

An 85-ft-deep tunnel-boring machine access shaft was constructed using reinforced concrete panels installed by Malcolm Drilling for the Silicon Valley Clean Water Tunnel in Redwood City, Calif.

PHOTO: ALEJANDRO VELARDE

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Underground Today III

What Lies Beneath

Digging into the current state of underground construction nationwide and beyond

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Deep Dive

Industry Experts Share Current Insights Into the Underground Sector

What's going well for the underground sector today? Where do you see struggles?



Theresa Engler,
Executive Director,
Deep Foundations
Institute (DFI): Based

on a healthy U.S. economic outlook and the busyness of DFI's member firms, the opportunities in the market for deep foundations, excavations and tunneling are plentiful. This is especially true for the need to update our aging infrastructure and, in other parts of the world, develop and employ new infrastructure.

Challenges I see are the ready availability of public funding for large

infrastructure projects due to the political climate, as well as difficulty in attracting the needed resources from talented, innovative engineers and skilled workers. There's also the added challenge on these large projects of managing the risk between all project stakeholders.



W. Barry Kannon,
Executive Vice
President and CAO,
Vice Chairman of
the Board, Malcolm
Drilling: In its 57

years in the foundation business, Malcolm Drilling has done more volume in 2019 than ever before, and we expect that trend will continue over the next few years, barring catastrophic

economic changes. However, the struggles we face are the same as those throughout the construction industry: people, people, people. As projects grow in size and complexity, we need more engineers and tradespeople—and those people must be brighter and more innovative at all levels. The equipment today is more expensive and more complex to operate; training is paramount.

What are some of the current trends for underground projects?

Engler: Technology in the sense of robotics, remote sensing, geographic information systems and digitalization of data is more and more useful to increasing the efficiency in design and construction of current projects and quick access of data for future projects. This is one of the main reasons DFI recently established a Project Information Management Systems Committee. Additionally, efficiency increases with the design-build models vs. the design-bid-build model, and we're seeing the design-build project-delivery models utilized more and more. The challenge of public funding previously mentioned is being offset somewhat through public-private partnerships (P3s), but we still see considerable shortfalls in capital investment in our entire infrastructure system. Inherent with P3s is the shifting or transfer of risk and the need for even better communication and collaboration among all parties—a core part of DFI's mission in bringing all disciplines together to find consensus.

Kannon: Today, projects are larger and more complex than ever before, and the focus is on cooperation between developers, contractors and subcontractors to best analyze design to positively impact costs and schedule. While the focus has been on private work, I believe the focus will change to the public sector, both at the state and federal levels.

Innovative Foundation Design for the Marc Basnight Bridge

The new 2.8-mile Marc Basnight Bridge in the Outer Banks of North Carolina, DFI's Outstanding Project award winner, was built using first-of-their-kind design and construction methods to provide a 100-year service life, resist unprecedented scour depths and minimize environmental impacts while offering a reliable, safe passageway to and from Hatteras Island.

The bridge can sustain wind, wave and vessel collision forces from the worst storms in the Atlantic Ocean. The new bridge is subject to 12 ft/s currents, winds up to 105 mph and vessel impacts up to 2,151 kips. The foundations were designed by the team of HDR (engineer), PCL Civil Constructors (general and foundation contractor) and the North Carolina Dept. of Transportation (owner) to resist scour as deep as 84 ft below sea level.

The bridge foundation design was key to the project's success but also posed the greatest challenges. Driven, prestressed concrete piles

were selected for the long spans as well as the approach and transition spans, and provided the required strength and durability. To address the concern of how to drive large displacement piles through dense sand, the team developed innovative jetting installation methods. The need to optimize the design led to the extensive use of refined soil-structure interaction analyses.

