SPECIAL CONDITIONS FOR MICROTUNNELING (MT)
October, 2006

1 Materials

1.1 Pipe

(a) Pipe shall be specifically designed and certified for microtunneling by the pipe manufacturer and shall comply with ASTM and ASCE (ASCE Standard Construction Guidelines for Microtunneling) Specifications for use in Microtunneling.
(b) All joints shall consist of an elastomeric sealing element, sleeve, and a compression cushion ring as required by applicable ASTM and ASCE standards.

1.2 Allowable Forces

The allowable jacking strength capacity of pipe shall be capable of withstanding the maximum jacking forces imposed by the operation.

1.3 Pipe Characteristics

(a) Steel pipe shall have a minimum wall thickness of $^1/_4$ inch or as specified in section 909 of the current MDOT Standard Specifications for Construction, whichever is larger. Likewise, concrete pipe shall have a minimum wall thickness as specified in section 909 of the current MDOT Standard Specifications for Construction.
(b) Pipe shall be round. Steel pipe shall have a roundness tolerance, so that the difference between the major and minor outside diameters shall not exceed 1% of the specified nominal outside diameter, or 0.25 inch, whichever is less. Likewise, concrete and other types of pipes shall have similar roundness tolerances.
(c) Pipe shall have square and machine beveled ends. The pipe end maximum out-of-square tolerance shall be 0.04 inch, (measured across the diameter).
(d) Pipe shall be straight. The maximum allowable straightness deviation over any 10 foot length of steel pipe is 1/8 inch.
(e) Pipe shall be without any significant dimensional or surface deformities. All pipes shall be free of visible cracks, holes, foreign material, foreign inclusions, blisters, or other deleterious or injurious faults or defects. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used.

2 Construction

2.1 Minimum Allowable Depths

Minimum allowable depth of cover shall be as specified in the approved plans.

In locations where the road surface is super elevated, the minimum depth of the bore shall be measured from the lowest side of the pavement surface. In addition, a minimum 3 foot depth shall be maintained in all other features including ditch bottoms.

2.2 Equipment

(a) The Microtunneling Boring Machine (MTBM) shall be mechanically articulated to enable steering of the shield and shall be capable of incremental adjustments to maintain face stability for the soil conditions encountered. A remotely controlled steering mechanism shall be provided that allows for the operation of the system without the need for personnel to enter the tunnel.

(b) The measuring and balancing of earth and groundwater pressure shall be achieved by use of a slurry system. The MTBM cutter face shall at all times be capable of supporting the full excavated area without the use of ground stabilization and have the capability of measuring the earth pressure at the face and setting a calculated earth balancing pressure.

(c) The MTBM shall be advanced by jacks mounted in a jacking frame and located in the drive shaft. The MTBM shall be moved forward by the jacks advancing a successive string of connected pipes toward a receiving shaft.

(d) The MTBM shall meet the following minimum performance requirements:

1. Capable of providing positive face support regardless of the MTBM type.
2. Articulated to enable controlled steering in both the vertical and horizontal direction to a tolerance of plus or minus 1 inch from design alignment.
3. All functions are controlled remotely from a surface control unit.
4. Capable of controlling rotation, using a bi-directional drive on the cutter head or by using anti-roll fins or grippers.
5. Capable of injecting lubricant around the exterior of the pipe being jacked.
6. Indication of steering direction.

(e) For slurry type MTBM, the following is also required:

1. Measurement of the volume of slurry flow in both the supply and return side of the slurry loop.
2. Indications of slurry bypass valve position.
3. Indication of pressure of the slurry in the slurry chamber.

2.3 Method

(a) At completion of the MT operation, the installed pipe shall be inspected by means of a Closed Circuit Television (CCTV) camera and/or a pressure test. Damaged pipe shall be jacked through to the receiving shaft and be removed. Other methods of repairing the damaged conduit may be used, as recommended by the manufacturer and approved by the MDOT Engineer/ Inspector.

(b) Perform shaft and tunnel excavation in a manner that will minimize the movement of the ground in front of and surrounding the excavation and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the excavation. Support the ground in a manner to prevent loss of ground and keep shafts stable. Support pit excavation by positive means and as necessary during all shutdown periods.

(c) The contractor shall continuously monitor and compare the actual volume of spoil recovered to the theoretical volume.

(d) If any damage is observed to any property, the work shall cease immediately until a plan of

action to minimize further damage and restore the damaged property is submitted and approved by the MDOT Engineer/ Inspector.

(e) Pipe ends shall be temporarily sealed until the drive and receiving shafts are made permanent, or other manholes are installed, to prevent water or earth infiltration.

(f) The control equipment shall integrate the method of excavation, removal of soil, and simultaneous placement of pipe. Line and grade shall be controlled by a guidance system that relates the actual position of the MTBM to a design reference (e.g. by a laser beam transmitted from the drive shaft along the center line of the pipe to a target mounted in the shield). As each pipe section is jacked forward, the control system shall synchronize spoils removal, excavation, and jacking speeds. The MTBM display equipment shall continuously show and automatically record the position of the shield with respect to the project design line and grade.

2.4 Drive and Receiving Shafts

(a) Location - A minimum distance, from the edge of the paved shoulder or curb, to the face of any access pit, equipment, and supplies, shall be 35 feet along freeways and limited access roadways and 25 feet along free access roadways. Any deviation from these distances shall require prior approval from the MDOT Engineer/Inspector.

