2013 NORTH AMERICAN MICROTUNNELING

ALSO INSIDE

ACHIEVEMENT AWARD
James W. Fowler Co. to be honored at Microtunneling Short Course

JOB LOG
A look at recent microtunneling projects in Canada and the United States

PUSHING THE BOUNDARIES
SARI PROJECT IN CALIFORNIA HELPS RAISE THE BAR FOR MICROTUNNELING IN NORTH AMERICA

A SUPPLEMENT TO:

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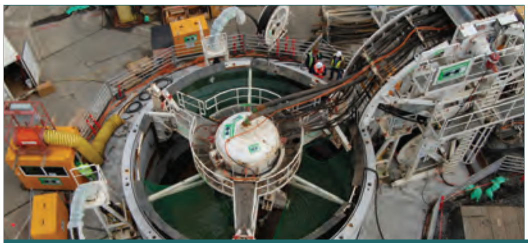
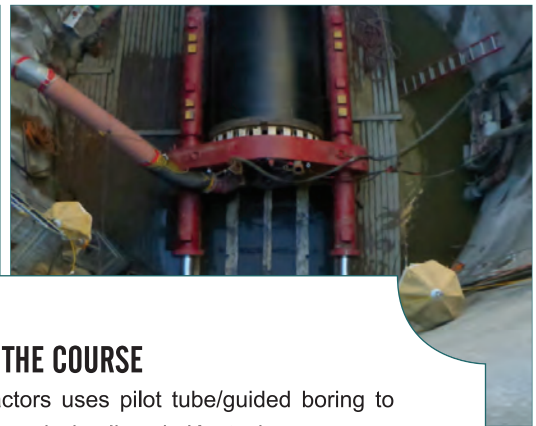
INDUSTRY REVIEW





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EDITOR'S MESSAGE

THE CHANGING FACE OF MIRCROTUNNELING

In the five years that Benjamin Media has presented the North American Microtunneling Industry Review, it has been interesting to the see the developments in the industry in that relatively short time span. Although microtunneling is a mature technology in the United States (dating back more than 25 years), the last five years has seen the emergence of new technologies that are leading to longer drives and curved drives that help make microtunneling more cost-effective.

In this space last year, we reported that Frank Coluccio Construction Co. (FCCC) completed tunneling on the final drive of the highly anticipated Beachwalk WWPS to Ala Moana Park project in Honolulu. The fifth and final drive included the first double-curve microtunnel drive, as well as the longest drive length for a curved drive (approximately 1,250 ft) completed in the United States and Canada.

Since that time, several more curved drives have been completed, including the Santa Ana River Interceptor (SARI) Relocation – SARI Mainline project in Santa, Ana, Calif., the Keswick WPCP Effluent Outfall Expansion in Keswick, Ont., and the Elgin Mills (PD7) Watermain in Richmond Hill, Ont. Each of these projects represented milestones: SARI was the first project in North America to include multiple curved drives; Keswick was the first Canadian project to include a curved drive; and Elgin Mills marked the longest curved drive completed in North America to date (2,427 ft).

There has been increased use of the Herrenknecht Direct Pipe system, which is basically a hybrid of slurry microtunneling and pipe thrusting technology used in HDD. Direct Pipe allows the installation of pipelines with lengths of 1,500 m or more. In this issue we profile a Direct Pipe project that involved a highway crossing in Pennsylvania (p. 26). In the 2013 Projects of the Year, *Trenchless Technology* awarded its Project of the Year for New Installation to the Empire Connector Project, which used Direct Pipe in combination with HDD for a river crossing near Corning, N.Y.

Also of note is the development of the North American Microtunneling Association (NAMA), an association of contractors dedicated to promote dialogue and education and ultimately strengthen the industry. NAMA was formed in 2012 and has been actively involved in educating the industry on how to maximize the occurrence of successful projects. On the subject of contractors, it is interesting to see new contractors (as well as some that are re-entering the market) building microtunnels.

Finally, it is interesting to the see the announcement by The Robbins Company that it is offering microtunneling systems. Robbins invented the first practicable tunnel boring machine and has been a worldwide leader in hard-rock tunneling. More recently the company has expanded its product line to include soft-ground TBMs. The foray into the microtunneling arena makes it just the second U.S.-based manufacturer of microtunneling equipment (along with Akkerman).

While the microtunneling market had been relatively flat for the past decade or so, these developments point to a promising future.

Jim Rush | Editor

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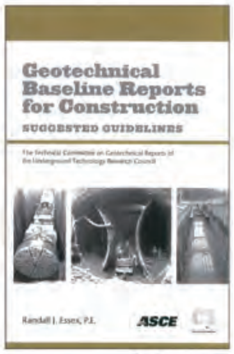

This resource examines geotechnical baseline reports (GBR) as a means of allocating and managing risks, and the importance of ensuring compatibility between the GBR and other contract documents. It offers recommendations based on industry-wide lessons learned from the engineers' and owners' perspectives.

Topics include:

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- Preparation of a GBR
- Applications for Other Excavations and Foundations
- Design-Build Procurement

62 pages/softbound
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PRICE: $39.99*

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228 pages/softbound
Author: Society for Mining, Metallurgy & Explorartion (SME)

PRICE: $109.99*

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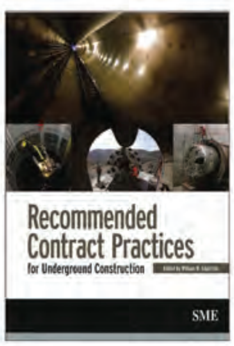

This manual is an indispensable resource for contractors, owners, consultants and suppliers anticipating underground projects. Underground construction is growing more complex as demand for space increases, technologies evolve, and stakeholders assert influence. This book will assist you through one of the most challenging facets of underground construction: contract language does not account for the unique nature underground.

137 pages/softbound
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Publisher: CRC Press

PRICE: $169.99*

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COVER STORY

THE FAMILY-RUN COMPANY IS LED BY (FROM LEFT) JOHN FOWLER, JIM FOWLER AND MARK WEISENSEE.

PIONEERING SPIRIT

JAMES W. FOWLER CO. BLAZES NEW TRAILS IN MICROTUNNELING

BY: JIM RUSH

From pioneering innovative technologies to completing record-setting drives, the James W. Fowler Co. (JWF) has established itself as a leading contractor in the microtunneling arena. For example, the company recently completed the longest compound curve drive completed in the United States as part of the Santa Ana River Interceptor (SARI) Relocation – SARI Mainline project.

But, like many contracting companies, JWF came from modest beginnings. The company was founded in 1972 in the mid-Willamette valley town of Dallas, Ore. by James and Candace Fowler, who started out constructing ponds for local farmers, roads and other small projects with one bulldozer and one pull scraper.

Today, the company is a diversified general contractor providing heavy civil and tunneling construction solutions for municipalities, agencies and private owners across the United States. JWF is still headquartered in Dallas, Ore., about 60 miles southwest of Portland, and has regional offices in Seattle and Los Angeles.

JWF's heavy civil division specializes in water, wastewater, sewer and transportation infrastructure projects including large diameter water and sewer utilities, water and wastewater treatment facilities, fish hatcheries and bridge and overpass construction. The tunneling division excels at challenging microtunneling, tunneling, auger boring and pipe ramming projects.

JAMES W. FOWLER CO. TO RECEIVE MICROTUNNELING ACHIEVEMENT AWARD FOR PROJECT EXCELLENCE

James W. Fowler Co., a diversified general contractor and a pioneer in the microtunneling market, is the recipient of the 2014 Microtunneling Achievement Award for Project Excellence. The awards were established by Tim Coss, Microtunneling Inc., and Levent Ozdemir, Ozdemir Engineering, organizers of the Microtunneling Short Course, to recognize leading individuals or companies who have made a lasting impact on the field. James W. Fowler Co. will be officially recognized at the Short Course banquet the evening of Feb. 13, 2014. The course will be held Feb. 11-13 at the Colorado School of Mines in Golden, Colo.

James W. Fowler Co. has had several notable and grounding-breaking projects in the last several years, including the pioneering the use of cutter soil mixing for shaft walls on the Balch Consolidation Conduit project in Portland, Ore.; the first use of the Herrenknecht vertical shaft sinking machine in Seattle; and most recently the completion of North America's longest compound-curve mircotunnel in Santa Ana, Calif.

HISTORY

From the beginning, Jim and Candace Fowler operated their business together from their home while raising four small children. Never ones to shy away from a challenge, the Fowlers worked tirelessly to build the construction business and if Jim didn't have the expertise to complete a particular project, he asked someone who did.

As small business owners, Jim and Candace wore many hats. Their children relate stories of being with Jim while he negotiated with a farmer to perform a job, talked to a banker, and then as he operated the bulldozer. The Fowlers taught their children from an early age the value of hard work and a job done well. This can-do spirit came in handy in 1977, when the family's home was destroyed by a fire. With the support of the local community and their church, which provided the Fowlers with clothes, food and necessities, the family was able to rebuild the home and their business. This challenge reinforced Jim and Candace's support of charities that benefit the local community and those less fortunate.

Over the years, the company continued to grow and prosper. In 1977, James W. Fowler Co. was awarded its first public construction project, building a 10 million gallon water reservoir for the City of Tigard, Ore. Over the next 10 years, the company expanded to build roads for the U.S. Forest Service, Polk County and the Oregon Department of Transportation. The company's first wastewater treatment plant was built in 1987 for the City of Astoria, Ore.

Jim and Candace's son, John, joined the company in 1980 to start learning the company from the ground up, progressing from laborer to equipment operator to project manager to his current role of Executive Vice President. Jim's son-in-law, Mark Weisensee, joined the company in 1993, starting as an equipment operator and progressing on to become a project manager, senior project manager and eventually to his current role as Senior Vice President.

The company, which is still family owned, plans to maintain that status going forward. "I am second generation and we have active involvement from many family members," John Fowler said. "We are setting the stage for a multi-generation construction company. Family is very, very important to us."

GOING UNDERGROUND

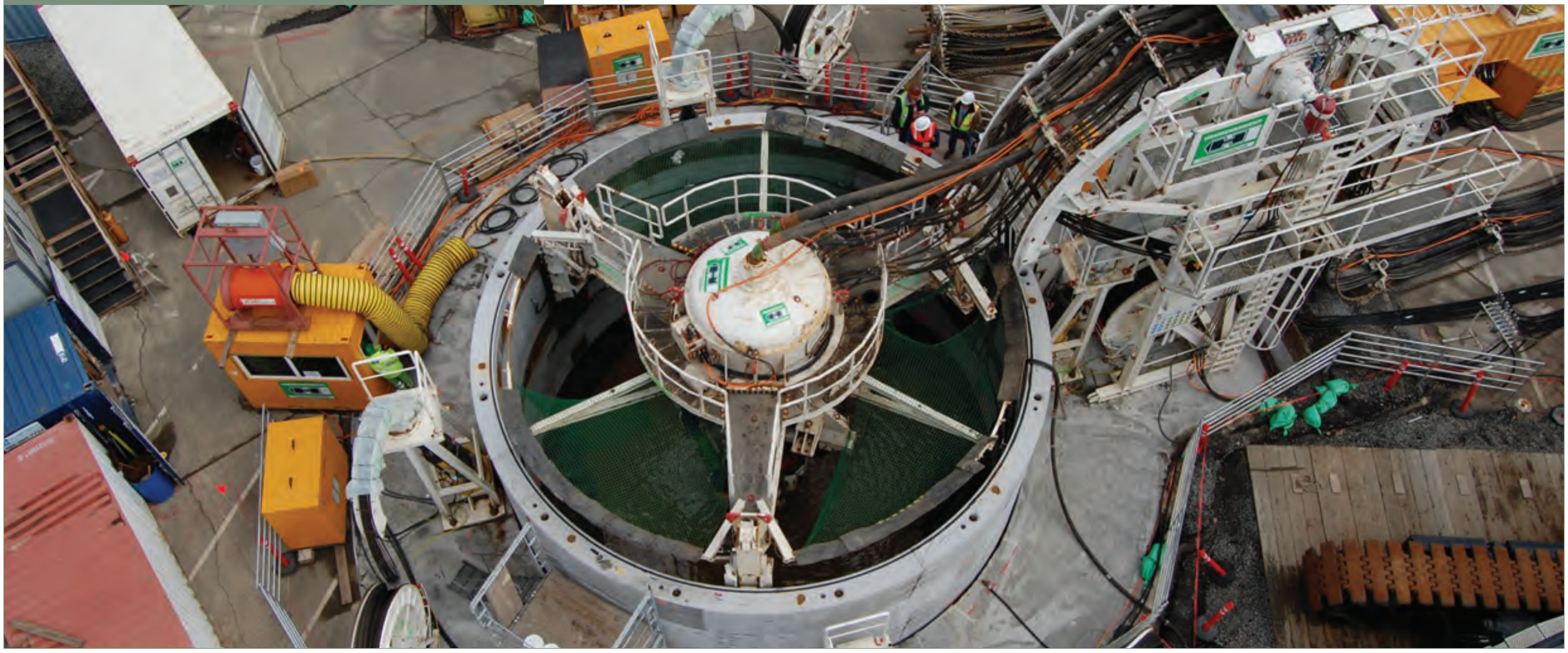
JWF became involved in the microtunneling market in the late 1990s. At the time, the technology was prevalent in Europe, but was still in its developmental stage in the United States. John's passion for the new world of microtunneling propelled the company in a new direction. His talent for innovative thinking and "project first" mentality has provided opportunities for the company to utilize new processes and technology to benefit the projects.

