

Tunneling & Underground Construction

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Robotics in Tunneling Machine Learning

Special Editorial Supplement from the publisher of

Mining
engineering

BART SILICON VALLEY EXTENSION PHASE II

SUPERSIZED EPB SHIELD FOR BART

Herrenknecht's supersized EPB Shield is driving a key section of VTA's BART Silicon Valley Phase II Extension, advancing urban mobility in the San Francisco Bay Area. The TBM is excavating 8 km of tunnel through fine-grained soils as part of the 9.7 km extension to Santa Clara. The project marks a major step toward improving public transit connectivity in Northern California.

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With the rapid advancement of artificial intelligence (AI) in all sectors, the tunneling and underground construction industry must address the fundamental questions of how and when the technology will be implemented and to what extent it should transform underground infrastructure.
Cover design by Ted Robertson.

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Source: Mallick 2024

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Exciting things are on the horizon for UCA and the tunneling industry

I am honored to begin my term as UCA Chair. The association's past chairs have done an outstanding job, setting a high bar for me to continue building upon. I would like to thank Mike Rispin for his diligent dedication. Mike completed his term of service on July 1, 2025, concluding 11 years with the UCA. He will continue forward by leading our bid for the 2030 World Tunneling Congress. In addition to this leadership transition, we will also be welcoming a new SME Executive Director, Melissa Russell, as David Kanagy approaches his well-deserved retirement after more than 22 years in the position.

The UCA is built on the efforts of volunteers. I encourage all our members to get involved and make the UCA your own. While I may be at the helm, it is the Executive Committee, the Conference Committee, the Conference Committee, and our many other volunteers who are the driving force behind the UCA. Transitions present valuable opportunities for all of us to reflect on our accomplishments, reassess our goals, and plan for the future.

We have an exciting start ahead with many things to look forward to, including SME's update of its strategic plan. This update will provide us with the opportunity to reflect on our past accomplishments, validate our progress, and reassess our focus areas. As we move forward, we hope to incorporate the voices of all our members by gathering feedback through surveys.

In November, we will kick off our conference schedule with Cutting Edge, followed by the George Fox Conference in January 2026, and concluding with the North American Tunneling Conference (NAT) in June 2026. These conferences are phenomenal opportunities for professional development and industry engagement, and I strongly



Lonnie Jacobs
2025-2027 UCA Chair

encourage your participation.

In addition to our regular conference lineup, we announced at the International Tunneling and Underground Space Association's (ITA) May 2025 meeting in Stockholm our intent to bid for hosting the 2030 World Tunneling Congress (WTC) in Miami. The UCA set the standard when it last hosted the WTC in conjunction with NAT in 2016, and we are eager to raise the bar again. Mike Rispin has graciously volunteered to lead our WTC Bid Committee in developing a winning proposal, which will be considered at the ITA's May meeting during WTC 2026.

On my end, I will be attending the SME Midyear Conference in September 2026, where I will present to the SME Board of Directors the UCA's accomplishments and future vision. This opportunity will broaden the Board's understanding of UCA activities and strengthen support for our budgeting needs.

In the broader construction world, innovation continues at a remarkable pace. The utilization of underground space for transportation, environmental, and energy solutions is growing at an unprecedented rate. The size, value, and complexity of these projects are also increasing. I cannot recall another period that

(continued on page 27)

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METRO MANILA SUBWAY PROJECT

TERRATEC Continuously Advancing Tunnel Conveyors are currently deployed for Phase I Contract Package CP101 of the Metro Manila Subway Project in Manila, Philippines.

A total of Four TERRATEC Continuously Advancing Conveyors play a vital role in the construction of the 33.1-kilometer subway section, connecting Mindanao Avenue in the northern part of Metro Manila to Western Bicutan in the south. TERRATEC's highly skilled team offers specialized TBM support and prompt onsite assistance throughout tunnelling operations.

