FASTRAK™

The Best Boring News from DCI DIGITAL CONTROL INCORPORATED DCI Vol. 3, No. 3 - July 1999

Innovative Auger Drilling Application

As the trenchless industry grows, so too are global sightings of horizontal directional drills (HDDs). For folks with no historic knowledge of this industry, an easy assumption is that most trenchless installations are completed by HDDs and HDDs alone. This couldn't be further from the truth, particularly because of the presence of auger boring machines. Auger machines were in fact the predecessors to HDDs, and they still occupy an impressive position in the trenchless marketplace.

Auger boring machines are commonly used for installations of steel casings that either are the end product or are to be used as conduits for other installations. In comparison to HDD machines, auger boring machines are routinely used for larger diameter and relatively shorter installations. An auger boring machine consists of a steel casing (which does not rotate) with an internal rotating auger that cuts and removes the soils. The auger machine has a thrust frame at the entry location that supplys forward advancement, and once a section of casing has been installed, the frame is retracted to allow the insertion of the next casing and auger sections.

One drawback to auger boring is the fact that the auger assembly must be removed at regular intervals to allow the positioning of survey equipment (most commonly a laser and a target) for confirmation of line and grade. On a single drive (installation) this process can consume up to several days.

Thrust frame at end of strock; note cutting spoils under frame and rails.

Auger sections and steel casings.

Geisert Engineering, a German manufacturer of auger boring machines, contacted Steve Edwards, one of DCI's European field service managers, about the possibility of using the DigiTrak System to monitor line and grade on their auger bores. Geisert's main interest was twofold: to reduce the time spent verifying line and grade and to eliminate unnecessary time spent boring at the wrong line and/or grade. Using the DigiTrak System would result in the machine operator being able to view, in real time, the grade of the steel casing and the line of the bore, providing that there is walkover access to locate the Transmitter.

Steve visited Geisert and after discussions with one of the design engineers, Jürgen Schmeer, a plan began to take shape. Geisert would manufacture a housing for the Transmitter using a similar slot configuration to what is used in the directional drilling industry. The housing would be mounted onto the auger's steel casing to allow walkover locating. However, because the casing does not rotate, a battery-operated Transmitter would go into sleep mode (to preserve battery life) after 15 minutes, resulting in no signal being sent. To avoid the sleep mode and to accommodate the duration of the bore, it was decided that a standard battery-operated Transmitter would not be a viable option. Instead Geisert and Steve chose the Cable Transmitter System, which transmits pitch and roll (not needed in this application) through the wire to the DigiTrak Remote Display unit at the thrust frame.

Geisert designed, built, and tested the housing to confirm that good signal emitted through the housing's slot configuration. They then installed the housing onto their

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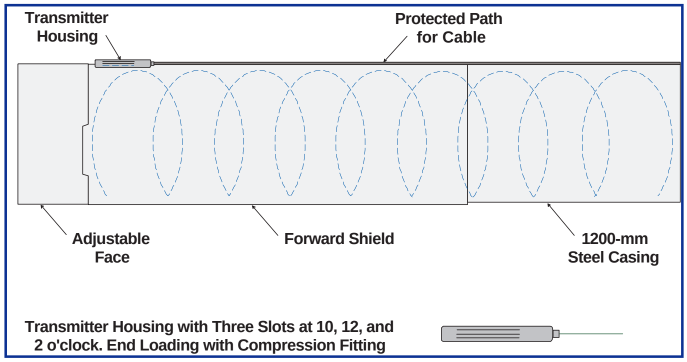
Geisert ENG BPU 220-270 rig, a machine with 270 tons (594,000 lb) of thrust force. (See sketch)

The Transmitter housing was installed in the top of the shield, about 60 cm (24 in.) behind the leading edge. Because they were using the Cable Transmitter, provisions had to be made for running the wire out to the Remote Display unit at the auger rig. This was done by welding angle irons on top of each section of casing to create a protected path for the wire. The final step was to identify an appropriate project where the concept could be tested to gain feedback and experience from actual working conditions.