JWF became familiar with microtunneling following one project on which it subcontracted the microtunneling work, and another job on which JWF was hired to build the shafts for microtunneling.

Past winners of the award include: Northwest Boring; Franco Coluccio, Frank Coluccio Construction Co.; Glenn Boyce, Jacobs Associates; Stefan Trumpi-Althaus, Jackcontrol Inc.; Matt Roberts, Kiewit; Dennis Molvik, Northwest Boring; Rick Turkopp, Hobas; Gary Huber, Permalok; James Kwong, Yogi Kwong Engineers; and James W. Fowler Co.

For more information on the Mirotunneling Short Course, visit: *www.csmspace.com.*

INTRODUCING NEW TECHNOLOGY, SUCH AS THE USE OF A VERTICAL SHAFT DRILLING MACHINE, ARE HALLMARKS OF THE COMPANY. (PHOTO: SEATTLE DJC.)



"We did a lot of heavy civil work and structures, and we always favored the challenging projects because that's where we feel we can excel," said Fowler. "So when we saw those two microtunneling projects, we thought, 'We can do this. This fits our model.' "

JWF's first job as a microtunneling contractor was the Spanaway Loop Bypass Interceptor project near Seattle. The project consisted of approximately 5,700 lf of 72-in. ID pipe, of which 2,336 lf was installed by microtunneling. To make things interesting, the challenging ground consisted of a mix face strata of gravel/cobbles over glacial till, with the entire pipeline below groundwater elevation – and dewatering was not permitted.

"The Spanaway Loop project was an awfully difficult project to start with," Fowler said. "It was one that had been terminated before and then redesigned and came out to bid again. We were one of two bidders. It was a tough, tough job, but those are the ones where you learn the most. There were very difficult ground conditions. It was extremely open-graded, lots of groundwater, very abrasive soil, 60,000-psi cobbles, mixed face, long drives – it had a bit if everything. But we also acquired several key people on that job who made a huge difference in successfully completing the work."

FORGING AHEAD

In recent years, JWF has gained a reputation for using innovation and new technology in the successful completion of award-winning microtunneling projects. Three projects that highlight the company's pioneering spirit include the Balch Consolidation Conduit in Portland; the Ballard Siphon Replacement in Seattle; and the Santa Ana River Interceptor (SARI) Relocation – SARI Mainline in Santa Ana, Calif.

Balch Consolidation Conduit: JWF worked together with consultant Jacobs Associates to evaluate, design and implement cutter soil mixing (CSM), a construction method new in Oregon at that time, to meet the City of Portland's goals of managing risk and reducing cost and schedule on the project. The method was effectively used to construct shafts and ground improvement for the project and reduced construction and completion risks to the project. CSM, which is gaining in popularity in the United States, mixes in-situ soil with cement and water to form rectangular soil-cement (soilcrete) panels. The individual panels can be interlocked to provide continuous straight walls, as well as a structural ring for circular shafts, and can serve as ground improvement.

The Balch project is a landmark use of the CSM method with the construction of five deep shafts in difficult ground. Not only have the CSM panels been utilized for shaft support, but the Balch project is the first known use of these panels for ground improvement for tunneling. Rows of soilcrete panels were employed to support the tunnel machine and pipe through soft alluvial soils between shafts.

Microtunneling on the Balch project consisted of 6,921 ft of 7-ft ID reinforced concrete pipe, 1,115 ft of 54-inch reinforced concrete pipe and six shafts up to 79 ft deep. Drive lengths ranged from 1,133 to 1,685 ft.

Ballard Siphon Replacement: This project required JWF to build two vertical shafts on either side of a ship canal in order for a 3.2-m EPB TBM to mine a 2,100-ft tunnel 60 ft below the canal and more than 150 ft below the ground surface. JWF investigated various shaft construction methods to help offset delays that occurred in the bidding process and eventually proposed the use of vertical shaft machine (VSM) to construct the south shaft. This innovative construction method offered the additional benefits of allowing the shaft to be shored using caissons at an extended depth while addressing the challenges associated with the high water table.

The VSM technology is similar in concept to a microtunnel boring machine, except that the excavation is completed vertically rather than horizontally. The VSM, built by Herrenknecht, was designed to work in Europe's dense urban areas with a small footprint and in difficult soil conditions with high groundwater tables. This description fit the conditions at the south shaft area perfectly, which is located in an industrial parking lot with high traffic and a limited project area. The soil conditions included loose sand, silty sand, medium stiff sandy clay, medium dense silty fine to medium sands with gravel, very dense granular and hard cohesive materials, and very stiff to hard clay containing very small sand-filled slickensides. Additionally, groundwater was encountered approximately 16 ft below the surface.

The 154-ft deep , 9-m inner diameter shaft was finished in about four weeks excavation time and the average excavated depth per shift was 6 to 7 ft. Upon completion of the excavation, the VSM was recovered by the three shaft winches and dismantled within one week.

Santa Ana River Interceptor (SARI) Relocation – SARI Mainline: JWF completed the milestone Santa Ana River Interceptor (SARI) Relocation – SARI Mainline Project for the Orange County Sanitation District in July 2013. It included four microtunneled drives, the third and fourth of which included curves in their alignments. This is first project in the United

States to include curves on multiple drives, and it included the longest compound curved microtunnel in North America.

JWF value engineered the curves to reduce cost by eliminating shafts and combining multiple drives. In completing the curves, JWF used the Jackcontrol hydraulic gasketed joint and full-time monitoring system to monitor the pipe string during installation, marking the first use of the Jackcontrol system in North America.

The SARI Project consisted of five four microtunnel segments totaling approximately 4,000 ft.

BUILDING A SUCCESS STORY

While many companies have come and gone since the time of its founding, JWF has been able to grow and succeed. Fowler points to two primary reasons for the company's success: its people and its commitment to excellence.

"You are successful as a construction company because of the people that you surround yourself with, and I firmly believe we have the best in the industry," he said. "We have amazing people and that's how you complete tough projects. When I was a kid, my dad said: 'Surround yourself with people who are smarter than you and you're going to succeed.' We've followed that advice and been fortunate to be successful."

In fact, Fowler says that some of the people who joined the company to complete the Spanaway job are still with the company.

Also key to the company's success is its commitment to getting the job done right, and that includes partnering with owners, engineers and other industry partners – like Jackcontrol and Herrenknecht. "We value our client relationships even though we are largely a hard-bid contractor," Fowler said. "We understand the need to maintain a good reputation and we set high standards.

"It's only when you have a good reputation and good relationships that you can implement new technology and new methods. When you have a track record of successful work it helps to open doors."

LOOKING TO THE FUTURE

When JWF got started in the tunneling and microtunneling business, it started out as a logical extension of the company's work. It has since become a significant portion of the company's overall revenue, accounting for about half of the company's volume in some years. And, Fowler is bullish on the future of the market.

"I am optimistic about the future of the microtunneling market," he said. "Cities are becoming more congested and it is getting more difficult to build in overcrowded utility corridors. Also, the public is less tolerant of disruption due to construction. As our industry continues to succeed at more challenging projects, it will open the eyes of designers and owners to what is possible, and more projects will naturally start to develop."

JIM RUSH IS EDITOR OF TRENCHLESS TECHNOLOGY AND TBM: TUNNEL BUSINESS MAGAZINE.

FEATURE STORY

STATE OF THE INDUSTRY: MICROTUNNELING 2013

BY: ROB TUMBLESON

In the past 27 years over a million of feet of pipe have been installed by the microtunneling method in North America. Even with all this experience, we are learning new things about slurry microtunneling that allow us to expand its possibilities. I would like to share a few thoughts and a few changes I have witnessed over my 23 years in the industry.

The biggest change in the industry has to be the formation of NAMA (North American Microtunneling Association). Among NAMA's primary purposes shall be to provide a venue for microtunneling contractors to meet and engage in discussion regarding issues of mutual interest, to foster education, exchange views, and to promote interaction with others having an interest in microtunneling. NAMA will also be proactive to help engineers and owners to understand issues of importance to microtunneling contractors and to promote safety and advancement in the microtunneling industry.

I feel travel is a problem also affecting our industry. In the first 15 to 20 years of microtunneling in North America, most microtunneling contractors traveled to find work, but generally, the travel was within a fairly small geographical region, about 200 miles. What we see today is that microtunneling has become a method of pipe installation that is used as a problem solver not as a method of first choice. Therefore, we have fewer projects bidding each year than we had in the 1990s and early 2000s. With fewer projects bidding we see fewer contractors, 28 in 1997 compared to 16 in 2013. With fewer contractors, we see expanding geographical regions. Most contactors are willing to go coast to coast; some are even looking to foreign countries for their workload. With this need to go further for work a new problem arises – people.

People are the most important asset of a company. I've heard contactors refer to their people as "the talent" or "our core people." When a contactor works out of town they will often get local labor to support the talent but with such a specialized workforce needed to operate and maintain slurry microtunneling equipment it's vital the contractor has their core people on the project. As some of us know working out of town is exciting but only for a week or two then it turns into working out of town! I see training and retention of a talented work force as one of the biggest challenges of a microtunneling contractor today.

Now let's talk about the equipment. In the mid-1990s we had four major suppliers of slurry microtunneling equipment. (Herrenknecht, Iseki, Soltu and Akkerman) It's interesting we still have only four major suppliers of microtunneling equipment in North America today however some of the names have changed (Herrenknecht, Akkerman, Rasa and MTS).

I have noticed in the past 10 years that a large percentage of slurry machines being manufactured for the North American market have been 50 in. and larger. I'm sure the introduction of the guided boring or pilot tube machine has had some impact on the smaller slurry market.

With the move toward larger diameter machines we have seen drive lengths extend. For over 20 years the longest drive was just over 1,500 ft in North America. We now routinely see drives of 1,500 ft and more. And, occasionally, they have planned curves in the drive.

The success of these drives has more to do with the ancillary equipment and planning by the contactor than they do with the base microtunneling system itself. Equipment such as advanced guidance systems, intermediate jacking stations and automated lubrication systems are just some of the things that have allowed the microtunneling industry to achieve these advances in recent years. In Asia and Europe, curved, long-distance drives are commonplace. I have heard that more than 10,000 curved drives have been completed in Japan and Asia alone. In my early days in the industry as a pipe salesman, I was never happy to hear about a curve on a microtunneling project, because they were never planned.

Another noteworthy change in the industry is the attempt to make things simpler. In the early days of microtunneling most control cabins were analog controls with clipboard data logging that were fairly simple to operate. The engineering community and the equipment manufacturers made the move to digital data logging, and with that, the control cabins got more complicated and expensive with each new generation. Some control cabins were designed and programmed to operate specific diameter MTBMs so the contactor needed to own multiple control cabins to operate his inventory. The latest control cabins have more versatility and less redundancy, making them easier to operate and train operators on. Remote monitoring is also a new feature that has become a valuable tool used by the contactor as well as the project engineer.

There are so many other topics that could be talked about on this subject, like face access, air locks, quality of pipe, and of course the use of bentonite in slurry, but I will leave them for another time. I would like to sum up my thoughts on the

state of the industry, and say I feel the Industry is maturing. We certainly don't see the growth there was in the 1990s; however, we do have a viable mature market. The formation of the North American Microtunneling Association is also sign of maturity. The idea is for this group of contactors to work together to better the industry by sharing lessons learned. I, for one, hope they are successful.

