St. Louis Turns to Pilot Tube Microtunneling

By Ed Sewing, Mike Luth and Jeff Boschert

After an experience with directional drilling that was less than satisfactory, the Metropolitan St. Louis Sewer District (MSD) was hesitant to consider another trenchless approach for installation of gravity flow sewer lines. But upon further evaluation, pilot tube microtunneling (also referred to as guided boring) was the only method of installation that met all of the demands of the Black Creek Sanitary Relief Sewer project.

The demands of this project weren't all that different than the requests system designers hear on a regular basis:

- maintain safe, pleasant ingress and egress
- limit the loss of parking spaces during the construction
- protect and maintain underground power, communications, water and gas utilities
- protect trees, landscaping, sidewalks and signage as much as possible, and
- minimize dust and debris

These demands were driven by a property owner who also represented an important community resource – a large regional mall. Other concerns on the site included a delivery truck and emergency vehicle access tunnel to avoid, multiple crossings under existing RCP storm sewers and a concern about the depth to rock and other undesirable materials for a pilot tube project.

Horner & Shifrin (H&S) worked closely with MSD to design the Black Creek Sanitary Relief Sewer, which included approximately 46 ft of 8-in. and 1,900 ft of 18-in. vitrified clay jacking pipe. Numerous design meetings and brainstorming sessions were instrumental in building a team that successfully reduced construction costs, enhanced schedule coordination, minimized contractor claims and improved the technical quality of the contract documents.

A thorough subsurface investigation was carried out in the design phase to identify the geologic conditions that would be encountered along the sewer alignment and their influence on the design and construction of the project. Subsurface investigations were performed by Geotechnology, Inc. of St. Louis, Mo. A total of 17 borings were drilled along the alignment of the proposed sewer. One at each proposed jacking/receiving shaft and a maximum spacing of about 200 ft between borings. Generally the soil along the sewer alignment was comprised of fill, silty clay, shaley clay, and clay.

"If I were to offer a general recommendation to engineers or cities considering undertaking a PTMT project, I'd strongly recommend that you take the old carpenter's adage to heart," said Ed Sewing, design engineer for Horner & Shifrin. "Measure twice and cut once. Only in this case that means make sure you thoroughly understand the soil conditions you'll be operating in. Good geotechinical information is critical when doing any kind of trenchless work."

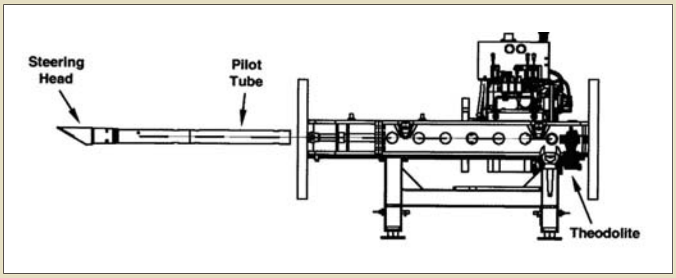
The final selection of pilot tube microtunneling as the installation method was driven by smaller construction staging footprint requirements and smaller jacking and receiving shafts, all facilitated by the diameter of pipe to be installed.

"This project was a great illustration of how things should be done," according to Jeff Boschert of the National Clay Pipe Institute. "The owner, designer and contractor all appreciated the importance of planning as a critical element in the success of the overall project. If I were to make one recommendation to an owner considering a pilot tube microtunneling project it would be to emulate this planning and teamwork approach."

Two different pilot tube microtunneling installation methods were used on this project – one for each diameter of pipe installed. The first two steps were the same for both methods.

Step 1: Install the 4-in. pilot tubes on line and on grade.

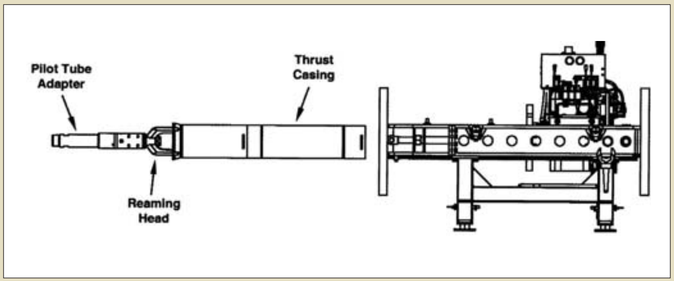
During this installation, soil was displaced by the slant-faced steering head on the tip and no spoil was removed.



The pilot tubes were then directed on line and grade by rotation during advancement. The hollow stem of the pilot tubes provide an optical path for the camera to view the LED target housed inside the steering head. This target also displayed the head position and steering orientation. This established the center-line of the new sewer installation; the remaining steps follow this path. Once the pilot tubes reached the reception shaft, the theodolite target, video camera and monitor (guidance system) were no longer needed and were removed from the jacking pit.

Step 2: Follow the pilot tubes with a reaming head.