Toward the end of April this year, all the details had been sorted out and it was decided to test the concept on a project in Saarbruecken, Germany. Albert Anders Rohrvertrieb had been contracted to install a 1200-mm-diameter (47-in.), 54-m-long (177 ft) casing. The project involved the eventual installation of a 1000-mm-diameter (39 in.) fiberglass pipe inside the casing to take waste from surrounding factories. Since this was a gravity installation, the grade was of utmost importance—the design specifications called for a grade of 2.5% ± 0.3%. Given the grade requirements, the sensitive-pitch Cable Transmitter (sewer Transmitter) was used, because it measures inclination (pitch) in 0.1% increments, as opposed to a regular-pitch Transmitter, which measures in 1% increments. The ground conditions on the test site consisted of sand with sandstone fragments, which indicated good boring conditions.



The machine was set up on the required grade, the Transmitter was powered up, and the first 60-m (19.6-ft) section of casing was installed. By the end of the first day, two more sections were installed during which Steve trained the crew on how to use the DigiTrak Receiver to monitor the line. The grade was being read at all times by the operator and was holding nicely. As a result, the crew considered the first 18 m (59 ft) a real success.

The following day the only mishap of the project took place. While retracting the jacking frame, the wire from the Transmitter somehow got entangled and the wire connection to the Transmitter tore. The augers had to be removed, a hole was cut in the casing from the inside behind the Transmitter housing, and the wire was reconnected. Once the wire was reconnected, the pitch signal was reestablished and the drive continued. A day was spent due to this mishap, but a valuable lesson was learned.

The remaining 36 m (118 ft) were finished over the next two days, leaving the total boring time at four days including the delay. On a bore of this length the contractor would normally have tripped the auger out three times to monitor line and grade. They estimated that using the DigiTrak System saved them two full days.

The entry angle was specified at 2.4% and the exit angle, after 54 m (177 ft) was 2.7%, which was acceptable. The actual exit elevation was 11 cm (4.3 in.) higher and 20 cm (7.9 in.) to the right of the specified exit location, but again this was well within the tolerance limits.

Operator on thrust frame viewing Remote Display and cable at exit of protective casing.

Casing with path for cable on top.

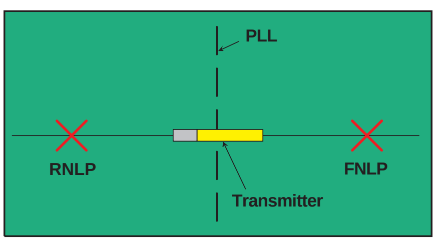
The project was a success in as much that the project time was cut by a third and the design parameters were met. About two weeks later Albert Anders Rohrvertrieb set up for a second project that involved two separate drives from the same pit. The length was 30 m (98 ft) and the required grade was 0.3%. Ground conditions were soft peat. The first of two tunnels was finished in a single day, and the auger entered the pit on line and about 20 mm (0.8 in.) below grade, which the contractor contributed mainly to the soft ground conditions.

According to Geisert's Jürgen Schmeer, using this method does not require any extra work on site, but the time saved over two projects could easily pay for the DigiTrak System. He further commented that he could see no reason why every auger bore couldn't use this system.

TECHNICAL TIPS - *Off-Track Guidance*

Off-track guidance is a method that allows the DigiTrak operator to track and locate the tool (Transmitter) without having to be directly on top of it. All other locating systems require the operator to stand over the drill head to determine its position. In many cases, due to physical obstacles or interference, this may not be feasible. Such cases require some extra tricks from your locating bag.

For this discussion, we will assume that the operator is already familiar with the front and rear locate points (FNLP & RNLP). These two points define the Transmitter's "line", which signifies the direction the Transmitter is heading. Perpendicular to this line is what we refer to as the positive locate line (PLL). The PLL runs through the center of the Transmitter and extends outwards until the Transmitter's signal becomes too weak to use. Determining the location of the PLL is the first part of off-track guidance.

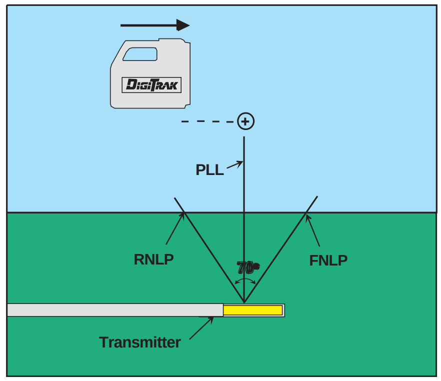


Geometry of PLL, RNLP, and FNLP (top view).