ROB TUMBLESON IS THE DIRECTOR OF SALES AND MARKETING FOR MICROTUNNELING INC. HE HAS 23 YEARS OF EXPERIENCE IN THE MICROTUNNELING AND PIPEJACKING INDUSTRY, INCLUDING SERVING AS VICE PRESIDENT OF SALES AND MARKETING FOR AKKERMAN INC. AND SALES MANAGER FOR MISSION CLAY PRODUCTS. TUMBLESON IS ACTIVE IN MANY INDUSTRY ASSOCIATIONS INCLUDING UCA OF SME, NASTT, NUCA AND ASCE. HE FORMERLY SERVED ON THE GREEN BOOK MICROTUNNELING AND AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) SPEC COMMITTEES.

THE SL52.5 INCREASED TO 60-IN. O.D. IS BEING LOWERED INTO THE JACKING PIT TO LAUNCH ON THE THIRD DRIVE.

FEATURE STORY

GOING WITH THE FLOW: SLURRY MICROTUNNELING IN WISCONSIN

BY: LAURA ANDERSON

A seasoned pipe jacking contractor is back in the slurry microtunneling game, after a 10-year hiatus. Crew members, with direction from the equipment manufacturers' field technician, encountered three distinctive crossings on their inaugural project, providing a well-rounded experience for the newbie microtunneling operators.

The Northeast Interceptor – SEI to FEI Relief/Replacement project for the City of Madison and Monona in Dane County, Wis., is owned by the Madison Metropolitan Sewerage District. The project was designed by AECOM of Middleton, Wis. It involved the installation 6,162 lf of 48-to 60-in. ID new sanitary sewer lines. Merryman Excavation of Woodstock, Ill., was the general contractor. EJM Pipe Services of Lino Lakes, Minn., was contracted for all slurry mircotunneling and trenchless pipe installations, including all of the shaft installations.

EJM installed 627 lf of 48-to 60-in. ID RCP in three drives with two MTBMs. The three microtunneling drives were staged incrementally over an eight-month time frame to align with the general contractor's progress. All crossings took place under multi-lane highways at nearly flat grades and in close proximity to a lake and multiple creeks. The 8-ft segment C-wall RCP pipe met tie-ins that were open-cut by the general contractor. Adapters connected the final microtunneled RCP segments to the open-cut HOBAS pipe to smooth the ID/OD size differential.

This project marked EJM's re-emergence into the microtunneling market after 10 years. EJM sought assistance from a factory-trained field technician to support its six crew members on operations. EJM used an Akkerman manufactured microtunneling system, comprised of an SL52.5 MTBM skinned to 60-in. OD and an SL74 MTBM both with soft-ground cutter face configurations, control container, remote hydraulic power pack, MT960K jacking frame, MT460 jacking frame, bentonite pump, slurry pack and booster pumps. EJM's slurry separation plant was manufactured and furnished by Derrick Equipment Co.

Construction for the first crossing began in late February 2013. The first interceptor had to be completed before the seasonal thaw. This 205-lf pass, situated from north to south crossed under the eight-lane Beltline Highway. The geology in this region, 200 ft north of Upper Mud Lake, was wet sand. When the highway was constructed in the 1960s, sand from Mud Lake was used as fill material. The contractor used the SL74 MTBM to install 60-in. ID RCP for this drive. The 20x24-ft shaft was trenched in at 13-ft deep to achieve the 0.12 percent grade. The field technician and crew members closely

EJM PIPE SERVICES CREW USED AN AKKERMAN SL74 MTBM ON THE FIRST SLURRY MICROTUNNELING DRIVE ON THIS PROJECT AND WORKED TOWARDS COMPLETION ON THIS DRIVE BEFORE THE SEASONAL THAW.

assessed the MTBM's advancement from the control container monitors until it emerged on the south side of highway. Full construction for this pass took place from Feb. 25 through March 29, 2013, with microtunneling consuming about a week of that time.

The second crossing, 202 lf in length, ran under four-lane East Broadway, diagonally from east to west. The construction shafts were located by a diner, gas station, hospital and large home improvement store, with both pits edging the highway. The SL74 MTBM had to pass under a creek toward the end of the drive and shallowly emerge to meet the tie-in at a nearly flat grade. The 20x24-ft launch shaft was set at 16-ft deep. Approximately 32 ft into the drive, the crew encountered some hard ground that caused the rotational torque to intermittently rise then fall back into normal ranges. Following the installation of several additional feet, they moved beyond the area to discover that they had mined through a region of densely set tree roots. Cleanout of the separation plant from the concentrated amounts of sands also contributed to delays and significantly reduced daily production rates. The last quarter of the bore under the creek was noted on the geological reports as a former dump site. Here the MTBM encountered some solid objects, creating the need for a few steering corrections. However, the MTBM emerged into the reception shaft on line and grade. Construction on this crossing took place from April 25 through May 23, 2013, with the pipe installation completed in six days with crews assuming 12-hour shifts.

Construction on the final 240-ft bore began in July 11 and microtunneling operations began on Aug. 20. The pits were located in

THE SL52.5 INCREASED TO 60-IN. O.D. EMERGED AFTER CROSSING UNDER HIGHWAY AND EMERGING IN A SMALL STREAM.

a residential area and the drive had to advance from west to east, under Highway 51. The 12x20-ft jacking pit was constructed at 20-ft deep in late August, near the shoulder of Highway 51. The drive commenced in a small stream on the east side. Crew members operated an SL 52.5 MTBM increased to 60-in. OD to install the 48-in. ID C-wall RCP. The geology on this bore was similar to the other two drives with the exception of a small amount of clay fill. The MTBM emerged into the reception pit on Aug. 27.

Mark Montgomery, Vice President of Field Operations for EJM Pipe Services stated, "We could see that our operators gained confidence in their own abilities to carry out the work as the job progressed. The knowledge that our crew was able to take away from each drive is priceless. There are so many obstacles that can affect a drive's outcome in all soil conditions and our crew did exceptionally well to overcome them and finished strong."

EJM crews concurrently installed 616 lf of 48- to 60-in. ID RCP with an Akkerman TBM 480 and TBM 600 pipe jacking system on the Northeast Interceptor – SEI to FEI Relief/Replacement project. Upon completion of this project, the EJM crew was headed to begin a microtunnel drive in rock conditions in Kansas City, Mo.

Regarding the need to adapt to the ever-changing ground conditions and construction challenges, Montgomery said: "Sometimes you just have to go with the flow" – pun intended.

LAURA ANDERSON IS DIRECTOR OF MARKETING FOR EQUIPMENT MANUFACTURER AKKERMAN OF BROWNSDALE, MINN.

FEATURE STORY

PRIOR TO CONSTRUCTION, THE CONSTRUCTION TEAM PROPOSED COMBINING MULTIPLE DRIVES INTO A SINGLE, LONG S-CURVE DRIVE THAT WOULD ELIMINATE ONE SHAFT AND CONVERT ANOTHER TO A PUSH-THROUGH SHAFT.

PUSHING THE BOUNDARIES

HISTORIC SANTA ANA RIVER INTERCEPTOR PROJECT COMPLETED IN SOUTHERN CALIFORNIA

In the early hours of the morning on May 1, 2013, microtunneling contractor James W. Fowler Co. broke through on the third of four drives for the Santa Ana River Interceptor (SARI) Relocation – SARI Mainline project, completing a difficult and record-setting drive that marked the longest S-curve completed in the United States to date.

The record-setting drive was an S-curve 1,567 ft in length. In fall 2012, Frank Coluccio Construction Co. had completed a 1,250-ft S-curve drive in Hawaii, marking the first double curve in the United States as well as the longest U.S. curved drive. Just this fall, Ward and Burke completed the longest curved drive in North America with the completion of a 740-m (2,427-ft) drive as part of the Elgin Mills Watermain project in Ontario.

The SARI project initially was designed as a conventional microtunnel project with several straight drives. Prior to construction, the construction team proposed combining multiple drives into a single, long S-curve drive that would eliminate one shaft and convert another to a push-through shaft.

John Fowler, executive vice president of James W. Fowler Co. said, "We recognize that this innovation would not have been possible without the partnership of the Orange County Public Works (OCPW) and its consultants, HDR, TetraTech, MWH Constructors and Hatch Mott MacDonald. OCPW showed great innovation by placing their trust in our team for this challenging project. The project truly has the ability to revolutionize the North American tunneling industry by allowing greater design flexibility in microtunnel drive alignments."

PROJECT BACKGROUND

Constructed in the mid-1970s, the Santa Ana Regional Interceptor in Yorba Linda, Calif., was originally constructed with approximately 20 ft of cover within the floodway of the Santa Ana River between Weir Canyon Road and the Orange/Riverside county boundary. In some locations, the low-flow of the Santa Ana River has meandered toward the existing SARI Line and the bed of the Santa Ana River has degraded, leaving the SARI line virtually exposed to the river at several locations and requiring the placement of temporary rock riprap revetment and grade stabilizers to protect the SARI line nearly every year.

The SARI Relocation Project relocated approximately 4 miles of existing interceptor sewer pipeline out of the Santa Ana River scour zone. Construction of the SARI Relocation Project began in mid-2011 and is expected to be fully completed by 2014. Approximately 4,700 ft of the product pipe was installed by 77- to 101.5-in diameter microtunneling in five segments, including two inverted siphon crossings and two curved drives, one of which is a 1,567-ft, S-shaped alignment. Tunneling was performed between May 2012 and July 2013.

Tunneling was chosen to avoid construction impacts to the community and environmental impacts along the river. Soil conditions on the project include a complex mix of alluvium with abundant cobbles and boulders in a weak sandy matrix. During design, subsurface investigation reports indicated abrasive soils based on Miller testing. Groundwater levels were well above the pipeline elevation during flood season along several of the tunnels. Temporary shaft structures were excavated up to 70 ft deep and included the use of cement deep-soil mixing, secant piles and soldier pile and lagging walls with permeation grouting designed to limit groundwater inflow.

The design team, led by Tetra Tech, with tunnel and shaft design by Hatch Mott MacDonald, was retained by the Orange County Flood Control District (OCFCD) to complete the preliminary and final design to relocate the existing SARI, as part of the U.S. Army Corps of Engineers Santa Ana River Mainstem project. The project consisted of the following two contract packages:

1. SARI Yorba Linda Spur (YLS) Contract – It consisted of 4,685 ft of 15-in. gravity sewer, including 794 ft of siphon pipes inside a 77-in. outside diameter (OD) casing pipe installed via microtunneling under the Santa Ana River for the construction of a twin barrel 12-in. siphon with a 16-in. overflow, and odor control facilities. The project was awarded to LA Engineering for $7.2 million; Vadnais performed the microtunneling.
2. SARI Mainline and Metering Station (Mainline) Contract – Consisted of approximately 20,700 ft of 54-in. diameter gravity sewer, with several reaches of 101.5-in. OD casing installed via microtunneling. Work included installation of gravity sewer and casing behind an existing tieback wall; open-trench construction; crossing a documented wildlife corridor; and four tunneling segments including two planned curved microtunnels, one that is the longest S-curved microtunnel in the United States. The project was awarded to W.A. Rasic Construction for $41.85 million; Fowler performed the microtunneling.

RAISING THE BAR

The planning, design and construction of the SARI Relocation Project required significant coordination with almost two dozen stakeholders. The project included five microtunnel drives driven through extremely abrasive soil conditions in environmentally sensitive areas with state-of-the-art Herrenknecht microtunnel boring machines (MTBMs). The specified minimum microtunneling equipment requirements with face access and compressed air lock was, in part, due to the anticipated abrasiveness of the ground and the possibility of encountering large boulders. However, all four drives were completed without the need for interventions.

The Mainline Contractor, WA Rasic, and its microtunneling subcontractor, Fowler, proposed a value engineering change in the project alignment to add three curves, thus eliminating a tunnel shaft. In addition to the savings this yielded to the project, one less shaft meant reducing the impact to the environment, as well as saving on the construction schedule. This revised alignment included the longest S-curve microtunnel drive in North America and a second single-curve microtunnel. The design team worked with OCPW and the contractor to evaluate the value engineering change and support the successful completion of the curved drives. The changes yielded a project cost savings of more than $1 million and more than a month of project schedule.

The reason for the curves in the tunnels was due to the narrow right of way along the project alignment. To one side of the available right of way is land owned by the State of California's Department of State Parks. The land is dedicated open space and provides a path used by various animals such as cougars, bears and deer to reach the Santa Ana River from the adjacent hillsides. The other side is owned by the California Department of Transportation (Caltrans) and is dedicated for the 91 Freeway.

VMT provided the theodolite guidance systems, which helped the contractor negotiate the curves and long distances. A tunnel-mounted system, such as VMT, is necessary as microtunnel drives become longer and incorporate curves because standard shaft-mounted lasers will not suffice.