Second Avenue Subway Phase 2 moving forward with award of tunneling contract

The Metropolitan Transportation Authority (MTA) Board has approved the tunnel-boring contract for Phase 2 of the Second Avenue Subway, the project extending the train from 96 Street to 125 Street that will deliver new transit access to East Harlem residents. This new tunnel will extend from 116 Street to 125 Street. Crews under this contract will also excavate space for the future 125 Street Station, and in a cost-containment measure that saves the MTA \$500 million, will outfit the tunnel along the route that was built in the 1970s to accommodate the future 116 Street Station.

The work to bore the new tunnel, between 11 and 36 m (35 and 120 ft) below Second Avenue, is expected to take place using 680 t (750-st) machines equipped with 7 m (22-ft) diamond-studded drill heads. Early work will commence later this year,

with heavy civil construction starting in early 2026 and the tunnel boring itself expected to begin in 2027.

“It’s been a century since the people of East Harlem were promised the new subway they deserve — and we are finally getting it done,” Gov. Hochul said. “East Harlem is one of the most transit-reliant neighborhoods in New York, but every day, tens of thousands of commuters lack subway access. The Second Avenue Subway will change everything; it will shorten commutes for over 100,000 daily riders and make East Harlem more vibrant than ever. Awarding this contract means that the time for promises to this community is over and the time for building is here — next stop 125 Street!”

The contract, valued at \$1.972 billion, is being awarded to Connect Plus Partners, a joint venture between Halmar International and FCC

Construction. It is the second of four construction contracts for the train extension. Despite New York City’s high construction costs, the Second Avenue Subway Phase 2’s cost-benefit is significant and is projected to have the lowest cost per rider of any active heavy rail project in the country.

MTA Chair and CEO Janno Lieber said, “This is a meaningful step forward not only for the project but everyone in East Harlem and Central Harlem. Locals have waited almost 100 long years for their promised subway extension. Thanks to investments from Governor Hochul and our partners in Washington, today the new MTA is moving forward with the largest tunneling contract in agency history, but — more important — with a project that pencils at the lowest cost per rider of any heavy rail project in America.” ■

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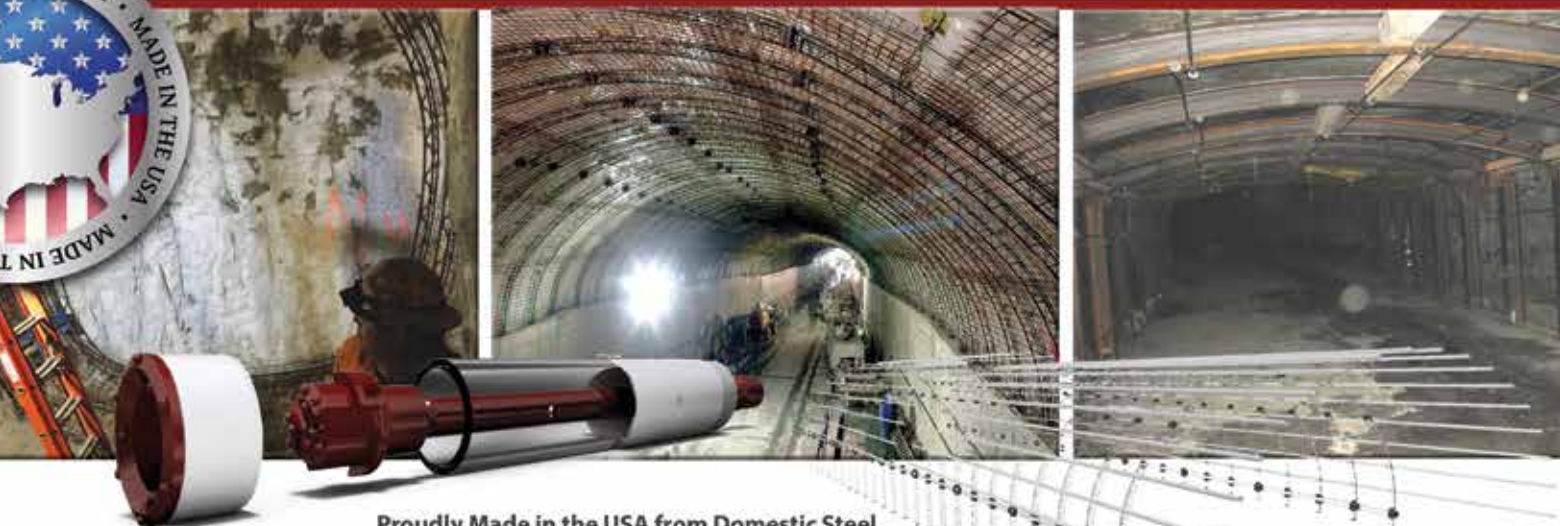


