Using HDD Tracking Systems for Auger Boring Guidance

by Bob Helm and Siggi Finnsson

Due to its dramatic rise in use, horizontal directional drilling has received a large amount of attention in the media and within the trenchless industry itself. However, before HDD came to the scene, there was auger boring.

Despite its lack of prominence, this construction method continues to be commonly used today. Auger boring technology has not changed much over the years, yet it is an effective means of accomplishing some of today's demanding projects.

Auger Boring Basics

The primary difference between auger boring and HDD is that auger boring has limited steering and is typically a one-pass approach. The head of the auger in most cases can only be articulated up or down to make corrections to the grade. The machine is positioned in a starting pit with the line and grade already established. The traditional means of verifying the grade is the use of water levels.

As an alternative to the water level sensing method, a laser can be used. The entire auger screw is retracted and a laser can be shot at a target mounted near the tunnel face to determine any deviations. This is a time-consuming and expensive procedure, especially on a shot of substantial length.

Helm & Sons Inc., a general engineering contractor based out of Murray, Utah, just south of Salt Lake City, has incorporated into its auger boring operations the "directional" from horizontal directional drilling. Specifically, the company uses a DigiTrak cable locating system. Although the water level is a time-honored method of determining grade, it does have drawbacks. The project described below is an example where traditional methods would not only have been very time consuming, but more important, the accuracy of readings would have been questionable.

DigiTrak Cable System

In his search for a quicker and more accurate way of determining the grade, a primary concern for most auger bores, Bob Helm was referred by American Augers to consider the use of the DigiTrak cable system. The system consists of a walkover receiver, a cable-ready remote display with power supply and a sensitive pitch cable transmitter. This particular transmitter is used exclusively for installing gravity flow pipes, where precise grade control is required. The transmitter will read both positive and negative grades with equal accuracy.

The DigiTrak system provides the operator with real-time pitch and roll position, which aids in keeping the bore on target.

Since the transmitter is powered via 12 to 28 volts through a continuous wire, battery life or the time it takes to finish the bore is not a limiting factor. The recommended wire is anywhere from 8- to 12-gauge regular stranded wire.

The cable transmitter system works as follows: The transmitter is connected with a wire the length of the bore to a display located at the operator's station. The wire powers the transmitter and carries the pitch/roll data back to the display. The steel of the casing acts as the ground connection. Because the transmitter is mounted on the lead casing, the display provides the operator with its real-time pitch and roll position. This instantaneous information allows the operator to react to any grade deviations as well as identify if the forward shield has begun to roll in either direction.

The auger's heading can be determined by using the DigiTrak's patented locate points. The front locate point is found approximately 70 percent of the depth out in front of the transmitter above the ground surface. The transmitter can be located using the walkover receiver at depths greater than 100 ft.

The Project

The project was located in Farmington, Utah. It involved the installation of a 15-in. PVC waterline under Union Pacific railroad tracks as well as the northbound and southbound lanes of I-15. The auger casing was 24-in. in diameter and the length of the bore was 387 ft. During the first 200 ft, the geology consisted of silty clays and the remaining 187 ft consisted of wet sticky clays. The line and grade requirements were demanding, particularly the grade requirement of 2.0 percent.

The prime contractor was Western Builders Inc., which was working for Farmington City Public Works. The project engineer was CRS Consulting Engineers.

Site Preparation

Once the pit was constructed and the machine (a Barbco 36/42 500) and jacking frame were placed in the pit, setup for the cable system commenced. The transmitter was mounted inside a housing, made from a 1 1/2-in. diameter pipe with a backhoe tooth welded to the front, which served as protection for the housing and transmitter. The housing was filled with silicone on each end to help absorb vibration on the transmitter. The housing had five 8-in. long slots cut lengthwise into it to allow the transmitter signal to "escape."

A wire spool mounted at the operator's station was connected to the wire coming from the transmitter, which was the only wire connection that needed to be made. As the casing advanced through the ground, the wire was simply being pulled off the spool. To protect the wire, a section of angle iron was tack welded onto each section of casing.

Pushing Pipe

Once the transmitter's pitch readings were verified in the housing, the actual bore began. The Helm & Sons' crew, consisting of foreman Stefan Ceasar and operators David Dare and Kim Lambert, battled the elements and the site conditions. Temperatures were below freezing and the high water table resulted in difficult pit conditions.

It soon became evident that the choice of not using the water level had been the correct one. First, the cold temperature would have prevented the water in the water level indicator from flowing freely, and eventually the water inside the water level pipe would have frozen, preventing accurate readings. Second, the length of the bore would require substantial amounts of water, particularly because the water level sometimes drains during the boring process. The crew would have to stop and fill the entire length of the water level pipe each time it wanted to check grade. Third, the water level, if not filled properly and completely, can give questionable readings, especially on bores of substantial length like this one. Finally, the high water table in the area could have caused problems. The crew noticed water coming out of the pipes on the top of the casing; had a water level been used, the ground water infiltration would have prevented any sort of accurate reading of the grade.

That being said, the grade measurements went without a hitch, as the transmitter is impervious to the above conditions. One of the biggest benefits of the transmitter was the fact that the grade could be read at any time, in essence giving the operator a real-time view of the grade as the bore was progressing. The Helm crew was able to complete the bore in eight days with only minimal stops for pit cleanout and weather problems.

Since the DigiTrak system, manufactured by Digital Control Inc., is a walkover locate system, it has the capability of determining line as well as grade. The crew used the walkover receiver to verify the line prior to going under the freeway. At that point, about 200 ft into the bore, the crew determined that line was perfect. This further reinforced the value of the system, as the crew could confidently continue to bore knowing its exact line and grade without tripping out the auger assembly.

At completion, the casing was determined to be almost exactly on grade (only 2 in. high) and about 4 ft off line near the end of the bore. The misalignment was due to the slight rotation of the casing, which caused it to be steered slightly to the side. This, however, was quite acceptable to the owner, who was thoroughly impressed with the grade accuracy.

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