For the first time in North America, this project utilized the Jackcontrol AG joint system to help protect and monitor the pipe joints during the tunnel drive. This unique system incorporates a hydraulic packer at each joint that distributes thrust loads during pipe jacking to prevent damage to the pipes. Fluid within the hydraulic packer allows the joint to compress on the inner side of the curve and expand on the outer side of the curve to create uniform loading of the pipe joint. The Jackcontrol system allows for real-time monitoring of pressure within packers and also monitors rotation of pipe joints. This information is fed to the operator who sees the system's recommendations for lowering jacking pressures in certain zones if packer pressure or joint rotations become excessive.

"We were able to liaise with Jackcontrol's offices in Switzerland as they monitored the joint and pipe performance and they supported us throughout the entire project," according to Fowler project superintendent Phil Hollingsworth.

Fowler project manager Jeff Anderson said, "James W. Fowler Co. appreciates the partnership of Jackcontrol and VMT in completing the [longest S-curved] drive using the Jackcontrol hydraulic gasketed joint and the VMT navigations system. We made a great team."

Both the Jackcontrol and VMT systems will be utilized more in North America as the number of curved tunnel drives increases in the industry to save time and money, and reduce disruption.

THIS ARTICLE WAS COMPILED BY *TRENCHLESS TECHNOLOGY* STAFF BASED ON INFORMATION SUPPLIED BY RORY BALL OF HATCH MOTT MACDONALD, AND SONDRA JAMESON OF JAMES W. FOWLER CO.

COMMITTEE MEMBERS AT A RECENT MEETING INCLUDE (FROM LEFT) LESTER BRADSHAW, BRADSHAW CONSTRUCTION; BOBBY LYS, FLOWTITE; BUCK BERGSTROM, BT CONSTRUCTION; GLENN BOYCE, JACOBS ASSOCIATES; DAVE BENNETT, BENNETT TRENCHLESS; DENNIS DOHERTY, HALEY & ALDRICH; CAL TERRASAS, NADA PACIFIC; AND BRENDEN TIPPETS, BT CONSTRUCTION.

ASCE TO RELEASE NEW MICROTUNNEL GUIDELINES

BY: DENNIS J. DOHERTY

A group of dedicated engineers, owners, suppliers, manufacturers and contractors have been working over the past few years to renew the American Society of Civil Engineers' (ASCE) Standard Construction Guidelines for Microtunneling (CI/ASCE 36-01). This group has been meeting via conference calls biweekly for two hours per meeting and several times a year face-to-face for full-day sessions to review and revise the guidelines. In recognition of the fact that owners and engineers refer to the guidelines for designing microtunnel projects and reference the guidelines in Contract Documents, the title of the guidelines has been changed to Standard Design and Construction Guidelines for Microtunneling. The group has invited input and feedback from the North American Microtunneling Association (NAMA), a group consisting of microtunneling contractors. The intent is to acknowledge their interests and collective experience with an attempt to address them in the document.

The new guidelines take into account the many changes and advances in microtunneling that have occurred since the original publication of the guidelines in 2001. A number of new sections have been added to the guidelines to improve the document. For example, a new section on sustainability in concurrence with ASCE's goal to promote sustainability in civil infrastructure has been added to address the environmental impacts of the microtunneling method. In addition, new sections on "In-Line Microtunneling" for when an existing pipe is replaced by new pipe installed by microtunneling, and "Underwater Recovery" used in outfall pipes (or intake pipes) have been added.

The sections on definitions of terms, reference standards and notations (abbreviations) have been greatly expanded to standardize use of common language and terms.

New sections on "Buried Objects" and "Obstructions" have been added to the guidelines. The section on "Buried Objects" focuses on design issues related to the buried objects in conjunction with a revised section on potential obstructions. The section on "Obstructions" has been added to better define what an obstruction is and what an obstruction is not. This includes differentiating between manmade objects such as abandoned building foundations from natural objects such as large boulders, nested cobbles and boulders, and gravel beds. Overall, these sections have been significantly improved with an attempt to have a more equitable method of managing buried objects.

Many of the other existing sections of the guidelines have been greatly expanded, including the section on Risk Analysis, so that the risk of a microtunnel project can be better understood by owners, engineers and contractors. This will eventually lead to better management of risk by those best suited to handle the specific risk identified.

The revised guidelines also have expanded sections on cost of microtunneling, both direct and indirect, as well as environmental cost and contingency cost, so that owners can better understand and budget a microtunnel project. Special considerations that owners and engineer should consider to make the project successful are included.

In general, the sections on Planning are designed to better assist the owners and engineers in laying out and preparing preliminary designs for an efficient microtunnel project, including shaft and workspace requirements, routing considerations (vertical and horizontal), geotechnical considerations, service connections, and impacts to adjacent structures.

The sections on Design have been expanded so that the owner and engineer can better understand what is needed in detailed site investigations to successfully design a microtunnel project. The geotechnical section outlines investigation approaches and methods, including depth and spacing of geotechnical borings, as well as identifying geophysical and other investigation methods that can be used for better defining the subsurface conditions that may be encountered by the microtunnel machine. This section also identifies various geotechnical laboratory testing requirements and the importance of laboratory testing to better characterize the ground conditions that will affect microtunnel operations. Early determination of ground conditions that present risks may allow for potential changes in alignment by the owner, and for better tooling of the cutter wheel by the contractor. A thorough geotechnical investigation also helps the contractor design the slurry system to assist in control of the surrounding ground and prevention of over excavation. For example, adding bentonite to slurry when microtunneling through cohesionless soil with little to no fines will improve stability of the face. The sections on geotechnical investigations also provide insight into anticipated challenges when microtunneling through gravel, cobbles and boulders. The various types of geotechnical reports – Geotechnical Data Report (GDR), Geotechnical Interpretive Report (GIR), and Geotechnical Baseline Report (GBR) – and when it is beneficial to use a GBR are discussed.

New sections on utility surveys, (both underground and overhead), traffic flow and vehicle access, environmental, flood zones, and seismic hazards have been added.

With respect to achievable line and grade tolerances for microtunnel equipment, one of the more important changes is the change relating alignment tolerances to required accuracy, diameter and anticipated ground conditions. In the old set of guidelines, vertical and horizontal tolerances on alignment were the same (plus or minus 1 in.) regardless of the geotechnical conditions or the size of the microtunnel machine. The new tolerances are plus or minus 3 percent of the outside diameter of the microtunnel machine or 1 in., whichever is greater, on grade (vertical) and 6 percent of the outside diameter of the microtunnel machine or 2 in., whichever is greater, on line (horizontal). This revision was recommended in recognition of the fact that the former 1-in. tolerance can be impossible to achieve under certain conditions and the fact that owners and engineers who sometimes do not fully understand the capabilities and limitations of microtunneling have been using the older tolerances to unfairly hold the contractor to standards that can have financial impacts on the contractor, even when the tighter tolerances did not impact performance.

Clear requirements on control systems and the importance of monitoring the systems have been expanded. Definitions of terms such as yaw, pitch and roll have been added, and the use of intermediate jacking stations and the importance of monitoring slurry have been added. With respect to monitoring slurry, detailed discussion on monitoring volume of slurry and slurry pressures have been added.

An expanded section on evaluating jacking forces identifies what needs to be considered in calculating jacking forces and provides guidance and references. There is also an added discussion on curved microtunneling and its effect on jacking forces. Microtunneling on a curved alignment has gained popularity throughout the world. Contractors in Europe and the Far East have gained significant experience in microtunneling on a curved alignment. However, there have only been a few curved alignment microtunnel projects in North America that have been designed or constructed. Still owners are requesting and designers proposing curved microtunneling on a more frequent basis. The new guidelines endorse the practice of microtunneling on a curved alignment while recognizing the additional challenges created.

A new section on settlement and ground movement risk has been added. Settlement or ground movement of the surface, adjacent utilities and sensitive man-made structures can be problematic to all. These risks can occur due to challenging ground conditions, inadequate clearance, poor design and poor microtunneling practices by the contractor. Risk of settlement or movement is best managed by the party best able to manage the risk, and many assume this means contractors because they control the means and methods. However, managing these risk starts with the owner and engineer. The owner and engineer must not only attempt to identify the risk but also design to manage the risk. The new section identifies different types of features including utilities, roadways, railroads, foundations and structures that should be considered with suggested allowable settlements, mitigation measures and instrumentation monitoring practices.

Sections on design and construction of shafts, including types of shafts, have been expanded, including the design of entry and exit seals for shafts and stabilization of surrounding ground when launching or receiving a microtunnel machine.

Methods for preparing Construction Contract Documents (drawings, technical specifications, and contractual (General Requirements in terms of CSI Division 1)) are addressed. This section also addresses not only the qualifications of the contractor to construct a microtunnel project in specific situations, it also recommends qualifications for the engineer who will evaluate, engineer, design, prepare contract documents, and potentially provide oversight for the owner. In addition, methods for managing disputes have been expanded.

The sections on materials, including pipe materials, have been revised. The group responsible for these sections is the pipe manufacturers. The engineers and contractors have provided valuable input as to what is desired in the industry from both a construction installation standpoint and an owner's operational standpoint. Important characteristics include pipe dimensional tolerances, lubrication ports and pipe joints. A discussion on the type of joint used in intermediate jacking stations has been added. While acknowledging the existing manufacturing capabilities of the U.S. pipe industry, new tolerances are suggested and encouraged for jacking pipe.

Finally, the sections on construction have been revised and expanded. Sections on pre- and post-construction activities now include recommended best practices. Contractor submittal requirements are discussed. The recommendations include inspection practices by the owner or their designated representatives, and the importance of reviewing contractor submittal and inspection of various items, including launch seals and launch methods.

The section on the microtunneling process has been expanded and revised to reflect advances in this process, including a new section on the use of lubrication and face slurry systems and their recommended design practices based on anticipated ground conditions and desired results. A new section has been added reviewing and recommending the best practices for guidance systems used in microtunneling. Significant improvements in best practices and technology have occurred in these systems and methods since ASCE published the original guidelines in 2001.

Microtunnel machine performance desired including drive completion and steering requirements as well as work hours has been revised. This is a new section to the guidelines. Items such as annular space and the difference between annular space and overcut are discussed. Also included are discussions on the important issues when upsizing microtunnel machines, machine modifications, cutter wheel design and selection and their effects on steering of machine, control of face, and jacking forces for different ground conditions. The sections on ancillary equipment such as slurry separation plants have also been significantly improved.

Overall, there has been a significant improvement in the Microtunneling Guidelines thanks to the dedicated individuals who have been a part of these revisions. The guidelines have increased in size from approximately 40 pages to well over 120 pages when completed. The committee's goal is to complete the document in October 2013 with publication by ASCE early 2014 in time for official unveiling of the document at the ASCE Pipeline Conference in Portland, Ore., in August 2014.

The committee would like to acknowledge the active participation by the following individuals:

- Glenn Boyce, Jacobs Associates
- Dave Bennett, Bennett Trenchless
- Craig Camp, Hatch Mott McDonald
- Dennis Doherty, Haley & Aldrich
- Lester Bradshaw, Bradshaw Construction
- Bobby Lys, Flowtite
- Ralph Carpenter, American Pipe company
- Brenden Tippets, BT Construction
- Cal Terrasas, Nada Pacific
- Buck Bergstrom, BT Construction
- Mo Najafi, University of Texas, Arlington
- Mark Hutchinson, City of Portland Oregon

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API CREW MEMBERS ARE GUIDING AND ADDING PILOT TUBES FOR THEIR 210-FT DRIVE IN PACUCAH, KY.

PLOTTING THE COURSE

API CONTRACTORS USES PILOT TUBE/GUIDED BORING TO RELOCATE TRANSMISSION LINES IN PADUCAH

BY: LAURA ANDERSON

This past spring, API Contractors completed a 210-ft drive using a GBM 240 jacking frame and guidance system to provide accuracy for their auger bore machine in the West McCraken County Industrial Park in Paducah, Ky. Geological deviations and the presence of deeply buried utilities required creative solutions to plot the course for an accurate drive.

The project owner, Jackson Purchase Energy Corporation of Paducah needed to relocate the overhead transmission lines in its industrial park into underground conduit pipes to connect to an electric substation. API Contractors of Calvert City, Ky., conducted the pilot tube bore and installation of 18-in. OD steel casing pipe in 20-ft segments. The general contractor, Murtco Inc., also of Paducah, installed 6-in. HDPE with two 1.5-in. conduits containing the high-voltage lines inside the 18-in. carrier.

Although guiding an auger boring machine to ensure line and grade tolerances is typically used in gravity flow installations, this project required precision and accuracy to bypass the buried utilities and achieve the necessary amount of cover under a creek to meet the tie-in.