(b) Sheeting and Bracing -Sheeting and bracing shall be required whenever any part of the access pit excavation is located within the roadbed influence area. Steel sheet piling shall be furnished and installed as indicated in the current MDOT Standard Specifications for Construction, section 704. An additional earth retention structure shall be required above and below the bore hole on the drilling face of all access pits to prevent loss of material during construction.

(c) Protection - Fencing barriers shall be installed adjacent to access pits, open excavations, equipment and supplies with suitable fencing and plastic drums to prohibit pedestrian access to the work site. Equipment shall not be used as fencing to protect access pits.

(d) Miscellaneous Items

- Thrust blocks should be designed to distribute loads into the ground in a uniform manner such that any deflection of the thrust block is uniform and does not impart excessive loads on the shaft itself or cause the jacking frame to become misaligned.
- Entry and exit seals should be provided at shaft walls if needed to prevent inflows of groundwater and slurry.

2.5 Overcut Allowance - Overcut is the annular space between the excavated bore and the outside diameter of the pipe. When using this method, the allowable overcut shall not exceed the outside pipe radius by more than one inch.

2.6 Watertight Joints

(a) Water tight pipe joints are required to ensure the integrity of the roadbed. Pipe shall be constructed to prevent water leakage or earth infiltration throughout its entire length.

2.7 Lubrication and Slurry Fluids

(a) Lubrication shall be used to reduce necessary jacking forces in cohesive soil. The most common lubrication is bentonite.

(b) The pumping rate, pressures, viscosity and density of the slurry shall be monitored to ensure adequate removal of spoil. The excess slurry at entry and exit points in pits shall be contained until they are recycled or removed from the site. All slurry fluids shall be disposed of or recycled in a manner acceptable to the appropriate local, state or federal regulatory agencies.

2. 8 Settlement/Heaving Monitoring

(a) This method shall be performed in a manner that will minimize the movement of the ground in front of, above, and surrounding the boring operation; and will minimize subsidence of the surface above and in the vicinity of the boring.
(b) Potential heave or settlement shall be monitored at each shoulder point, edge of pavement, the edge of each lane (or centerline for two lane roads), and otherwise at 50 foot intervals along the pipe centerline.
(c) A survey shall be performed prior to initiating this operation at each required monitoring location. A similar survey shall then be performed at each location, on a daily basis, until the permitted activity has been completed. All survey readings shall be recorded to the nearest one-hundredth (0.01) of a foot. Digital photographs of the pavement conditions shall also be taken prior and after the pipe installation.
(d) All operations shall stop immediately whenever monitored points indicate a vertical change in elevation of 1/2 inch or more, or any surface disruption is observed. The Contractor shall then immediately report the amount of settlement to the MDOT Engineer/ Inspector.

2.9 Ground Water Control

(a) Dewatering shall be conducted whenever there is a high ground water table level to prevent flooding and facilitate the operation. The water table elevation shall be maintained at least 2 feet below the bottom of the casing at all times. When needed, dewatering may be initiated prior to any excavation.
(b) Minor water seepage or pockets of saturated soil may be effectively controlled through bailing or pumping. This control shall be accomplished without removing any adjacent soil that could weaken or undermine any access pit, its supports, or other nearby structure.
(c) Larger volumes of ground water shall be controlled with one or more well points or with staged deep wells. Well points and staged deep well pumping systems shall be installed and operated without damage to property or structures, and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors. Any pumping methods used for de-watering and control of ground water and seepage shall have properly designated filters to ensure that the adjacent soil is not pumped along with the water. Well diameter, well spacing and the pump's pumping rate, shall provide adequate draw down of the water level. Wells shall be located to intercept ground water that otherwise would enter the access pit excavation and interfere with the work. Upon removal of a well, the hole shall be filled and grouted according to the specifications identified in MDOT's flowable fill special provision, and MDOT's Plugging Drill Holes special provision.
(d) Existing storm sewers shall only be used to discharge water from the dewatering operation in accordance with a permit obtained from the appropriate storm sewer owner. Filters or sediment control devices shall be required to ensure that the existing system is not adversely affected by construction debris or sediment.(e) If grouting is used to prevent ground water from entering the area of the access pit, the grouting shall be installed without damage to

property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors. The material properties of the grout shall conform to the specifications identified in MDOT's flowable fill special provision.

2.10 Failure

(a) Should anything prevent completion of this operation, the remainder of the pipe shall be constructed by methods approved by the MDOT Engineer/Inspector.
(b) Abandonment of any component of the installation shall only be allowed as approved by the MDOT Engineer/Inspector.

2.11 Contamination

When an area of contaminated ground is encountered, all operations shall stop immediately, and shall not proceed until approved by the MDOT Engineer/Inspector. Any slurry shall be tested for contamination and disposed of in a manner, which meets Local, State and/or Federal requirements.

2.14 Work Site Restoration

(a) Access pits and excavations shall be backfilled with suitable material, and in a method approved by the MDOT Engineer/Inspector. The shafts shall be backfilled and sealed upon completion of the microtunneling. The supports shall be removed to 10 feet below the original ground surface. The disturbed work site area shall be restored to existing grades and original material condition.
(b) The disturbed grass-surface area shall be top-soiled, seeded, fertilized, mulched, and anchored according the current MDOT Standard Specifications for construction, sections 816 and 917. Slopes steeper than 1-on-3, shall be seeded according to the current MDOT Standard Specification for Construction, sections 816.03 and 917.11.
(c) Upon completion of the work, the contractor shall remove and properly dispose of all excess materials and equipment from the work site.