The front of an 11-in. reaming head was attached to the



last pilot tube in the same manner the pilot tubes fasten to each other. The remaining pilot tubes and the reaming head were then advanced using 11-in. (OD) thrust (auger) casings, which transported the spoil to the jacking shaft for removal. The contractor removed the spoil conventionally using a muck bucket, but a vacuum method is sometimes a good alternative. During the installation of the auger casings, the pilot tubes were dismantled and removed as they were advanced into the receiving shaft. This step was completed when the reamer and auger casings reached the reception shaft and all spoil was removed from the bore.

Method 1

This method was used on the part of the project that included 8-in. diameter pipe.

Step 3: Install pipe.

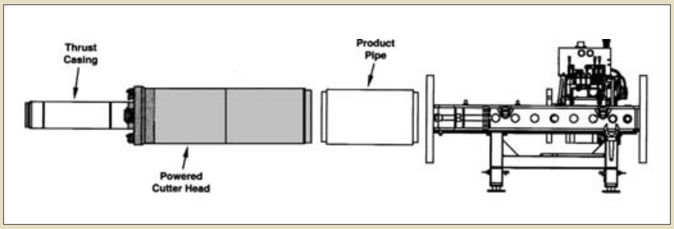
The jacking pipe was used to advance the auger casings into the jacking shaft where the casings were uncoupled and removed one-by-one. There was no spoil removed in this step since the pipe had the same outside diameter as the auger casings.

Method 2

This method was used for all the 18-in. diameter pipe on this project and is the newest innovation to pilot tube installation.

Step 3: A powered cutterhead (PCH) is installed behind the auger casings advanced by the product pipe.

The cutterhead increased the diameter of the bore to



match the outside diameter of the larger pipe. The remaining soil around the previously installed 11-in. auger casings (Step 2) was taken into the PCH and discharged via the reception shaft by reversing the auger flight direction. The final product pipe was then installed directly behind the PCH. As each section of auger casing was removed from the reception shaft, a section of pipe was installed in the launch shaft. This step was completed when the PCH entered the reception shaft.

The outside diameter of the PCH matched the OD of the vitrified clay jacking-pipe. There are two hydraulic motors housed in this particular PCH; the first to drive the auger flights and the second to drive the rotating cutterface. Housed inside the cutterface are three jetting ports connected by one hose for water distribution to keep the face clean and ease spoil transport. Lubrication ports keep jacking pressures down and were located in the rear of the machine connected by a single hose.

A total of seven hoses (four hydraulic, one for lubrication, one for jetting and one from a check valve) ran through the pipe to the PCH unit. Staging the pipe at the surface with the hoses installed before the start of this step was crucial to production times.

Conclusion

This project was delivered on time and on target. The pipe was installed on a 0.5 percent grade. Even with the longest drive at 280 ft, the greatest deviation from the exact target, both horizontally and vertically, was less than ¼ in. The success of this project demonstrates why pilot tube microtunneling can be a viable or even preferred method for trenchless installation of gravity sewers.

The considerations that drive a decision to undertake a pilot tube project are generally the same goals communities always plan to achieve:

- High levels of worker safety
- Minimal disruption to the community
- Reduced requirements for site restoration
- Maximization of long-term value to the community

The selection of pilot tube installation methods is becoming more common as added emphasis is placed on the social costs of traditional open-cut construction. The inconveniences, business disruptions and property destruction, as well as engineering, environmental and safety issues involved with open-trench sewer construction, are beginning to challenge the practicality of open-cut in urban areas. Pilot tube microtunneling technology virtually eliminates the social costs of open-cut trenching and reduces basic construction costs in congested urban settings.

Some of the other important considerations when considering a pilot tube project include:

- Low equipment costs.
- Small topside footprint, small jacking pits and minimal surface disruption.
- No need for slurry separation tanks.
- Serious reduction in the amount of excavated material to be stockpiled or removed.
- Elimination of bedding. No materials purchase, no stockpiling and no trucking it in.
- Minimization of problems in contaminated soils as soil is not removed with a slurry.
- Eliminates the need to dewater an open-cut pipe trench.
- Significantly reduces the risk of collapse/settlement to surrounding structures and roads.
- Pipe movement/settlement from soil disturbance in an open trench and in the surrounding pipe zone is eliminated by tunneling.

This particular project used No-Dig pipe from Mission Clay. "Vitrified clay jacking pipe is well suited to this application," Boschert said. "Its compressive strength is unmatched and no other pipe material can reasonably challenge the life-cycle offered by clay pipe."

This article is abridged from a white paper on this project by Ed Sewing, Horner & Shifrin (*www.hornershifrin.com*), Mike Luth, Luth & Sons (*www.fredmluth.com*), and Jeff Boschert, National Clay Pipe Institute (*www.ncpi.org*). For a copy of the complete paper, visit the library page of the National Clay Pipe Institute's Web site.