The design-build nature of the project allowed the contractors to choose which installation method made the most sense for the series of complexities involved. Design decisions had to be approved by the Kentucky Department of Transportation.

ABOVE: API CREW MEMBERS ARE SURVEYING THE SHAFT FLOOR PRIOR TO SETTING UP THE EQUIPMENT TO ENSURE THAT THE ELEVATION IS CORRECT.

BELOW: THE 18-IN. CASING SECTIONS EMERGING FROM THE 7-FT EXIT SHAFT.

CREW MEMBER RANDY STORY OF API CONTRACTORS INSTALLING THE PILOT TUBES.

Initially, the drive was expected to be 150-ft in length. The buried utilities in this area consisted of a water main, gas main, gravity sewer line and a sewer force main. The pipe line also had to cross under a 10-ft creek, while allowing at least 42-in. of cover above the pipe. The utility locating contractor had difficulties identifying the locations of the utilities. By means of spot excavating, API was able to determine the exact location and grade of each utility. The water and gas mains were found to be 4-ft deeper than initially expected. With this information, API revisited its original project design and decided to relocate the launch shaft 65-ft back from its original position. Doing this allowed API to clear the utilities and achieve the 1.7 degree grade at the necessary depth under the creek and to ultimately unite with the electrical tie-in.

GUIDING THE BORE

Work began on April 22, 2013. Crew members set up their Akkerman GBM 240A jacking frame and guidance system on the American Augers 24-150 auger bore rig rails, powered with a 100-hp P100Q Akkerman diesel power pack. Submersible pumps were installed in the shaft and ran continuously for the remainder of the project to mitigate inflow of water in the saturated and permeable soils. The launch shaft was trenched in at 14-ft deep.

When using the GBM 240A jacking frame with an auger boring rig, the pilot tubes establish the desired path on line and grade. The jacking frame is mounted on the auger bore machine rails with a universal adapter. The theodolite and camera are mounted between the jacking frame and auger bore machine to sight-down the center of the pilot tubes. An LED target is placed in the steering head. The theodolite's cross hairs are aligned to the drive's line and grade and the camera relays this data to the computer-controlled digital monitor, mounted to the GBM jacking frame. The operator assesses the target's position throughout the course of the drive on this monitor. If a line and grade adjustment is necessary, the operator turns the pilot tube string in the appropriate direction. This action rotates the angled steering head and displaces the ground until it achieves the appropriate grade. Once the pilot tubes span the full length of the drive, a choice of ground specific tooling is available to weld onto the first casing and auger section. As the pipe string advances, pilot tube sections are removed from the reception shaft.

A bore log was not available near the West McCraken County Industrial Park, so the pilot tubes provided the opportunity to act as a probing tool to reveal the ground conditions. API crew members carefully monitored the thrust and torque pressures during the pilot tube pass. They found that the first half of the drive consisted of loose gravel and sandy clay that mixed with running water when approaching the creek crossing. The last half of the bore transitioned to sandy then moist clay. Pilot tube sections were removed from a 7-ft exit pit near the power pole.

In lieu of a weld-on reaming head, an Akkerman pilot guide rod was attached to the last length of pilot tube and first section of casing to reduce thrust at the face of the bore. The casing and auger pass was heavily lubricated with a bentonite solution. Extra lubrication kept the pipe string moving despite the abrasive gravel and moisture during the first portion of the drive, and reduced friction and prevented stickiness on the outside of the casings during the second half. API crews found that the extra lubrication was an appropriate decision, as they did not encounter thrust pressures above 10 tons during both passes.

Using the GBM guidance system to monitor and maintain line and grade allowed the drive to accurately advance a mere 8 in. under the deepest utility, proceed correctly below the creek bed and emerge within the 6-ft power pole easement. API was able to complete the utility location work, pilot tube and casing, and auger passes in one week's time.

API Contracting is a water, sewer and auger boring contractor serving a five-state region. The privately held, second-generation, family-owned business has been in operation since 1983. APIU's primary methods of construction include auger boring and horizontal directional drilling. With its GBM system purchase in November 2012, API has found increased demand in subcontracting to other auger boring contractors to provide line and grade control. The Jackson Purchase Energy Corporation project represented their ninth project since their GBM purchase, and 13th to date.

LAURA ANDERSON IS COMMUNICATIONS MANAGER FOR AKKERMAN OF BROWNSDALE, MINN.

PROJECTS SUCH AS THE KESWICK WPCP EFFLUENT OUTFALL EXPANSION PROJECT IN ONTARIO ARE EXTENDING THE BOUNDARIES FOR MICROTUNNELING PROJECTS IN NORTH AMERICA.

ADVANCES IN MICROTUNNELING

In recent years, the microtunneling market in North America has achieved several significant milestones, including a new record for drive length and the completion of the first curved drives. These two advances mean that owners and their engineers, in tandem with the microtunneling contractors, can save time and money, while minimizing disruption, for their microtunneling projects. As these types of projects are successfully completed and the benefits realized, the microtunneling market could be poised for growth.

1989 – E.E. Cruz & Co. begins the Hylan Boulevard project on Staten Island, which includes a drive of 1,625 ft. That marked the longest drive completed in North America for nearly two decades.

1990 – Hochtief Incorporated completed an unprecedented 3,415-foot pipe jacking drive in Sayreville, NJ for the Middlesex County Outfall Project. Although the 13.7-foot diameter hydroshield TBM was pipe jacked, guided, and provided continuous face-support, the operator's station was located in the shield instead of at the surface and therefore does not meet the ASCE definition of a microtunnel. The alignment included planned spatial (vertical and horizontal) curves and utilized the largest pre-cast concrete pipe in the world at the time. It was also the first use of a large diameter hydroshield in the USA.

1995 – The Greater Houston Wastewater Program reaches its height and leads to a two-fold increase in pipe installed via microtunneling in the United States. More than 150,000 ft of microtunnels were completed in Houston between 1987 and 1995.

2008 – Kiewit-Bilfinger-Berger completes a record-setting 3,000-ft drive as part of the Portland East Side CSO project. The contractor combined two separate drives to eliminate an intermediate shaft.

MAY 19, 2010 – Northeast Remsco completes the first planned curved drive as part of a value engineering proposal in the United States – a 600-foot drive in Hartford for the Metropolitan District Commission's Clean Water Project.

AUGUST 2010 – REM Directional Inc. installs the first use of Herrenknecht's Direct Pipe system in the USA – a 705-foot drive in Arcadia, Florida. Direct Pipe is a hybrid technology combining the benefits of microtunneling and horizontal directional drilling (HDD). The spatial (vertical and horizontal) curve drive was completed in only three days of drilling.

FALL 2012 – Frank Coluccio Construction Co. completes a double curve as part of the Beachwalk Forcemain Project in Honolulu. The S-curve drive spanned 1,241 feet and was the first microtunnel project bid as a curve in the United States.

MAY 1, 2013 – James W. Fowler Co. completes the longest S-curve drive as part of the Santa Ana River Interceptor (SARI) Relocation Project in California. The curve drive spanned 1,567 feet and was the first use of the Jack-control joint system in North America.

2013 – Ward and Burke completes four microtunnel drives as part of the Keswick WPCP Effluent Outfall Expansion Project. One drive marked the first curved microtunnel drive in Canada (March), another drive marked the first spatial (simultaneous vertical and horizontal) microtunnel curve in North America (May), and the last drive marked the first underwater MTBM extraction in Canada (June).

FALL 2013 – Ward and Burke completes the longest curved drive in North America with the completion of a 740-m (2,427-ft) drive as part of the Elgin Mills Watermain project in Ontario.

Information for this article was compiled by Jim Rush, Benjamin Media, and Rory Ball, Hatch Mott MacDonald, from industry publications and information obtained by speaking with professionals involved in the projects. The authors welcome input from anyone in the industry regarding updates to the preceding information or for details on notable projects that may be missing from the list above.

CANADIAN FIRSTS

KESWICK PROJECT MARKS CANADA'S FIRST CURVED DRIVES, FIRST WET RETRIEVAL

To meet the demands of the growing Greater Toronto community of Keswick, The Regional Municipality of York (York Region) has being expanding the existing Keswick Water Pollution Control Plant (WPCP). Included in that expansion is the construction of a new outfall to accommodate future flows.

Hatch Mott MacDonald (HMM) was retained by York Region to undertake detailed design and construction administration for a new, 750- to 1,200-mm outfall. McNally Construction Inc. was awarded the construction contract as the general and marine contractor, with Ward and Burke Microtunnelling as the microtunneling subcontractor. Equipment manufacturers and suppliers on the project included Herrenknecht (microtunneling system), Munro (pipe) and VMT (guidance).

The new outfall is approximately 1,800 m long, and runs from the WPCP to a point 900 m offshore in Lake Simcoe. Along its 900-m onshore alignment, the outfall traverses regulated wetlands, arterial roadways containing both ambulance and fire stations, a busy "five corner" intersection containing numerous existing utilities, a quiet residential subdivision with mature trees and narrow roadways, a city park and a regulated shoreline/floodplain. Once offshore, Lake Simcoe is subject to stringent environmental regulations intended to maintain the lake as a valuable ecological and recreational resource.

Geotechnical conditions along the alignment consist of very soft/very loose silts, clays and sands, along with local areas of glacial tills with cobbles and boulders. The groundwater table is at or near the ground surface along the entire alignment. The combination of very soft/very loose soils and a high groundwater table indicated that unstable (i.e., flowing) ground behavior would be predominant.

In order to address the identified project challenges, several alignment alternatives and construction methods were evaluated with regard to cost, schedule, community and environmental impacts. Evaluated construction methods included open-cut trenching with continuous solid-sheet shoring, horizontal directional drilling and microtunneling.

Microtunneling was considered to provide the lowest risk for schedule, community and environmental impacts. Microtunneling was subsequently recommended as the primary onshore construction method despite having the highest anticipated construction costs. This recommendation was significant as until this point, the history of microtunneling in Ontario had been limited to approximately only 10 projects. Most of those projects had occurred in the 1990s and had met with limited success.

There were also several constructability issues that needed to be addressed. The presence of very soft/very loose soils was considered problematic for microtunnel stability due to the risk of machine sinking and/or inability to make steering corrections. This was mitigated by requiring the contractor to configure the microtunnel boring machine (MTBM) to its lightest configuration and to install a minimum length of trailing cans to aid in the distribution of MTBM weight. Provisional measures for intermittent ground improvement were included in the contract to provide an additional safeguard.

For the trunk sewer undercrossing, the limits of existing sheet pile shoring were verified by geophysical surveys, as well as by direct probing using horizontal directional drilling. The risk of settlement and/or disruption of the trunk sewer was mitigated by a combination of advance jet-grout support, bypass pumping and having a cured-in-place liner stocked and available should damage occur.

FEATURE STORY

THE KESWICK PROJECT REPRESENTED CANADA'S FIRST CURVED DRIVES AND FIRST UNDERWATER RETRIEVAL.

The project has proven to be a tremendous success. Through a prequalification process, York Region was assured of having qualified, experienced contractors to do the work. Through collaboration between the owner, design consultant and contactor team, several notable microtunneling firsts were achieved on the project including: the first offshore/underwater reception of a microtunnel drive completed in Canada; the first curved microtunnel drive completed in Canada; and the first compound (simultaneous plan and profile) curved microtunnel drive completed in North America.

Of particular note is the collaborative effort that led to the incorporation of curves into the microtunnel design. The contractor proposed the curved drives as a means of eliminating two shafts, which resulted in more than $1 million cost-savings for York Region. However, in order to accommodate this change, the diameter of the outfall had to be upsized from 750 to 1,200 mm and modifications to existing permits had to be obtained. The design and contractor teams, along with York Region, worked together to evaluate the technical risks and benefits of these changes. Once it was decided to adopt the changes, the teams further collaborated to make the modifications necessary to implement them.

The microtunneling work was completed on time, under budget and with no third-party damage claims. All four project drives were completed on line and on grade. In completing this project, the limits of what can be done using microtunneling have been pushed forward significantly, both in Ontario and across North America.

[EDITOR'S NOTE: THIS PROJECT WAS NAMED AS THE RUNNER-UP IN THE 2013 *TRENCHLESS TECHNOLOGY* PROJECTS OF THE YEAR IN THE NEW INSTALLATION CATEGORY AND WAS FEATURED IN THE OCTOBER 2013 ISSUE.]

FACED WITH THIS DIFFICULT GEOMETRY AND GEOLOGICAL CONDITIONS, TENNESSEE GAS AND ITS PROJECT TEAM DEVELOPED AN INNOVATIVE SOLUTION USING PERMALOK PIPE INSTALLED IN A VERTICAL CURVE USING HERRENKNECHT'S DIRECT PIPE SYSTEM.

