The Evolution of Pilot Tube Microtunneling in the United States

By Jeff Boschert

Pilot Tube Microtunneling (PTMT) originated in Japan and Europe two decades ago as a way to install 4- and 6-in. gravity flow house connections. It was first introduced in the United States in 1995 and has steadily grown in both capabilities and popularity for gravity sewer main installation.

PTMT evolved as a combination of three existing trenchless installation methods, namely microtunneling, horizontal direction drilling (HDD) and auger boring. The installation process of PTMT resembles that of HDD through the use of pilot boring, followed by reaming head/temporary casing and pipe installation. Both PTMT and HDD use a slant-faced steering head for directional control. PTMT adopts the use of an LED target; digital theodolite and a real-time camera-based accurate guidance system specifically suited for gravity installations. The technology is similar to auger boring in the use of a jacking system and auger flights for spoil removal.

Initial applications of the process in the United States had a range of 4- to 12-in. outside diameter pipes with single drive lengths up to 250 ft. The technology has now grown to install pipes up to 48-in. outside diameter with common drive lengths ranging from 350 to 400 lf. Pilot tube installations as long as 580 lf in a single drive have been completed successfully. Accuracy in line and grade of ¼-in. is possible on drive lengths of 500 lf. Improved optical guidance systems and hydraulics in the jacking frames have made larger diameters and longer drive lengths possible. While the technology performs well in a variety of displaceable soil conditions, cobbles and boulders may pose some difficulties. Recent developments such as hydraulically powered cutter and reaming heads, lubricants for loose sands and water control reaming heads for wet sands have increased the capabilities of this technology in a wide range of soil conditions. The process can install a variety of jacking pipe materials, such as vitrified clay, fiberglass, polymer concrete and steel. Small diameter fusible pipe has also been successfully pulled back from the reception shaft behind both the pilot tube, as well as the temporary casings.

Vitrified clay jacking pipe has been the predominant product pipe material used in the PTMT process due to its high compressive strength (18,000 psi average), low-profile zero-leakage joint, affordability in the typical 1- or 2-m pipe lengths (suited to the small shafts) and elimination of an external casing pipe. The guided accuracy of this system eliminates the need for the typical larger diameter steel casing and the grade-adjusted inner carrier pipe as is necessary when using a non-guided boring technique.

Today, PTMT is most commonly used in congested urban settings, areas of weak soils or near existing utilities, where a low impact new installation is required. The PTMT jacking frames, equipment and tooling are compact requiring smaller surface lay down areas thereby cutting down societal costs, business and traffic disruptions. With jacking shafts as small as 8 ft in diameter and reception shafts as small as 6.5 ft in diameter, large projects can be accomplished with a limited construction footprint.

PTMT offers the same level of pinpoint accuracy as microtunneling at significantly lesser costs. The reliable line and grade accuracy associated with PTMT make it possible to install pipes in close tolerances to existing utilities.

The pilot rods installed in the first step have the capability to discover unknown underground obstacles prior to full commitment of the bore, eliminating an unplanned retrieval shaft, which would be required in most other trenchless methods. Also, a survey can be performed on the pilot tube at the reception shaft to verify the intended line and grade. If an alignment/grade error is discovered or an obstacle is encountered during the installation, the pilot tubes can be retracted and reinstalled before proceeding to the second step of the installation.

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The evolution continues with new equipment development to work in hard non-displaceable ground conditions up to Standard Penetration Test (SPT) values of 100. These systems are allowing PTMT equipment to bridge the gap between displaceable ground applications (SPT values up to 50) and hard rock.

The high degree of accuracy, the ability to discover the unknowns and the reliability of experienced contractors make PTMT an invaluable option for municipalities. The National Clay Pipe Institute and its member companies work diligently to produce a sustainable product and develop new and innovative methods for the installation of that product. PTMT is one of those methods. The combination of low social impact, a very efficient installation method and the most environmentally friendly, longest-lasting pipe material available will continue to drive evolution in this field and provide better options for the future.

Jeff Boschert is a civil engineer at the National Clay Pipe Institute in St. Louis, Mo.