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Tunneling completed on Italian side of Brenner Base Tunnel

Tunneling on the Italian side of the Brenner Base Tunnel has been completed. The last of three Herrenknecht tunnel boring machines (TBM) reached the end of its construction lot beneath the Italian-Austrian border, coming from the south.

The Brenner Base Tunnel is a key project for the sustainable expansion of European rail infrastructure. Under the direction of the Austrian-Italian BBT SE, the world's longest underground railway connection, spanning 64 km (40 miles), is being built between Innsbruck (Austria) and Franzensfeste (Italy) on the trans-European north-south corridor from Finland to Malta. It is being designed as a particularly high-performance flat railway line — that is, with very low gradients. Herrenknecht has won orders for a total of eight TBMs for the

construction of the Brenner Base Tunnel.

On the Italian side, the last of three Herrenknecht machines has successfully completed tunneling in the western main tube for construction lot H61 Mauts. Using two double-shield TBMs with a diameter of 10.65 m (35 ft), the miners of the joint venture between Webuild, Ghella, P.A.C. and Cogeis excavated 14.3 km (9 miles) of the two main tubes. They mastered both high-strength rock and challenging geological fault zones. They used another double-shield TBM with a diameter of 6.8 m (22 ft) to construct a service and rescue tunnel beneath the main tubes.

On the northern, Austrian side of the Brenner, four machines manufactured in Schwanau are currently driving the main tubes forward. The tunnel builders had

already completed the Austrian section of the service and rescue tunnel with a Herrenknecht TBM in 2020.

Once the Brenner Base Tunnel is completed it will redesign transport between Italy and Austria, strengthening Europe's sustainable mobility and reducing the environmental impact of transport in the Alpine area.

The project work is part of the Munich-Verona railway axis. It also represents a central element of the Scandinavian-Mediterranean Corridor of the TEN-T network, of which it is also the most important section because it allows to go beyond the natural barrier formed by the Alps.

The tunnel will connect the cities of Fortezza, approximately 50 km (31 miles) north of Bolzano, and Innsbruck in Austria. ■



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Parsons Corporation tapped to lead Dubai's Metro Blue Line project

Dubai's Roads and Transport Authority (RTA) has chosen Parsons Corp. to be the project management consultant on the massive \$5.6 billion Metro Blue Line, a 30-km rail link project. The contract represents new work for Parsons and spans five years.

Under the contract, Parsons will provide comprehensive project management services including design review, procurement support, construction supervision, testing and commissioning oversight, and project handover management. The Dubai Metro Blue Line, expected to commence operations in 2029, is a key component of Dubai's D33 Economic Agenda, which aims to position Dubai among the world's fastest, safest and most connected cities by 2033.

"We are proud of our long-standing partnership with the RTA and are committed to working with their expert team on expanding the Dubai Metro network in line with the RTA's goal to provide seamless, safe and sustainable mobility solutions that cater to the needs of Dubai's growing population," said Pierre

Santoni, president of infrastructure EMEA at Parsons. "Our team will leverage our 80-plus years of global experience coupled with our local knowledge to deliver a world-class transportation system using the safest methods and most innovative technology available."

Engineering News Record reported that Parsons' scope includes coordinating detailed design checks, advising on procurement strategy, supervising construction quality and safety, and overseeing testing, commissioning and turnover to RTA operations.

The company's resume in Dubai already includes the Red and Green Metro lines, the Route 2020 extension and the city's intelligent traffic systems. The new line will expand the city's rail network to 131 km, with 78 stations and 168 trains in operation.