CROSSING INTERSTATE 84 AND U.S. HIGHWAY 6 NEAR MATAMORAS, PA., PRESENTED UNIQUE CHALLENGES FOR TENNESSEE GAS PIPELINE CO. LLC.

DIRECTIONAL MICROTUNNELING AIDS IN PENNSYLVANIA PIPELINE PROJECT

HERRENKNECHT DIRECT PIPE SYSTEM USED FOR CROSSING

In planning the trenchless crossing of Interstate 84 (I-84) and U.S. Highway 6 (US-6) near Matamoras, Pa., the Tennessee Gas Pipeline Co. LLC, a Kinder Morgan Co., had a challenge: How do you navigate the relatively deep, alluvial deposits of the Delaware River on the south side of I-84 and the shallow sedimentary bedrock and steep talus slopes leading up away from I-84 on the north side of the crossing?

Faced with this difficult geometry and geological conditions, Tennessee Gas and its project team – which included Willbros Engineering (lead civil engineer), GeoEngineers Inc. (trenchless and geotechnical engineer), and Michels Directional Crossings (trenchless contractor) — developed and installed an innovative and crucial trenchless solution. The plan utilized a 42-in. diameter Permalok casing pipe installed in a vertical curve using Herrenknecht's Direct Pipe system.

Project "firsts" include: 1) First trenchless project for Tennessee Gas using Direct Pipe system, 2) First installation of Permalok in purposefully curved alignment, 3) First installation of Permalok using Direct Pipe system.

PROJECT BACKGROUND

As part of Tennessee Gas' Northeast Upgrade Project (NEUP), a 30-in. diameter natural gas pipeline needed to cross Interstate 84 with a trenchless technique. A frontage road (US-6) and parking lot parallel to I-84 at this location required the crossing length be 470 ft. Due to ground surface geometry and subsurface geology, several conventional methods of crossing I-84, such as horizontal directional drilling or conventional road boring, were deemed infeasible or highly risky. Conventional microtunneling was considered but ultimately discounted due to the depth and cost of entry and exit pits. Conventional Direct Pipe also was considered but would have required a pipe stringing area through a wetlands and the nearby Delaware River.

Weighing these factors, the project team developed a curved design profile, reducing the depth and expense of entry and exit pits. The team also decided to use push-together, 42-in. diameter Permalok casing pipe in which the 30-in. diameter product pipe would subsequently be installed. Using Permalok pipe reduced the welding fabrication time in the entry pit and the need for an expansive stringing area through a sensitive area.

Accordingly, curved or directional microtunneling was selected to accomplish the crossing. Recognizing the need to assess the likely jacking loads and associated stresses on the curved steel casing pipe during installation, GeoEngineers developed a design methodology for curved, jacked steel pipe. This design methodology incorporates conventional microtunneling design theory along with API steel design code to assess jacking forces; axial, bending, hoop, and combined stresses; buckling; and the factor of safety to the pipe during installation. (This work was published in the 2013 ASCE Pipelines Conference Proceedings, page 864.)

HOW IT WORKS

The Herrenknecht Direct Pipe system uses a conventional slurry microtunneling machine to excavate the hole. The difference is the use of a Pipe Thruster in place of the a jacking frame used in traditional pipe jacking applications. The Direct Pipe system typically uses prefabricated pipe pushed into the hole behind the microtunneling machine (in contrast to HDD, in which the pipe string is pulled into place). In combination with Permalok push-together pipe, the project team eliminated the need to lay out the entire pipe string prior to installation.

The soil excavated by the cutterhead at the tunnel face is mixed with the slurry in the excavation chamber and then pumped through the entire pipeline to the se¬paration plant using a slurry pump integrated inside the machine. Apart from transporting off the excavated material, the slurry also provides support at the tunnel face. After treatment in the separation plant, it is conveyed back into the circuit via a feed line.

The Direct Pipe system was used successfully in Europe before being used for the first time in the United States in 2010.

TRENCHLESS CROSSING

Michels began construction in June 2013 by installing entry and exit pit shoring systems and excavations. The microtunnel boring machine (MTBM) was launched June 29, 2013, and punched out in the exit pit July 23, 2013. The Permalok casing was installed within the project specifications of 1 ft right and left and above and below planned alignment. The thrust loads on the pipe were less than approximately 100 tons for the crossing, below the project specified maximum of 400 tons.

Due to land survey issues unrelated to the actual mining process, several days were spent between launch and completion without mining. When the contractor could proceed, average mining rates were good, ranging from 4 to 8 ft or more per hour. On its best day, Michels achieved an installed distance of 91.2 ft.

"The job went smoothly with advance rates better than anticipated," said Jon Robinson of GeoEngineers. "In addition, the pipeline was installed within tight line and grade tolerances."

Robinson said the design team looked first at traditional trenchless construction methods before selecting Direct Pipe. He envisions it to become another tool in the trenchless toolbox going forward. "When we began the design for this project in 2010, there were probably a dozen jobs done in the world with this method. Now there are more than 30, and there are several more in design."

JOB LOG

ALABAMA

MOBILE

Smith WWTF Force Main Improvements – Phases A & B

Bradshaw Construction Corp.

Bradshaw Construction has recently completed two microtunneling projects in Mobile, Alabama. The projects, SMITH WWTF Force Main Phases A & B, included a 120 LF and 235 LF micro-tunnel. Both 60" OD welded steel casing two-pass tunnels were constructed below the water table in soft ground (one clay and one course grained) beneath operational railroad lines. The micro-tunnels were executed under the supervision of different prime contractors, both working for the City of Mobile, Board of Water and Sewer. Information: Michael Gibson; mgibson@bradshawcc.com.

CALIFORNIA

MURRIETA

Whitewood Gravity Sewer

Vadnais

This $2 million project for the Eastern Municipal Water District includes five separate tunnel drives totaling 1,608 ft of 38.5-in. OD Permalok steel casing with 21.5-in. OD VCP carrier pipe. The drive lengths range from 155 to 545 ft, with shaft depths of approximately 20 ft. The drives, being completed with a 39.5-in. OD Iskei TCC800, are installed up to 15 ft below the groundwater table in alluvium soils with bedrock intrusions, and gabbro rock. Tunneling was completed beneath Interstate 215, environmentally sensitive open areas, and residential streets. There are extremely tight work areas in a residential neighborhood with launch and reception shafts located in residential streets that had to remain open. The prime contractor is Utah Pacific Construction Co. The engineer is Hunsaker & Associates. Work started in September 2013 with an estimated completion date of January 2014.

NORCO

Chino Desalter Phase 3 Expansion Product Water Pipeline

Vadnais

This $979,500 project for the Chino Desalter Authority is a single tunnel drive of 725 lf to install 48-in. OD Permalok casing under the Santa Ana River. Shafts will be approximately 30 to 40 ft deep. Ground conditions include moderate groundwater and primarily fine sand. Crews will use a 48-in. OD Iskei TCC800. Work is scheduled to begin in March 2014. Vido Artukovich & Son Inc. is the prime contractor and Dudek is the engineer.

PITTSBURG

Citywide Sewer Rehab/Water and Sewer Conversion Project

Vadnais

This $307,250 project for the City of Pittsburg consisted as a single tunnel drive of 245 lf of 24-in. ID VCP using a 31-in. OD Iskei TCC600. Shafts were approximately 30 to 35 ft deep. The ground conditions included a high groundwater table in bay mud, clays and sand. The project involved tunneling beneath the Pittsburg Marina with approximately 10 ft of cover beneath the marina floor, as well as working in tight areas in a residential neighborhood with the launch and reception shafts located between houses. Ranger Pipelines Inc. was the general contractor and Brown & Caldwell was the engineer. Microtunneling was completed in March.

SAN MARCOS

San Marcos Interceptor Phase 1

James W. Fowler Co.

This $4.5 million project for the Vallecitos Water District consists of 658 ft of sewer pipeline installed by microtunneling and 1,544 ft by open-cut methods. Ground conditions include alluvial soil and weathered granitic rock, with dewatering required for both the trenchless and open cut operations. Completion is scheduled for March 2014. Kennedy/Jenks Consultants is the engineer.

SANTA ANA, CA

Santa Ana River Interceptor (SARI) Relocation – SARI Mainline

James W. Fowler Co.

This $8.8 million project for the Orange County Sanitation District consisted of 4,000 ft of 101.5-in. OD microtunnel done in four drives with installation of 2,900 ft of 84-in. ID reinforced concrete pipe and 1,100 feet of 99.5-in. ID steel casing. The first drive was approximately 620 ft under Gypsum Canyon Road and the Gypsum Canyon Drainage channel. The second drive was 1,089 ft under a portion of the Green River Golf Course and the Santa Ana River channel. The third drive was adjacent to the 91 Freeway and was approximately 1,567 ft. The final drive was 622 ft and was adjacent to the 91 Freeway. Ground conditions were mixed face with soft to stiff silt and loose sand, gravel, sand, and clay exhibiting a flowing behavior with cobbles and some boulders. The water table ranged from the tunnel invert to up to 17 ft above the tunnel invert. The third drive set a U.S. record as the longest compound curved drive and was the first use of the Jackcontrol hydraulic joint system with real-time monitoring in the United States. The final drive had a standard curve and also utilized the Jackcontrol hydraulic joint system with real-time monitoring. This project was the first in the United States to have two curved drives. The radius of each curve was approximately 4,000 ft. Microtunneling completed in July 2013. Tetra Tech was the engineer with Hatch Mott MacDonald as the trenchless specialist. The MTBM was a Herrenknecht AVN 2000D.

VISTA

Watson Way Upsizing and Realignment CIP No. 8070

James W. Fowler Co.

This $5.7 million project for the Buena Sanitation District was originally designed as a 3,300-ft pipeline to be installed via microtunneling, horizontal directional drilling and open trench construction. JWF offered a value engineering proposal to install the pipeline using a combination of microtunneling, guided auger boring, pipe ramming, directional drilling and open trench construction. The microtunneling portion of the project included three 42-in. drives totaling 1,750 ft in mixed face conditions with moist, dense clayey sand and weathered granitic rock. The 20-in. PVC carrier pipe was installed in the 42-in. reinforced concrete pipe casing. Two guided auger bores of 24-in. steel casing with 16-in. PVC carrier pipe were constructed with lengths of 200 and 220 ft. JWF used a guided auger bore to maintain the precise grade control and alignment required for the gravity sewer to meet design grades and within 1 ft of existing underground utilities. A single pipe ram of 250 ft of 24-in. steel casing and 8-in. PVC pipe is scheduled for completion. The final open-cut excavation phase consisted of 1,300 ft of 8-, 16- and 20-in. PVC pipe. The project site is located within a residential neighborhood that required ongoing communication with the neighbors and traffic control to protect the traveling public. This land also has cultural significance to the San Luis Rey Band of Mission Indians and required close monitoring for potential impacts and the discovery of cultural artifacts. Substantial completion has been achieved. Psomas was the engineer. Crews used a Soltau RVS 600.

SANTA MONICA

Whitewood Gravity Sewer

Vadnais

This $2 million project for the City of Los Angeles consists of a single tunnel drive of 846 lf of 63-in. OD Permalok casing. Shafts will be approximately 18 to 20 ft deep. The groundwater table is approximately at the springline of the tunnel. The drive is to be installed with the use of a mixed-ground cutter head in beach deposits with silty sands, gravel, cobbles and potentially boulders using a 63-in. OD Soltau RVS600AS. The project involves extremely tight work areas along Highway 1 (Pacific Coast Highway), a heavily trafficked thoroughfare in Southern California. The alignment is severely congested with existing utilities. Work is scheduled to begin in March/April 2014. Ford E.C. Inc. is the prime contractor and Psomas is the engineer.

COLORADO

BRIGHTON

Metro PAR 1088 – South Platte Interceptor

Bradshaw Construction Corp.

Bradshaw Construction Corp. has recently begun construction of four microtunnel crossings on the Metro PAR 1088 – South Platte Interceptor project. Crossings of 168th and 160th Avenues will be by jacking 96-in. steel casing. Crossing for the South Platte River and E-470 will utilize 78-in. steel casing. The ground conditions consist of sand and gravel below the groundwater table and Bradshaw's scope also includes shafts and installation of FRP in the tunnels. Construction is scheduled to be complete in late spring 2014. Information: Todd Brown, tbrown@bradshawcc.com.