If you use the FNLP and RNLP for locating, you know that as the Receiver passes over the Transmitter, the minus ("–") sign changes to a plus ("+") sign (when the Receiver's trigger is held in). The place where the sign changes from "–" to "+" is on the PLL.

As a practical application, let's suppose there is a chain link fence running parallel to and practically on top of the intended drill path. The chain link fence has the potential for distorting both the depth reading and the locate points, making off-track guidance advantageous. To find the PLL, step a given distance (say 3 m or 10 ft) off to the side of the drill head and follow these steps:

1. Back up until you have a solid "–" sign in the display.
2. Move the Receiver forward until the "–" sign changes to a "+" sign.
3. Mark this point on the ground.

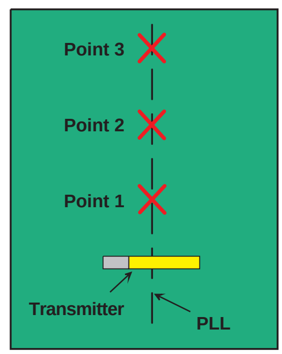


Finding the PLL over the Transmitter (side view).

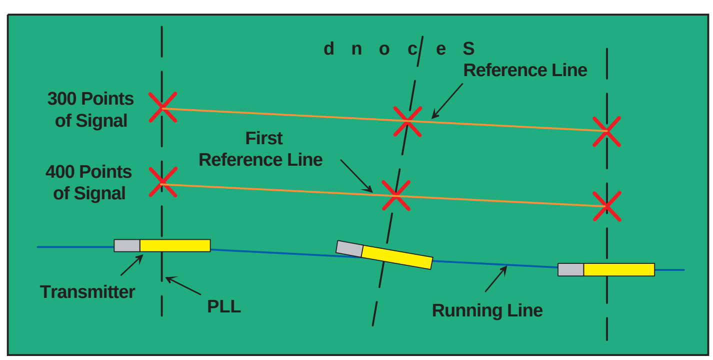
Move the Receiver a further distance from the drill head and repeat steps 1-3 above. You should now have two points marked on the ground. Again, move the Receiver further yet from the drill head and repeat steps 1-3 above to mark a third point. The line that connects these three points is the PLL.

Because we have identified the PLL and we know it is always perpendicular to the Transmitter, we now have an idea of which way the Transmitter is heading. The next part to off-track guidance is to identify a reference line that runs parallel to the intended drill path. We'll suppose that the reference line is 3 m (10 ft) from the intended drill path and the signal strength at this distance is 400 points. Now move another 3 m from this reference line to create a second reference line where the signal strength is 300 points. You have now created two reference lines, both of which are offset from the intended drill path by a given distance. You can now track the Transmitter with respect to these lines using the signal strength.

Should the Transmitter wander off course, the PLL will start to turn. In addition, the reference lines will mirror the movements of the Transmitter. If the reference lines shift to the right, the Transmitter in the ground is doing the same. For example, if the reference line with 400 points of signal moves 15 cm (6 in.) to the right, then the Transmitter has moved the same distance to the right. This method allows you to track the drill head and make steering corrections even when walkover access is not possible.



Three points on PLL.



Using reference lines and off-track locating to track the drill head.

New Field Service Managers

To match the growing pace of the HDD industry, DCI has added two field service managers to our field operations. Frank Maida and Craig Caswell will be relocating from Washington State to Texas and Michigan, respectively.

Frank Maida (shown below) joined DCI in 1996 as a customer service manager based in Renton and has been responsible for the Great Lakes area and a number of machine manufacturers. His extensive time in the field, in particular with the Cable Transmitter System, has earned him the title of “Cable Guru.” Frank and his family will be relocating to Michigan this summer where he will support dealers and contractors in the Great Lakes area: Michigan, Ohio, Indiana, Kentucky, Wisconsin, Minnesota, and Ontario. He can be reached on his mobile phone at 248-760-5306 or by e-mail address at fmaidajr@aol.com.

Craig Caswell, one of DCI’s original customer service managers (shown at right), joined DCI at our Renton headquarters in 1994. Since then Craig has been instrumental in the development and manufacture of the Mark III system – he knows the DigiTrak products inside and out – literally! Craig and his family will relocate to Texas in August to support the large number of HDD contractors and dealers in the south central states: Texas, Oklahoma, Arkansas, and Louisiana. Craig can be reached on his mobile phone at 206-321-3374 or via his e-mail address at ccdci@aol.com.

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