. Plans for boring, monitoring of uplift and settlement, lining, carrier pipe installation, and grouting of large diameter tunnels shall be submitted to Engineer for review.

**STANDARD DETAILS RELATED TO THE WORK OF THIS SECTION:**

UG 2100-A TRENCH DETAIL

UG 2100-B SANITARY AND STORM SEWER BEDDING

UG 2100-C PLATFORM FOR EXPOSED PIPE INSTALLATION

END OF SECTION 2100