Malek Ramadan Mishmish, director of rail planning and project development at RTA, said: "We are pleased to appoint Parsons as the project management consultant for the Dubai Metro Blue Line, particularly given the company's extensive and proven experience in

delivering projects awarded by the RTA since its establishment in Dubai. Parsons is a key partner in the RTA's success and achievements, which it continues to deliver."

Mishmish added: "The RTA is committed to working with leading global companies to implement its various projects and initiatives in line with the vision and ambitions of the Government of Dubai to make the Emirate the smartest and happiest city in the world. The RTA also strives to play an active role in achieving this vision, which is based on excellence, innovation and future foresight, while leveraging advanced technologies in the field of smart and sustainable transportation."

The Dubai Metro Blue Line will span 30 km and include 14 stations, enhancing connectivity between key districts, including Mirdif, Dubai Silicon Oasis, Dubai Creek Harbour and Dubai Festival City.

Upon completion, the line is expected to accommodate up to 320,000 passengers per day, supporting Dubai's 2040 Urban Master Plan for sustainable urban mobility. ■

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DC Water completes major repairs on century-old sewer tunnel

DC Water announced it is has completed repair work on a 3-m (9-ft) diameter sewer tunnel. Construction on the 140-year-old sewer tunnel on 22nd Street Northwest was completed in two phases, with the second phase completed one month ahead of schedule and under budget.

An inspection of the tunnel built in the 1800s revealed a large void in the soil above, measuring 4 m (13 ft) long and 3 m (10 ft) wide, and the tunnel in danger of collapse, necessitating the long-term closure of a section of 22nd Street. The tunnel section is part of the Northwest Boundary Trunk Sewer.

Significant structural issues were also identified, as well as upstream and downstream from the emergency repair. These included longitudinal cracks, missing cobblestones and bricks, and root penetration prompting emergency repairs.

Construction, sometimes 24 hours a day, seven days a week, posed challenges with crews working two stories below ground in difficult conditions. At the same time, the sewer pipe remained active with combined stormwater and sewer debris flowing through and prompting work stoppages when heavy rain inundated the system.

The work involved reinforcing the sewer tunnel and stabilizing the soil around the initial void. This required injecting grout into the soil, framing the walls with rebar, and using high-pressure, spray-applied shotcrete and geopolymer, four inches to as much as nine inches thick. This included 139,000 linear feet of rebar, 25,450 rebar anchors, 28 t of shotcrete and 459 t of geopolymer.

Emergency repairs began in July 2024 as part of the first phase of the project, which involved stabilizing the soil and reinforcing the tunnel

around the initial void. Additional inspections identified more structural deficiencies requiring a second phase to repair more than 1,200 linear feet further upstream and downstream.

DC Water worked closely with the District Department of Transportation to minimize the disruption to traffic in the area. To help relieve the impact of the road closure, one northbound lane of 22nd Street was closed earlier this year while construction continued.

DC Water operates approximately 2,000 miles of combined, separate and stormwater sewers.

Addressing aging water and sewer infrastructure throughout the district is a critical part of its 10-year, \$9.6 billion Capital Improvement Program.

This includes replacing or rehabilitating similar large-diameter sewer lines that have reached the end of their useful lives. ■

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East River Tunnel Rehabilitation project gets underway

Amtrak crews kicked off the first long-term track outage in support of the East River Tunnel Rehabilitation (ERT Rehab) project on May 27.

The project is a critical infrastructure investment that will restore the two tunnel tubes damaged by Superstorm Sandy (line 1 and line 2).

While still structurally sound and safe for passenger use, the reliability of the systems inside the tubes has continued to deteriorate since the 2012 storm. The century-old tunnels have reached the end of their useful lives and must be completely rehabilitated for another 100 years of service.

The ERT Rehab project will involve demolishing the existing tunnel systems down to concrete

liners, then reconstructing the tunnels with modern, state-of-the-art tunnel systems. The work is scheduled to take place in one tunnel tube at a time under a full closure for maximum efficiency, beginning with line 2 on June 2.

