OTD
Operations Technology Development

Cross-Bores Detection Using Mechanical Spring Attachment

Research is under way to develop a tool that will detect a hit to a sewer pipe during the installation of a gas pipe. The tool utilizes a mechanical spring system that is activated inside the sewer pipe void to provide a real-time alarm identifying a hit.

Project Description

Horizontal directional drilling (HDD) has become a common method for installing polyethylene (PE) gas pipe. Although rare, hits to sewer pipes during the HDD/mole installation process have occurred ("cross bores") that resulted in gas leaks into the sewer system when sewer-cleaning operation damaged the gas line.

Sewer laterals typically run perpendicular to the proposed route of a new gas pipeline. The laterals also rapidly change depth in that same area. Currently, there is no practical technology for locating sewer laterals and determining their depth in all types of soils.

Several approaches, including advanced utility locating and camera inspection, may contribute to reducing these threats. However, these operations are performed by different crews either before or after drilling and standard drilling technologies are still "blind" with respect to the underground environment.

The objective of this project is to develop a tool that will detect a hit to sewer laterals during the HDD or mole installation of PE gas pipe. The tool is designed with a low-cost and easy-to-use mechanical spring system that is attached to the HDD/mole head during drilling or to the PE pipe during pullback. The spring system is activated inside the sewer pipe void; thus locating the lateral and providing a real-time alarm identifying a hit.

Deliverable

The deliverable for the project will be a functional prototype unit.

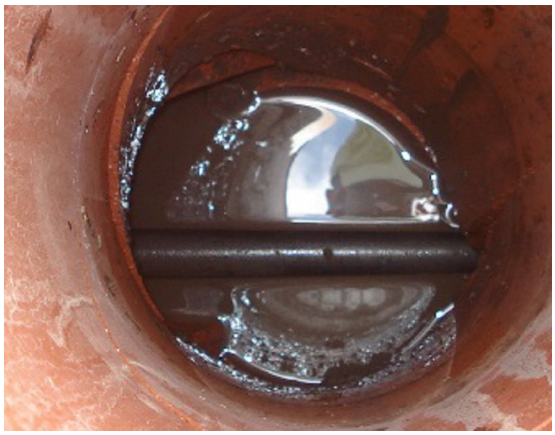
Benefits

The implementation of the cross-bore detection tool increases safety and enhances the installations of distribution gas lines in difficult areas where sewer lines intersect.

The ability to attach the detection system to either the drilling head or to PE pipes during pullback makes it an economic and practical solution to detect incidents of pipe encroachments during HDD and mole operations and will help minimize risks.

Technical Concept & Approach

The design consists of a cylindrical unit attached to the HDD/mole head during drilling or to the PE pipe during pullback. The unit has spring arms around its perimeter. The springs are in a closed position when confined in soil. When the unit encounters a void space inside a sewer pipe, the spring arms open and an electronic signal is sent to the surface (using a signal wire or wireless system) indicating the arms' movement.



Left: Alignment of the sewer lines in the test section. Right: HDD tool crossing the sewer pipe in field tests.

An on/off electronic signal can be sufficient to indicate if the apparatus encountered a void representing a sewer lateral when some or all the springs are opened inside the sewer pipe.

Specific tasks included:

- **Initial Design of the System**

  The development of prototypes consisted of several steps to address the operational requirements.

- **Prototyping, Testing & Modification**

  The selected prototype was tested under various soil conditions in a laboratory environment.

- **Field Testing and Troubleshooting**

  A field test and a demonstration was conducted at the Gas Technology Institute (GTI) pipe farm.

Results

In 2012, two designs of the system with mechanical springs were built as preliminary prototypes. Various systems were considered, including the use of pressure bags at the perimeter of the attachment and installing a simple load-sensor indicator during the PE pipe pullout. In addition, the electronic system for transmitting the signal to a readout box at the surface was designed and a prototype of the system was built.

A prototype for field testing at GTI was subsequently built. This prototype includes a set of eight mechanical arms around the perimeter configured to improve the detection of voids with minimum soil intrusion inside the tool. Data is collected during the pullback process of the PE pipe and stored in a memory stick mounted inside the tool.

The prototype was tested in 2013 in a soil test box where the 4-inch-diameter pipe crosses a 4.5-inch sewer pipe. Further tests were conducted to evaluate the tool in wet soil conditions. Various sizes of sewer lines (6-, 8-, and 12-inch PVC and clay pipes) were installed at a GTI test facility for testing of the tool. The pipes were placed vertically in the test section to monitor the cross boring process from the surface.

Communications were initiated with manufacturers to adopt the tool and to determine further development needs.

A patent application was filed in 2013.

In 2014, researchers completed a field test of the cross-bore tool in an HDD installation of two-inch-diameter PE pipe. The tool was connected to the back reamer during the PE pipe pullback. The crossing of the tool inside the pipes was recorded by the tool and visually monitored and photographed. The tool was able to successfully indicate the voids in pipes which were hit (i.e., providing positive indications). The pullback reamer did not go through two pipes and there was no signal in the tool accordingly (i.e., successful negative indications).

Several modification of the prototype may be performed with future commercializers. These may include a real-time data display during pullback.

Status

A report on the results of field-test activities is being prepared. The report will include an initial investigation of future Phase 2 of the project if warranted. Phase 2 tasks may include working with an HDD vendor/ contractor to modify and produce the product.

For more information:

Maureen Droessler
Program Administrator
Operations Technology Development, NFP
Phone: 847/768-0608
maureen.droessler@otd-co.org