Project of the Year for New Installation

Indianapolis Airport Utility Connector Tunnel
Pam Stask — Oct 24, 2007

Great teamwork and careful planning can make any kind of project easier and more efficient. In the case of the CEP-IMC Utility Connector Tunnel, *Trenchless Technology's* Project of the Year for New Installation, cooperation and preparation made the job less expensive, less risky and much more successful.

The project required the installation of 2,000 lf of 102-in. O.D. prefabricated pressed steel liner plates, as well as filling the annular space between tunnel lining and thermal utilities, using 3,000 cu yds of lightweight cellular grout. The utility tunnel, which runs beneath the busy runways and taxiways of the airport, stood to be a great task.

To handle a task of this magnitude, a project team was assembled including BHMM Energy Services/Citizens Thermal Energy, the owner; Parsons Brinckerhoff (PB), the design engineer; Shiel Sexton Construction, the construction manager; The Etica Group, engineering consultants; Bowen Engineering Corp., general contractor; Midwest Mole Inc., tunneling contractor; Akkerman Inc., tunnel machine manufacturer; Earth Exploration, geotechnical instrumentation; American Commercial Inc. (ACI), tunnel liner manufacturer; Hany Grouting Systems, specialized grouting equipment; Condat Lubricants, soil conditioning and two component grout; and Cellufoam Concrete, cellular grout.

This was a value solution, said Joe Butor, project manager for Midwest Mole. Everyone, from the owner and engineer down to the subcontractor, had to sit on the same side of the table to make this project a reality.-

Planning for Success

Before the team could dive into the utility tunnel project, which would install high-temperature hot water, cool water, telecommunications and electrical conduit, intense pre-planning needed to be done. From numerous meetings to assessing risks, all the bases of the job were to be covered before work began.

To our knowledge, the approach we took and methods we used have never been done before — for example the combination of an earth pressure balance machine with tunnel liner plates, said Butor. I'm sure the large volume of grout we placed has been previously installed, but under the conditions and requirements of the project, it took an immense amount of pre-planning.

Meetings between the members of the project team began months before setting foot in the tunnel. A collaboration of the owner, engineers and contractors helped determine the proper steps to be taken.

We had meetings continuously with the design engineer, the owner, Bowen Engineering and ourselves probably six or seven months prior to mobilizing the site, said Dan Liotti, president of Midwest Mole. We met for four to five months before we even had a contract.

Also prior to beginning of the project, a risk management plan was developed to assess the possible risks associated with the job. The plan described any probable risks and ways to avoid them and minimize their effects. This practice allowed for changes to be made to particular terms of the project, in order to steer clear of risky ventures and save money for the owner.

It allowed us to attempt to foresee every possible problem that could occur during the project and develop contingency plans, said Butor. So if those problems should occur, we could react with the contingency plan. It was a huge time and cost-savings down the road.

Another feature of the risk management plan was a risk matrix. With the matrix, the team was able to evaluate different tools, equipment and methods of installation to construct a successful project with minimal risk and maximum cost-

savings.

Next, the team needed to select an earth pressure balanced tunnel boring machine (EPB TBM) that would meet the requirements (and budget) for the tough job. Taking into consideration the size of the project and ground conditions, which included glacial till, water bearing sands and gravels and boulders, an Akkerman model EPBM108 EPB TBM was chosen.

Precise engineering played a huge role in the project, before and during construction. Prior to the project's commencement, PB engineers performed extensive analysis on the proposed steel liner plates that were to be installed. The end result was to use a 5/16-in. thick gasketed liner plate in combination with steel stiffeners, manufactured by American Commercial, to withstand the thrust pressure of the EPB TBM and the soil and grout loading.

In order to maneuver the 100-plus lb liner plates, Akkerman created an erector arm to increase productivity and ease the burden on crewmembers. The newly developed arm allowed the plates to be rotated into position, saving time and easing the crew of the physically straining task.

The work shafts used in the project were supplied by Bowen Engineering, which also installed the utility piping. Bowen engineered a system that allowed the installation of 1,000-ft long sections of pre-welded utility pipe — a process that saved time on an already tight schedule.

Thanks to a remote display developed by Akkerman, project officials were able to monitor the EPB TBM and liner plate installation from the surface. To minimize the burden of tedious paperwork, details from the jobsite were posted on the project's Web site every day.

Conquering the Challenges

As with any trenchless project, this one had its own technical challenges and limitations to face. Boulders became the first obstacle for the team to deal with. Midwest Mole investigated other excavation projects at the airport, in order to determine the boulder conditions the team could expect to face at the jobsite.

A couple of months before we mobilized to the site, we obtained boulder samples from nearby excavation sites and sent them to the Colorado School of Mines for a linear cutting test, said Butor. We were able to define the boulders strength and abrasitivity, from which we were able to select the appropriate disc cutter for the job. With the new information at hand, a dome-type carbide insert disc cutter was specified.

The team also faced the complex task of having to pump the two-component grout from the surface. Due to space requirements and regulations, the grouting equipment could not fit inside the tunnel machine. With the assistance of Hany Grouting Systems, the team was able to accommodate to the size issues and function from the surface 2,000 ft away. Hany also offered input on the grouting to best fit the project's needs.

Strict settlement limits were also in place for the project. Being underneath an airport runway, the crews were bound to 0.5 in. at paved surfaces and 0.7 in other areas. By using the right soil conditioners, proper advance rates and grouting continuously as the liner plates exited the TBM, ground loss was kept to a minimum and settlement was negligible.

Tunneling was not the end of the project for Midwest Mole. Once Bowen had completed the installation of the thermal utilities, Midwest Mole was responsible for filling the annular space between thermal utilities and liner plate with 3,000 cu yds of lightweight cellular grout. The tunnel was divided into six equal sections and each section was poured in two lifts. A unique aspect of the operation was the use of sacrificial cameras in each section to ensure the void was completely filled and to allow crew members to visually see discharge pipes submerge before pumping, in order to prevent air pockets along the alignment. The crews also utilized temperature data loggers to record the maximum temperature of the grout during each pour. Midwest Mole field engineer David Howell performed mock trials at their equipment yard and developed and tested the mix design to ensure the heat of hydration limits were met and that the mix could be pumped 1,000 lf without separating.

Along with the project, came the milestones and records that accompany it. The best production during a 10-hour shift was 30 lf. The best day was recorded at 48 lf in two 10-hour shifts. The most cellular grout poured in one day was 350 cu yds.

I think this project would've been nearly impossible without trenchless technology. We did a crossing of two taxiways and a runway at the Indianapolis Airport. Without trenchless technology, they would have had to use open-cut, said Butor. The airport is currently building a new terminal and had to close an adjacent runway because of another project, separate from ours. If we had to complete this project using open-cut, the airport would have to function with only one runway.

With exceptional teamwork, strategic planning and supreme execution, the project was completed on May 16, 2007.

Pam Stask is an assistant editor of *Trenchless Technology*.