The approach spans, with significantly less scour and ship impact loads, are supported by highly efficient foundations with 54-in.-dia vertical concrete cylinder piles. The transition spans and high-level, long navigational spans use a combination of cast-in-place reinforced concrete pile caps with 36-in. square concrete piles in a battered configuration to provide greater lateral resistance against wind and ship impact loads under deeper scour conditions. In total, there are 690 piles measuring more than 15 miles in total length of piles installed. ♦

What current or upcoming underground projects should be on our radar?

Engler: Underground and high-speed rail projects are exploding worldwide. Through our chapter in India, DFI is closely involved in assisting the Chennai Metro Rail with the second phase of that project, which will require the application of a multitude of technologies for soil investigation, ground improvement, foundations and retaining structures. Other rail projects throughout India as well as in Europe, Australia, China and right here in the United States are also underway or just getting started. Last year, at our conference in Rome, we focused on mega projects in one session, where the Thames Tideway Tunnel Project, Fehmarnbelt Fixed Link, Rome Metro C and Chennai Metro Rail were presented and the many lessons learned were discussed.

What does the future hold for underground construction?

Engler: Having been involved with DFI for more than 20 years, I find that there's always something to be optimistic about because the members of the underground construction sector have such a wealth of knowledge and desire to be creative and problem solve. Currently, the only concern I have is the lack of public visibility of the underground construction world and how critical it truly is to our everyday lives. We need to do a better job as a sector of publicizing our successes and showing the resourcefulness and innovation of our community.

Kannon: We're extremely optimistic that the underground sector will continue to grow, even as the work becomes more public vs. private. Our forecast for the next two years is one of strong growth. ♦

Underground Parking Utilizes Sheet Piles to Save Time and Maximize Space

The growing population and interest in tourism in the city of Culiacán, Mexico, is creating new opportunities for building. The newest addition to the economy is Plaza Santander, a five-story multipurpose retail space and hotel built by developer Grupo Premier.

Space is limited in the downtown Culiacán area, making underground parking a necessity for the new tower. Nucor Skyline partnered with Versum Ingenieria for the installation of a steel sheet pile wall for the finished parking garage. The use of sheet piles saves time and money, as no concrete wall is needed. It also maximizes space because sheets can be driven to the perimeter of the property.

The site conditions lent themselves perfectly to the sheet pile foundation wall. Using AZ 19-700 sheet pile, which Nucor Skyline stocks, the job was finished within the customer's tight schedule constraints. The welded interlocks of the AZ sheet pile wall keep the parking structure watertight. The sheet piles were then painted to reflect light, making the space bright.

To learn more about this and other below-grade parking structures, visit www.nucorskyline.com. ♦



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Coated steel sheet pile walls saved time and money on the underground parking structure in Culiacán, Mexico.

PHOTO: COURTESY OF SKYLINE COMERCIAL DE MEXICO

Intelligent Pumping Systems Replace Generators in Underground Construction Trend

The demands of managing lift station operations for underground construction projects are changing with the times, and today diesel-driven backup pumping is quickly replacing generator backup systems as the preferred contingency plan.

With a wide range of concerns, from addressing inclement weather to power outages, construction demands are moving away from generators to more intelligent systems, such as the emergency backup lift station standby system provided by Thompson Pump and Manufacturing. The company's permanently installed standby unit is fully automatic and independent; it continues pumping despite power loss or primary pumping failures, and it acts as the primary pumping system during maintenance or repairs. The pump's eco-friendly Enviroprime System® actively prevents blow-by or pumpage from discharging on the ground, keeping the environment clean and safe.

A municipality in Southwest Florida recently explored the option of permanent, diesel-powered, dry-priming backup pumps as a more reliable and cost-effective replacement to generators. Thompson Pump tailored a proposal for each of the municipality's lift stations.

"The municipality quickly discovered that Thompson Pump's products, service and engineering staff provided a

night-and-day difference," says David Perry, municipal sales manager for Thompson Pump. Perry says that, as a result, the municipality plans to add new lift stations each fiscal year.

