Section 02250 - TUNNEL EXCAVATION

1. SCOPE. This section covers tunnel excavation, installation of carrier pipe, and all associated items. Refer to Standard Details for additional information.

2. INSTALLATION. When pipelines are shown to be installed in tunnels or when pipelines shown to be bored and jacked cannot be installed due to obstructions, the pipelines shall be constructed in tunnels, in conformity with the requirements which follow. Before starting work on any tunnel, detailed drawings, specifications, and other data covering the liner to be used shall be submitted in accordance with the submittals section.

The clear inside diameter of tunnel liners shall be within 4 inches of the nominal diameter indicated on the drawings.

The Contractor shall furnish and install tunnel liners suitable for the installation of the interceptor sewer or water main at locations shown on the contract drawings. The tunneling operation shall conform with requirements of Division 1, Section 16, of the interim Standard Specifications for Highway Bridges, published by the American Association of State Highway and Transportation Officials, 341 National Press Building, Washington, D.C. 20004.

The tunnel liner plates shall be fabricated from structural quality, hot rolled, carbon steel sheets or plates conforming to ASTM A569. The mechanical properties of the plates and sheets before cold rolling shall be as follows:

Modulus of elasticity of steel	$E = 29{,}000{,}000$ psi
Ultimate strength of steel	$F_u = 42{,}000$ psi
Yield strength of steel	$F_y = 28{,}000$ psi

All liner plates shall be galvanized in accordance with the requirements of AASHTO M167. Bolts, nuts, washers and other accessory hardware shall be hot-dip galvanized in accordance with the requirements of ASTM A153. If additional protection is required, the plate shall be bituminous coated to meet the requirements of AASHTO M190 or M-243-751 (Field Coating).

Bolts and nuts shall not be less than 1/2 inch in diameter for plate thickness up to and including 0.179 inch (7 gage) and not less than 5/8 inch for plate thickness equal to or greater than 0.209 inch (5 gage). Bolts and nuts shall be quick acting coarse thread and shall conform to ASTM A307, Grade A.

The tunnel shall be installed using plates of the gage (thickness), size, and dimension indicated and shall conform with the line and grade shown on the contract drawings.

Liner plates shall be assembled in accordance with manufacturer's instructions. Courses of plates shall be staggered 1/2 plate when the course contains all whole plates. When the course contains a 1/2 plate, the course shall be staggered 1/4 plate with the 1/2 plates being placed on opposite sides of the tunnel in alternate courses.

Coated plates shall be handled in such a manner as to prevent bruising, scaling, or breaking of the coating. Any plates that are damaged during handling or placing shall be replaced by the Contractor at his expense, except that small areas with minor damages to the coating may be repaired by the Contractor as directed by the Engineer.

The tunneling operation shall proceed only a distance sufficient for placing one section of tunnel liner. The tunnel liner must be placed before proceeding further. At no time will jetting be allowed.

Where blasting is required, only small controlled charges of forty percent dynamite or plastic explosives are to be used. The depths of the holes for these charges shall not exceed the depth necessary for clearing an area sufficient for placing one section of tunnel liner. The charges for the initial series of blasting should be placed in the triangle method. The second series shall be placed in the radial method a minimum distance from the desired diameter of the tunnel. The triangular charges shall be set to go off first, with the radial charges to go off in a short interval or using the timelag method.

Where rock is encountered before approaching the shoulder or pavement, the first four series of charges will be used in determining the amount of controlled blasting to be used beneath the shoulders or pavement of the highway; however, if rock is encountered after proceeding beneath the pavement, only small charges shall be used until the proper amount of charge is determined. In no case will an overshot be permitted. If a boulder is encountered and is removed by blasting, a bulkhead will be formed immediately after removal of the boulder and the area filled with grout before proceeding with the tunneling operations.

If there is any indication of a vertical split in the rock formation, or any indication of settlement of the roadway during the tunneling operations, all operations shall be stopped and the NCDOT engineer shall be notified immediately. If the vertical split is not determined to be of too great a magnitude or too close to the pavement, the split shall be filled with grout at a pressure specified by the NCDOT engineer, allowed to set and tunneling operations may be continued. If it is determined that the vertical split is too great of a magnitude or too close to the pavement, the NCDOT engineer shall advise as to the proper method to be used to correct the vertical split. If settlement of the roadway occurs, the NCDOT engineer will advise the Owner and his Contractor as to the proper steps to be taken to correct this settlement.

The space outside the liner plates is to be held to a minimum and shall be grouted with a minimum of 1:3 portland cement grout at not less than 50 psi pressure to completely fill all voids created by excavation for and installation of the liner plates through 2 inch openings on 4 foot 6 inch centers provided in the top of the steel liner plates. This grouting operation will be done with installation of the liner plates so that at no time will the grouting operation be further than 25 feet from the front end or head of tunnel construction. At the end of each day's operations, the space outside the liner plates is to be grouted whether 25 feet or less. Grout will be forced into each grout hole. If the grout from one hole should flow along the liner plate so as to plug the next grout hole, the plugged hole will be opened by punching through the grout layer so that each hole may be used for grouting. The grouting operation will be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

The entire operation shall be subject to inspection by the NCDOT engineer or inspector on the project, who shall have full authority to stop work if, in his opinion, it shall cause any damage to the roadway. All materials shall be subject to inspection by the NCDOT.

The method of shoring the pits for tunneling operations shall be approved by the Design Services Unit of the NCDOT prior to any work beginning at the site.

All shoring material shall be removed in such a manner so as to avoid collapse and to allow proper backfill. The backfill shall be placed in accordance with the NCDOT specifications.

After installation of the tunnel liner plate, a paved invert shall be poured using 2,500 psi grout. The invert shall be poured at grade to facilitate installation of the carrier pipe on line and grade shown on the contract drawings. Support blocks shall be used to restrain lateral movement of the carrier pipe. After the alignment, grade and elevations of the carrier pipe have been checked and approved by the Engineer, both ends of the tunnel shall be bricked up and the void space between the carrier pipe and the tunnel liner shall be filled with 2,500 psi grout.

The Contractor shall make all necessary repairs or he shall reimburse the Board, and subsequently, the board shall reimburse the NCDOT for repair costs, should any settlement or damage result to the roadway within a one year period after completion of the tunneling operation.

The Contractor and any of his Subcontractors performing work on the state right-of-way in connection with tunneling operations shall furnish to the Department of Transportation to the attention of the State Design Services Engineer, North Carolina Department of Transportation, Division of Highways, Raleigh, North Carolina 27611, for his approval, a certificate of insurance, in an original and one copy, in the amounts of $300,000 Bodily Injury and $100,000/$300,000 Property Damage as evidence of proper coverage before beginning work at the site. The certificate is to show that explosion, collapse and underground insurance coverage is provided.

It will be the responsibility of the Contractor and/or his Subcontractor to furnish and keep in force the insurance requirements for a one year period after completion and acceptance of the work by the Owner and the Department of Transportation. The certificate is to be countersigned by an authorized North Carolina Resident Agent with the name and address of the agent denoted thereon. The certificate is to make reference to the project and county. The NCDOT engineer is to be notified of the completion of the installation, with copy to head of the Design Services Unit.

The length of tunnel to be paid for will be the length measured along the tunnel liner plate invert. Payment for footage of each size of tunnel as determined by measurement shall be paid for at the contract unit prices per linear foot bid for the various sizes. The payment shall include full compensation for furnishing all labor, materials, tools, equipment, including the carrier pipe support assembly, removal and disposal of materials from the excavation of the bore, and force-grouting voids.

End of Section