DENVER

Denver International Airport STRP EWP B Storm Sewer

Vadnais

This $4.4 million project for the City & County of Denver consisted of a single drive of 1,593 lf of 66-in. ID RCP using an 82.5-in. OD Herrenknecht AVN1500TB. Construction was performed adjacent to the DIA Main Terminal beneath heavily trafficked roads. Tunneling activities occurred nearby critical FAA Communication Cables and an active 102-in. ID storm sewer. In December 2012, a pipe failure halted tunnel progress 130 ft short of reaching the receiving end. A back-tunnel was required to retrieve the MTBM and 60-in. Hobas slipliner was installed and grouted to complete the pipeline in October 2013. The prime contractor was Kiewit Building Group Inc., and JVIATION was the engineer.

DISTRICT OF COLUMBIA

WASHINGTON

Tingey Street Tunnel

Northeast Remsco

This work is part of the Tingey Street Diversion Sewer. The 8-ft diameter TBM was launched from a shaft just east of Nationals Park and is remote-controlled, set on a specified course connecting from 2nd to just beyond 5th Street, SE, running under Tingey Street. The tunnel is part of a massive $2.6 billion environmental program, called the DC Clean Rivers Project, to improve the health of local waterways. The Tingey Street tunnel is about 1,200 ft long, has a 6-ft diameter concrete lining and will be able to convey more than 50 million gallons per day of combined sewage to Blue Plains for treatment.

FLORIDA

MIAMI

Government Cut Utility Relocation

Super Excavators

In early March 2013, Super Excavators executed a subcontract agreement with Ric-Man Construction, Florida, Inc. to construct 700 lf of 74-in. OD Permalock steel casing microtunnel pipeline for the Miami-Dade Water & Sewer Department. The new pipeline was installed underneath the Government Cut between Fisher Island and South of the City of Miami Beach, approximately 60 ft below sea level. The ground was composed of coral. The microtunneling, valued at $2.3 million, was completed in May using an Akkerman SL-74 MTBM.

KENTUCKY

PROSPECT

River Road Interceptor

Bradshaw Construction Corp.

Bradshaw Construction just recently completed 1,133 lf of tunnel of 96-in. steel casing by microtunnel for the Metropolitan Sewer District. The tunnel was converted from bid time revising the design from six separate tunnels to one cost-effective large, long tunnel. The tunnel was completed for the purpose of installing both a 42-in. fiber reinforced gravity sewer and 30-in. PVC forcemain. The tunnel was completed in clays and silts well below the water table, beneath a major roadway and Harrod's Creek. Information: Michael Gibson, mgibson@bradshawcc.com.

MARYLAND

BALTIMORE

Herring Run Interceptor Phase I

Cruz Contractors

This $11.7 million project for the City of Baltimore Department of Public Works involved the construction of 2,200 lf of 69-in. OD (54-in. ID) RCP under roadways, parks and wetland areas. The project was completed in May using a Herrenknecht AVN 1500 MTBM.

FORT MEADE

Fort Meade Reclaimed Water Project

Bradshaw Construction Corp.

Bradshaw Construction Corp. is preparing to install 240 ft of 60-in. steel casing and twin 20-in. DIP water lines under MD Route 32, and 410 ft of 43-in. steel casing and 24-in. DIP water line under the Little Patuxent River as part of the Fort Meade Reclaimed Water Project. The casings will be jacked behind microtunnel boring machines in soft ground conditions below the water table. Bradshaw will also be installing liner plate launch and receiving shafts for the MD 32 crossing and a steel sheeted launch shaft for the river crossing. Information: Doug Piper, dpiper@bradshawcc.com.

MISSOURI

KANSAS CITY

KCMO-75th & Westridge Storm Sewer

EJM Pipe Services

This project for KCMO Water Services includes one drive of 205 lf of 74-in. steel casing for culvert pipe. Soils consist of mixed face limestone rock and clay conditions. The jacking pit depth is 10 ft. EJM, working as a subcontractor to Redford Construction, is using an Akkerman SL74 MTBM. The bid value of microtunneling is $515,000. The tunnel crosses an existing railroad under mixed face conditions. The expected completion date was mid-October.

NEBRASKA

GRAND ISLAND

North Interceptor Phase 1

EJM Pipe Services

This $1.4 million project for the City of Grand Island includes three drives totaling approximately 850 lf. Two drives are for installation of 60-in. steel casing and one drive for Hobas pipe. Soils are sand with silt and clay. Pit depths range from 12 to 20 ft. Crews are using an Akkerman SL60 MTBM. The project was scheduled to start in October and end in January. The general contractor is Merryman Excavation and Black & Veatch is the engineer.

NEW JERSEY

HUDSON COUNTY

18th Street Pumping Station CSO Forcemain and Outfall

Cruz Contractors

This $3.6 million project for the North Hudson Sewerage Authority included the construction of 300 lf of 72-in. OD Permalok steel casing under NJ Transit light rail tracks. The project was completed in May 2012 using a Herrenknecht AVN 1500 MTBM.

MIDDLESEX COUNTY

Turnpike Sanitary Crossing

Cruz Contractors

This $2.2 million involves the construction of 760 lf of 51-in. OD Permalok under the New Jersey Turnpike (14 lanes) and under Conrail railroad track. The project is on pace for completion in November using a Herrenknecht AVN 1000 MTBM.

NEW YORK

NEW YORK

East Side Access-Queens Microtunnels

Cruz Contractors

Cruz Contractors performed microtunneling as a subcontractor to Perini Corp. on this $139 million project for MTA Capital Construction. Micrtounneling, valued at $10.5 million, involved 13 crossings under railroad tracks and roadways, including five runs of 60-in. OD Permalok steel casing and eight runs of 48-in. ID RCP to accommodate various electrical cables and drainage pipes. The project is on pace for completion in December. Crews used a Herrenknecht AVN 1200TB MTBM.

STATEN ISLAND

Richmond Valley Road Sewer Construction

Cruz Contractors

This $22 million project for the New York City Department of Design and Construction involves the construction of sanitary and storm sewers in the area around Richmond Valley Road. The project includes the installation of 2,200 lf of 52.5-in. OD (42-in ID) RCP under local roads. The project began in November 2012 and is scheduled for completion in June 2014. The longest drive is 1,400 lf. Crews are using a Herrenknecht AVN 1000XC MTBM.

STATEN ISLAND

Woodrow Road Sewer Construction

Cruz Contractors

This $12 million project for the New York City Department of Design and Construction involves the construction of sanitary and storm sewers in the area around Woodrow Road. The project includes the installation of 1,872 lf of 52.5-in. OD (42-in. ID) RCP under local roads. The project began in March 2012 and is expected to be complete in December. The longest drive is 624 lf. Crews are using a Herrenknecht AVN 1000XC MTBM.

NORTH CAROLINA

RALEIGH

Crabtree Basin Wastewater Conveyance Improvements – Phase 1

Bradshaw Construction Corp.

This project consists of 3 tunnels totaling 660' by pipejacking 72" and 60" Hobas pipe behind microtunnel boring machines. The tunnels cross under existing pipelines and roadways. Subsurface conditions ranged from hard granite to loose alluvium below the water table. Bradshaw has completed the all of the microtunneling including a 260' tunnel though a fill deposit with buried tree trunks. Information: Eric Eisold; eeisold@bradshawcc.com.

OHIO

AKRON

Englewood Avenue – Little Cuyahoga Interceptor (LCI)

Vadnais

This $2.8 million job for the City of Akron comprised five separate tunnel drives totaling 3,500 lf of 57-in. ID Hobas primarily along Englewood Avenue. Drive lengths vary from 445 to 988 lf. Shafts are approximately 22 to 37 ft deep. The ground conditions included a high groundwater table in boulders, cobbles, silts and sand. H.M. Miller Construction Co. is the prime contractor with GPD Group providing engineering services.

CLEVELAND

Dugway West Interceptor Relief Sewer

Walsh/Super Excavators JV

This $12.8 million project for the Northeast Ohio Regional Sewer District is part of a network of sewers and tunnels being constructed to drastically reduce combined sewer overflows. This project includes approximately 7,000 lf of 72-in. diameter relief sewer via MTBM, open-cut construction of approximately 2,200 lf of sewer ranging from 24- to 108-in. diameter; trenchless construction in rock of approximately 600 lf of 36-in. diameter sewer; trenchless construction in soft ground of approximately 3,300 lf of 36- and 48-in. diameter sewer; sewer flow diversions, regulating structures, tie-in connections to the existing Dugway culverts, modifications to 39 existing combined sewer flow regulating structures and demolition of eight buildings. Crews plan to use both the Akkerman SL60 MTBM and Akkerman SL74 MTBM to compete the project, which was awarded on Oct. 3, 2013.

RHODE ISLAND

PROVIDENCE

Woonasquatucket CSO Interceptor Project

Super Excavators

In April 2012, Super Excavators was selected by Barletta Heavy Division Inc. to perform a $14.8 million microtunneling subcontract on the Woonasquatucket CSO Interceptor Project for the Narragansett Bay Commission (NBC) Combined Sewer Overflow (CSO) Abatement Program. Approximately 12,000 lf of pipeline with diameters ranging from 30 to 72 in. will be installed using microtunneling and pipejacking methods. The pipe sizes to be installed are: 3,980 lf of 72-in. RCP; 2,072 lf of 60-in. RCP; 932 lf of 54-in. RCP; 3,350LF of 48-in. RCP; 788 lf of 42-in. RCP; 98 lf of 30-in. RCP; and 109 lf of 36-in. RCP. The pipe will be installed with the Akkerman SL74, Akkerman SL60, and Akkerman SL36 MTBM. The ground conditions consist of saturated sands and silts. Ground water is controlled by grouting at the launching and receiving portals, dewatering at shaft locations, and use of a slurry microtunnel machine. Construction for the project began in mid-September 2012, and the project has an estimated completion deadline of February 2014.

TEXAS

AUSTIN

Mansfield WTP Intake Tunnel

Bradshaw Construction Corp.

Bradshaw was selected to install a 42-in. steel casing from a 170-ft deep pump station shaft at the shoreline of Lake Travis to an intake structure in the lake. The 530-ft casing is to be installed by microtunneling. The MTBM will be recovered underwater. The subsurface conditions consist of weak limestone transitioning to clay at the lake bottom. Information: Eric Eisold, eeisold@bradshawcc.com.

LIVINGSTON

Livingston WTP Intake Tunnels

Bradshaw Construction Corp.

Bradshaw was selected to install twin 36-in. steel casings from a 30-ft deep pump station shaft at the shoreline of Lake Livingston Reservoir to an intake cofferdam in the lake. The 390-ft (each) casings are to be installed by microtunneling. The subsurface conditions consist of clay and sandy silt 20 ft below the water table. Information: Eric Eisold, eeisold@bradshawcc.com.

VIRGINIA

FAIRFAX

I-66 Sanitary Sewer Crossing

Bradshaw Construction Corp.

Bradshaw Construction Corp. has completed the I-66 Sanitary Sewer Crossing in Fairfax, VA. The project included installation of 330' of 43" steel casing and 18" DIP sewer pipe utilizing a microtunnel boring machine. The ground conditions are predominantly sand and silt below the ground water table; however, some rock was also encountered. Bradshaw also self-performed the open-cut tie-ins and by-pass pumping. Information: Doug Piper, dpiper@bradshawcc.com.

VIRGINIA BEACH

East Princess Anne Trunk Force Main

Bradshaw Construction Corp.

Bradshaw Construction Corp. has successfully completed the installation of 350 ft of 60-in. steel casing and 42-in. sewer pipe as part of the East Princess Anne Trunk Force Main Project. The casing was jacked behind a microtunnel boring machine. The ground conditions were predominantly medium dense sands below the ground water table. Information: Doug Piper, dpiper@bradshawcc.com.

WISCONSIN

FRANKLIN

Ryan Creek Sanitary Sewer Interceptor

Super Excavators

The Ryan Creek Interceptor for the City of Franklin was an improvement program designed to provide sanitary sewer service for the ultimate build-out of the service areas. Super Excavators constructed 2,404 lf of 48-in. RCP via microtunneling. Super Excavators also constructed 5,042 lf of 36-in., 1,283 lf of 42-in. and 1,319 lf of 48-in. pipe at an average depth of 32 vf using open-cut methods. The microtunneling, valued at $5.4 million, was completed between November 2012 and September 2013 using an Akkerman SL60.

MADISON

Northeast Interceptor SEI to NEI Relief & Replacement

EJM Pipe Services

This project for the Madison Metropolitan Sewerage District included three drives totaling 605 lf of 48- and 60-in. RCP. Drive depths ranged from 15 to 25 ft. Soils were sands and silts with some clays. EJM, working as a subcontractor to Merryman Excavation, used an Akkerman SL74 MTBM. The bid value of microtunneling was $2,090,000. AECOM was the engineer. Crews worked in unfavorable ground conditions, including wetlands and marsh areas. The project was completed in mid-September.