Family-owned Thompson Pump and Manufacturing is a full-service manufacturer and provider of high-quality pumps, pumping equipment and engineering expertise for bypass pumping, dewatering, mining and flood control. ♦



Diesel-driven backup pumping stations are replacing traditional generator backup systems on many underground projects.

PHOTO: COURTESY OF THOMPSON PUMP AND MANUFACTURING



Hydro-cutter equipment was used to construct a water-supply tunnel in British Columbia.

Deep-Water Challenge Requires Special Equipment and Techniques

Metro Vancouver is constructing a new water-supply tunnel deep under Burrard Inlet, east of the Ironworkers Memorial Bridge in British Columbia. This project is one of five new regional water-supply tunnels that are being designed to meet current seismic standards to ensure the reliable delivery of drinking water in the region in the event of a major earthquake. When complete, the tunnel will also increase the capacity of the existing system to meet the long-term needs of the growing population.

Metro Vancouver has selected the Traylor-Aecon Joint Venture to construct the 3,609-ft-long tunnel with a 22 ft dia excavated deep underground using a tunnel-boring machine (TBM). The TBM will launch from a vertical entry shaft on the North Vancouver side and progress south under Burrard Inlet to the vertical exit shaft on the Burnaby

side. The 50-ft-dia entry shaft will be 275 ft deep and had to be constructed through very challenging alluvial deposits that contain a high percentage of cobbles and boulders, with groundwater level being right at ground level. Due to very tight verticality tolerances of only 0.4%, the design of the support of excavation (SOE) was based on a 48-in.-wide unreinforced diaphragm wall ring. Malcolm Drilling employed state-of-the-art hydro-cutter equipment in combination with real-time verticality monitoring systems to meet these strict requirements. The difficulties that the subsurface conditions posed for the team were overcome by quickly adopting means and methods to stabilize such loose geotechnical formations. The SOE for the North shaft was installed as specified and ahead of schedule. Learn more at www.malcolmdrilling.com. ♦

PHOTO: COURTESY OF MALCOLM DRILLING



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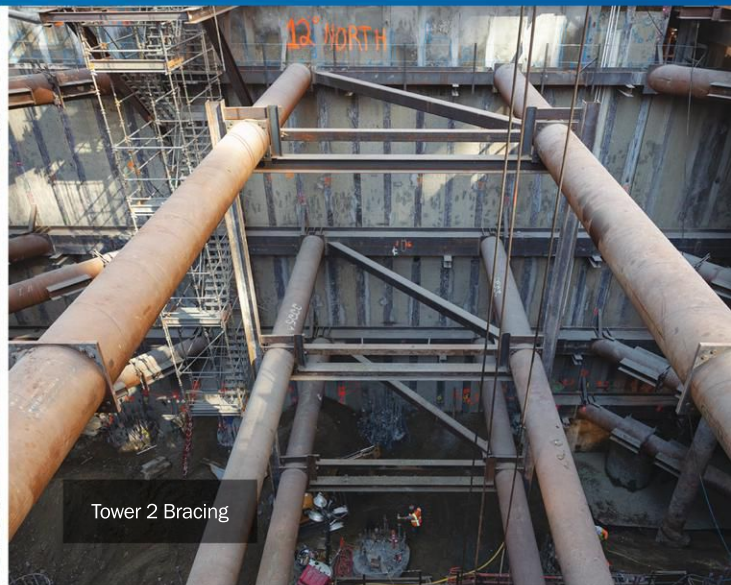
Look to the Blue

Malcolm's unmatched experience and specialized resources drive the construction state-of-practice, evolving new solutions to meet the demands of our clients. Our deep foundation services offer the most cost-effective solutions for virtually every project need in some of the most difficult ground conditions. We combine the most modern equipment fleet with construction and engineering experience for all types of deep foundations. When you have projects that require a higher level of expertise, contact us at malcolmdrilling.com

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Top of 332-foot-deep shafts