Throughout the project, three of the four East River Tunnels will remain available for service to ensure continued Amtrak, Long Island Rail Road and NJ Transit service. Amtrak crews are on standby throughout the Penn Station complex to respond quickly to any emergencies and minimize the impact of the track outage to the maximum extent possible.

In the months and years leading up to the long-term outage that began over the Memorial Day weekend, Amtrak had performed work in the

tunnels that will remain open to prepare them for additional traffic and reduce the risk of infrastructure failures during the three-track operation. This work has included repairing damaged sections of benchwall, sealing the tunnel liner to prevent water infiltration, replacing the third rail, and making signal and power upgrades throughout line 1, line 3 and line 4.

With mitigation work completed in line 3 and line 4, crews used the first 10 days of the long-term outage to complete remaining mitigations focused on final “hardening” of the infrastructure in Line 1. This work — which began over Memorial Day weekend and incurred no interruptions to planned service — included power-cable relocation and block-tie replacements. ■



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BART Silicon Valley Phase II receives \$100 million in state transportation grants

The Valley Transportation Authority (VTA) was awarded \$100 million in state funding for BART Silicon Valley Phase II (BSVII), a transformative regional infrastructure investment that will ring the Bay with electric rail and significantly enhance mobility across the Bay Area in San Francisco, CA. This award is a significant contribution to filling VTA's remaining funding gap for the project.

The California Transportation Commission approved the awards. The funding includes:

- \$25 million from the 2025 Local Partnership Competitive Program, which supports infrastructure projects that address mobility and transportation challenges through strong local investment.

VTA submitted this application directly.

- \$75 million from the 2025 Solutions for Congested Corridors Program, a competitive grant nominated by the Metropolitan Transportation Commission with VTA as the implementing agency. This program focuses on projects that relieve congestion and promote sustainable, equitable transportation solutions.

"These grants are a critical milestone in delivering BART Silicon Valley Phase II," said Carolyn Gonot, VTA general manager and chief executive officer. "This investment reflects our region's long-standing commitment to sustainable transit and the collective determination to bring BART farther into the heart of Silicon

Valley. We are also working to set the standard for efficiency and fiscal responsibility in the transit industry by ensuring every taxpayer dollar is spent wisely and strategically."

The project will extend BART service 10 km (6 miles) into downtown San Jose and Santa Clara, supporting state and regional goals around congestion relief, equity and economic development. The estimated \$12.7 billion project is being funded through a combination of local, state and federal sources, including a planned nearly \$5.1 billion contribution from the Federal Transit Administration's New Starts program.

In response to evolving funding challenges, VTA has identified \$400 million in cost savings and is pursuing additional efficiencies to close a funding gap of \$700 million to \$1.2 billion. ■



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Robbins TBMs break through at Delhi Metro DC-07

A pair of Robbins 6.65-m diameter earth pressure balance (EPB) tunnel boring machines (TBMs) successfully broke through on India's Delhi Metro Phase IV DC-07 package, achieving a seamless drive from Airforce Station to Tughlakabad Railway Colony Station via Maa Anandmayee Marg Station.

The Robbins TBMs broke through at Tughlakabad Railway Colony station, marking the successful completion of the DC-07 contract for Delhi Metro.

This milestone reinforces Robbins' commitment to delivering high-performance TBM solutions for critical urban transit projects across India. "This breakthrough is not just a milestone in tunneling, but a testament to the robustness of Robbins technology and the strong collaboration between our field teams and Afcons. The performance of the

PLC systems throughout the DC-07 drives was exceptional, ensuring real-time control and precision even in highly variable ground conditions," said Laxman Khatri, PLC expert at Robbins India.

The twin TBM drives totaled 2,469 rings, spanning a combined 3,456.6 m of tunnel. Drive 1 totaled 2,651.6 m between Airforce Station and Maa Anandmayee Marg, while drive 2 totaled 791 m between Maa Anandmayee Marg and Tughlakabad Railway Colony.

The recent breakthroughs in early June 2025 mark the completion of Robbins' tunneling scope under the DC-07 package. The drives successfully passed through densely populated urban sectors with difficult logistics and challenging mixed-ground geology consisting of rock with gravel, sand, silt and clay — all with minimal surface impact.