CANADA

ONTARIO

KESWICK

Keswick WPCP Effluent Outfall Expansion

Ward and Burke Microtunnelling Ltd.

This $7.1 million project for The Regional Municipality of York Region involves the construction of 760 m of 1,200-mm ID reinforced concrete microtunnel constructed at a depth of 8 to 1 0m in extremely challenging weak sand/silts with an average SPT of 0. The project included 590 m of microtunnel built onshore, with the remaining 170 m of microtunnel constructed as an outfall drive underneath Lake Simcoe. Ward and Burke were also responsible for the construction of four concrete caissons, which were used to launch and receive the Herrenknecht AVN1200. The project was the first ever designed combined vertical and horizontal curved microtunnel ever constructed in North America. As well as the first ever "wet reception" removal of a TBM from within a lake in Canada. McNally Construction Inc. was the general contractor and Hatch Mott MacDonald was the engineer.

REGION OF PEEL

King Street Feedermain Project

CRS Tunnelling/Dibco Underground

CRS Tunnelling/Dibco Underground was announced as the low bidder on the King Street Feedermain Project for the Region of Peel, Ontario. The project includes construction of four shafts and installation of approximately 850 m (2,789 ft) of 1,200-mm (47-in.) concrete tunnel via three microtunneling drives, as well as installation of the final product pipe, other connections and restoration works.

RICHMOND HILL

Elgin Mills (PD7) Watermain

Ward and Burke Microtunnelling Ltd.

This $8.1 million project for The Regional Municipality of York Region involved the installation 740 m of 1,500-mm ID reinforced concrete microtunnel. It was constructed at a depth of 8 to 9 m in stiff glacial tills, and saturated sand/silts. Following construction of the microtunnel from one primary drive shaft 600-mm ID concrete pressure pipe was installed and the resulting annulus was grouted with cellular concrete. The project is the longest (740 m/2,427 ft) designed multi-curved microtunnel ever constructed in North America. All tunneling operations were conducted from one drive shaft. Crews used a Herrenknecht AVN1500. Drainstar Contracting Ltd. was the general contractor. Cole Engineering Ltd. was the design engineer.

TORONTO

Keele St. Storm Sewer

Ward and Burke Microtunnelling Ltd.

This $1.3 million project for the City of Toronto involved the construction 134 m of 1,500-mm ID reinforced concrete microtunnel constructed at a depth of 6 m in saturated sand/silts in a very congested urban area using a Herrenknecht AVN1200. The project was scheduled for completion in December 2013. The general contractor is Dom Meridian Construction Ltd. with CH2M Hill serving as the engineer.

PRODUCTS

AKKERMAN MIRCOTUNNELING SYSTEMS

Akkerman microtunneling systems are a fusion of high productivity, dependability and accuracy for gravity flow pipelines requiring exact line and grade in poor soil conditions. Standard MTBMs are available from 30- to 74-in. OD and can be fitted with increase kits to accommodate larger pipe diameters. Akkerman MTBMs feature a project-appropriate cutterhead for precise ground excavation. Akkerman control containers, the information center for all microtunneling functions, house the control console, motor controls for slurry pumps, MTBM drive motor and bulkhead panel. The Akkerman line of keyhole jacking frames allows customers to operate a high-capacity jacking frame out of a minimal launch shaft. Collectively, keyhole jacking frames operate out of a 16- to 24-ft shaft and feature 800 to 1,200 tons of thrust capacity at 8,000 psi.

BAROID BORING FLUID SYSTEM

BORE-GEL single-sack boring fluid system is specially formulated for use in trenchless applications. BORE-GEL fluid system is a proprietary blended product using high-quality Wyoming sodium bentonite. When BORE-GEL fluid system is mixed with fresh water, it develops an easy-to-pump slurry with desirable fluid properties for HDD.The use of BORE-GEL fluid system promotes the following: Optimum gel strength for cuttings suspension and transport; Pumpable slurry with minimal viscosity; High reactive solids concentration for improved borehole stability in poorly consolidated/cemented sands and gravel formations; Reduced filtration via a thin filter cake with low permeability; and, Lubrication of pipe in microtunneling operations.

DERRICK CENTRIFUGE

The Derrick DE-7200 VFD Controlled “Big Bowl” Centrifuge offers up 500 gpm of volumetric capacity and a maximum of 15 T/Hr of ultra-fine solids removal from drilling slurries. The DE-7200 is a critical component to the overall solids removal process on tunneling and other civil construction projects that utilize drilling fluid in the excavation process, as it removes high volumes of ultra-fine drilled solids from the mud system. The DE-7200 is capable of removing solids down to 5 um without any chemical enhancement. If a finer separation is needed, the DE-7200 can be paired with a polymer mixing and dosing unit to remove solids down to 0 um, and achieve a semi-clear effluent. This high-volume centrifuge allows one to better maintain desired fluid properties and also facilitates mud disposal, both of which can help increase production and reduce disposal costs on challenging civil drilling projects.

EZEBREAK MICRO-BLASTER

The Ezebreak Micro-Blaster IIx3 System allows users to break rock and concrete in almost any location, quickly and economically. Extremely portable, weighing only 20 lbs, the system requires only 5/16-in. diameter drilled holes 10 to 16 in. deep. With excellent scalability users have the option of using a single head or all three with 1 to 4 Micro-Blaster cartridges in each hole. Utilizing proprietary cartridge technology, the system is capable of breaking competent material from a few hundred to several thousand pounds. Used by builders, excavators, landscapers, rural landowners, rescue personnel and mine workers, Micro-Blaster Systems solve difficult demolition problems quickly and easily. Micro-Blaster systems are exempted from Canadian and U.S. Federal Blasting Regulations and do not require licensing in most locations. Micro-Blasters are available in single head versions for smaller projects.

HAYWARD BAKER GEOTECHNICAL CONSTRUCTION

HAYWARD BAKER
Geotechnical Construction

Hayward Baker Inc., North America’s leader in geotechnical construction and a member of the worldwide Keller Group of companies, is ranked No. 1 among excavation/foundation contractors by ENR. The company has decades of experience with the full range of geotechnical construction techniques to solve a variety of microtunneling issues. Jet grouting and soil mixing stabilize soft soils prior to tunneling. Jet grouting and soil mixing create tangent or secant pile shafts for tunnel access. Jet grouting, chemical grouting and cement grouting stabilize soils around break-ins and break-outs and control groundwater. Anchors, shotcrete and grouting techniques stabilize tunnel liners. Compaction grouting densies loose soil under tunnel alignments, and helps relevel MTBMs. Fracture grouting, chemical grouting and compaction grouting control settlement of overlying structures during tunnel boring. Whatever the size of the project, Hayward Baker has the experience and technology to provide an innovative, robust and cost-effective solution.

HERRENKNECHT PIPE EXPRESS

Pipe Express is an innovative semi-trenchless installation method for the overland near-surface installation of pipelines. It is an alternative to open-cut installations where the surface is too congested to allow open-cut or the ground conditions make it very difficult, like in swampy areas or wetlands. Pipelines of up to 2,000 m (6,500 ft) in length and with diameters of 900 to 1,500 mm (36 to 60 in.) can be installed in a one-pass operation. The modular design of the entire system includes an excavation unit with a specially design cutting wheel as well as a trencher that transports the excavated material right behind the machine to the surface. The whole operation is controlled from the operator cabin by a single person, thus making it very economical and safe installation method. After intensive in-house development and testing the system has been proven successfully on two pilot projects in Europe and Asia.

HOBAS PIPE

Hobas Pipe USA has been manufacturing centrifugally cast, fiberglass-reinforced, polymer mortar (CCFRPM) pipe at its Houston plant since 1987. CCFRPM is inherently corrosion resistant and lasts 100 years or more. After more than a quarter-century of reliable service, most U.S. municipalities have used Hobas pipe in new construction and rehab in critical installations. Contractors prefer its leak-free, push-together joints that reduce installation time and costs. Main Hobas benefits are superior hydraulics, light weight, high strength and long, maintenance-free service life. Applications include storm and sanitary sewers, potable water, force mains, outfalls, industrial effluents and other corrosive environments. Hobas is ideal for a variety of installation methods including nearly every trenchless application: sliplining, jacking, microtunneling, two-pass tunnel and casing carrier, plus open-cut and above ground. Hobas offers pipes ranging from 18 to 126 in. in diameter and is ISO 9001 and 14001 certified.

MCLAUGHLIN AUGER BORING STEERING HEAD

The McLaughlin ON Target auger boring system steering head allows contractors to not only control horizontal directional changes, but also allows for lateral changes. Until now auger boring contractors were limited to a steering head that offered only horizontal or grade (up and down) direction changes during the bore. The ON Target system allows contractor to also control the direction of the bore in a lateral (left to right) movement, providing more accuracy for difficult on-grade bores. The cutting path — grade and lateral movement — of the steering head is controlled by hydraulic actuated panels that open and close to help keep the bore on the intended path. A control station features a hydraulic power pack to control the movement of the steering head, and a built-in water level helps monitor grade. Two halogen lights in the control station indicate lateral (left and right) steering head movements. More contractors are discovering that auger boring is a cost-efficient way to install steel casings between 12 and 70 in.

MISSION CLAY NO-DIG JACKING PIPE

NO-DIG Vitrified Clay Jacking Pipe is manufactured in Pittsburg, Kan., by Mission Clay Products. This gravity flow sewer pipe has been used for slurry microtunneling, pilot tube microtunneling (GBM), static pipe bursting and sliplining applications. This vitrified clay pipe is manufactured from 100 percent natural materials: a blend of clays, shales and slate. NO-DIG is manufactured with a Precision Ground Joint, a Polyisoprene, EPDM, or Nitrile Elastomer Gasket, and a Series 316 Stainless Steel Collar. Chipboard compression rings, for axial load transfer during installation, are supplied and used at each joint. NO-DIG Pipe meets the specification requirements of ASTM C1208/ C1208M and EN 295-7. NO-DIG Vitrified Clay Jacking Pipe has been the predominant tunneling pipe material used in the 8 through 36-in. size range due to its high compressive strength (18,000 psi average), low-profile zero-leakage joint, and affordability in the typical 1- or 2-m pipe lengths.

PERMALOK PIPE

Permalok Steel Pipe with its patented Interlocking Press-Fit Connection requires no field welding, making it the ideal solution for all trenchless steel pipe installations, including microtunneling, augur boring, pipe ramming, pipe jacking and guided boring. Modified joint configurations also allow Permalok Steel Pipe to be used in single-pass pressure applications and HDD installations. Permalok is available in sizes from 6 to 147-in. diameters and wall thickness up to 1.75 in. Coatings and linings to many specifications are also available. Permalok has manufacturing facilities in St. Louis Mo., and Salt Lake City, Utah, to facilitate prompt and accurate deliveries nationwide.

ROBBINS MICROTUNNELING SYSTEMS

Robbins Small Boring Units (SBUs) are time-tested and trusted by contractors worldwide, and now the small diameter line is expanding to include Robbins Microtunneling Machines. The Robbins Company offers a full range of microtunneling systems (MTBMs) suitable for the direct installation of pipe sizes from DN 600 through DN 3000 (24 to 118 in.). These systems are capable of maintaining industry-standard line and grade on one-pass installations. Robbins MTBMs are designed with appropriate tooling to efficiently excavate soft ground, mixed face or rock formations. The machines utilize a slurry excavation method for face pressure control during excavation, and can operate below the water table in pressures up to 3 bar. Larger MTBMs can be manufactured with face access, allowing for efficient tooling changes from within the machine. Robbins MTBMs can use jacking frames in either compact or telescopic configurations, while jacking station capacity can be tailored to suit individual job requirements.

VERMEER AXIS GUIDED BORING

The AXIS guided boring system, developed by Vermeer, is designed to install 10- to 14-in. pipe at lengths up to 350 ft, and can maintain grades of less than 0.5 percent. Made up of four main components, the AXIS system includes a power unit, rack, vacuum pump and vacuum tank. The power unit contains the engine and hydraulic pumps and connects to the rack to power thrust and pull back of the drill stem. The rack includes the thrust/pullback carriage assembly and gearbox. As the thrust/pullback carriage assembly moves up the rack, the gearbox simultaneously provides rotation to the cutter bit at the front of the drill head. The drill head uses a flat-face cutter and when combined with the laser guidance system, the AXIS system is capable of completing flat grades accurately. As the drill stem cuts its way through the soil, the displaced material is simultaneously removed by a high-power vacuum system. Spoil is then diverted to a vacuum storage tank.

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