"From launch to breakthrough,

our focus was on delivering precision tunneling with minimal surface disruption and maximum efficiency. Despite complex logistics and mixed ground conditions, both drives were completed on schedule with excellent performance. This success reflects the strength of Robbins machines and the dedication of our field teams," said Gaurav Singh Bisht, field service manager at Robbins India.

This accomplishment marks another successful chapter in Robbins' long-standing partnership with owner Delhi Metro Rail Corp. (DMRC) and contractor Afcons Infrastructure Ltd, contributing to the transformation of Delhi's urban mobility infrastructure.

With the tunneling phase for DC-07 now completed, Robbins will continue to assist Afcons Infrastructure Ltd during the TBM dismantling and removal from the tunnels. ■

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Major construction expands across entire route of 9.2-km Eglinton extension

Metrolink reported that crews in Toronto began digging the tunnels that will connect the Eglinton Crosstown West Extension to the existing terminus of the Eglinton Crosstown LRT (to be known as Line 5 Eglinton when it opens) at Mount Dennis Station.

The extension will make Line 5 Eglinton another expansive east-west rapid transit line for the Greater Toronto Area (GTA), running from Scarborough, through midtown Toronto and into Mississauga. The project will add seven new stations to Line 5 Eglinton's 25 stations and stops.

Last year, the contract to design and build the second underground segment of the Eglinton Crosstown

West Extension was awarded to Strabag Inc.

The 500-m (1,640-ft) twin tunnels are being built using the sequential excavation method, which is often used for smaller sections of tunnels. With this method, the area to be tunneled is divided into smaller sections and excavated in sequence. Concrete is then sprayed onto the tunnel walls as the sections are excavated to reinforce the exposed walls. About one to two meters of tunnel are excavated each day.

Last spring, Renny and Rexy, the twin tunnel boring machines that excavated the western tunneled section of the line, completed their 6.3-km (4-mile) journey.

The twins spent two years carefully carving out two tunnels that

start at Renforth Drive and end at Scarlett Road, where the future rapid transit line will come to the surface and transition to an aboveground section.

Construction is also marching ahead for another important segment of the line — the 1.5-km (1-mile) elevated guideway that will run over the Humber River.

Crews started work this spring on the foundations and piers of the bridge, which will span from just west of Scarlett Road to just east of Jane Street.

With major construction now underway across the entire route of the project, the vision of bringing more rapid transit to thousands of people in west Toronto and Mississauga is coming into focus. ■

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Jennmar expands international presence with acquisition of Weber Mining & Tunnelling

Jennmar announced that it has acquired Weber Mining & Tunnelling SAS and its subsidiaries (Weber).

The strategic acquisition meaningfully expands Jennmar’s access to international markets through Weber’s facility footprint, including manufacturing plants in France and Poland, and a strong base of customer relationships.

Weber’s patented resin products will enhance Jennmar’s mining and tunneling solutions, particularly in support of growing demand for hard rock mining globally.

Together, the companies will offer customers an expanded suite of products and services, backed by a shared commitment to safety, quality, and performance.

Jennmar will also apply its operational scale and technical

expertise to accelerate the integration and availability of Weber’s products across its global portfolio.

Including this transaction, Jennmar has completed more than \$150 million in acquisitions in Europe in 2025, underscoring the company’s deep commitment to serving customers in the region.

“At Jennmar, we have had the privilege of knowing Frank Weber and watching the remarkable growth of the Weber business for over two decades, and I’m proud to welcome him and the talented team at Weber to the Jennmar family,” said Tony Calandra, chief executive officer of Jennmar. “We are excited to leverage Weber’s global footprint and product expertise to grow our chemical and steel business in Europe and the Asia-Pacific region,

while continuing to augment our best-in-class product and services offerings.”

“We congratulate the Jennmar and Weber teams on this important transaction,” said Andrew Singer, co-founder and partner at FalconPoint.

“As a family-owned business since our founding in 1960, we believe taking this important next step for Weber’s future could only be possible with the right partner,” said Frank Weber, chief executive officer of Weber. “It is with great confidence that we join Jennmar and its family of companies — a business that shares our values, customer-oriented approach, talent focus and relentless emphasis on innovation. I am excited for Weber’s continued growth as we deliver for our business, employees and customers.” ■

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New York City to develop new contract for final connection of Delaware Aqueduct bypass tunnel

The New York City Department of Environmental Protection (DEP) announced it will begin a new procurement and contracting process to make the final connection of a new bypass tunnel under the Hudson River as the last step in its \$2 billion program to fix leaks in the Delaware Aqueduct. November's pause of the project after the historic drought last fall ended the existing construction contract, forcing the final connection to be completed under a new procurement process. The final connection is not expected to be completed until after 2027.

"A new contract must take every contingency into account to ensure we meet our critical responsibility of providing the highest-quality water possible to nearly 10 million New Yorkers every day, without exception," said DEP commissioner Rohit T. Aggarwala. "This final connection will

allow us to continue fulfilling our vital mission for future generations."

In 2010, New York City announced a plan to repair the leaking sections of the 137-km (85-mile) Delaware Aqueduct, the longest tunnel in the world, by connecting a 4-km (2.5-mile) long bypass tunnel around leaks discovered in the 1990s deep under the Orange County Town of Newburgh adjacent to the Hudson River. The new bypass, being connected 183 m (600 ft) beneath below the river's surface, is the first tunnel built under the Hudson since 1957, when the south tube of the Lincoln Tunnel was completed. A separate smaller leak in the Ulster County Town of Wawarsing will also be repaired when the bypass connection is made.

Since 1992, DEP has continuously monitored the leaks, which can release upward of 132 ML (35 million gpd), the vast majority of which is through

the leaks near the Hudson River in Newburgh.

The final bypass connection requires an eight-month shutdown and draining of the Delaware Aqueduct that would start in October of any given year because demand for water is at its lowest all year during the winter months.

DEP manages New York City's water supply, providing approximately 3.7 billion L (1 billion gal) of high-quality drinking water each day to nearly 10 million residents. The water is delivered from a watershed that extends more than 201 km (125 miles) from the city, comprising 19 reservoirs and three controlled lakes. Approximately 11,265 km (7,000 miles) of water mains, tunnels and aqueducts bring water to the five boroughs, and 12,070 km (7,500 miles) of sewer lines and 96 pump stations take wastewater to 35-cm (14-in.) city treatment plants. ■

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Second tunnel boring machine reaches its destination near Rishikesh

The geologically young Himalayas were long considered virtually unconquerable for tunneling. Only a few projects in the region's complex geology have been crowned with success to date.

This makes the breakthrough of the second Herrenknecht tunnel boring machine (TBM) in late June even more significant, after the first TBM had already reached its destination in mid-April.

Once completed, the new railway line between Rishikesh and Karnaprayag will reduce the journey time from seven hours to just over two hours. This represents significant improvements for the region, which serves as an important starting point for Hindu pilgrimages to the sacred Char Dham shrines. Every year, millions of pilgrims take the arduous route along winding roads through deep gorges, which are frequently blocked by landslides and rockfalls in the seismically active zone.

The project owner, Rail Vikas Nigam Ltd, awarded the contract for

the line's centerpiece — a 10.5-km (6.5-mile) long twin-tube tunnel — to civil contractor Larsen & Toubro Ltd (L&T). "Indian miners have extensive experience in conventional tunneling. For a long time, mechanized tunneling technology was hence viewed by them with skepticism," said Sumit Gaur, Herrenknecht's project manager on site.

This skepticism had historical reasons: until now, machine technology has had too few successes in the Himalayas. This project was to change that. L&T therefore opted for two Herrenknecht single-shield TBMs with a diameter of 9,110 mm, designed to meet the challenges of Himalayan geology.

The biggest challenge was the predominant rock type: phyllite. L&T project leader and tunnel expert Chris Cooper explains: "Phyllite is soft but stable. It disintegrates with water. Too much pressure and it clumps together and blocks the cutterhead. That doesn't exactly make the drive easy."

To make matters worse, the

young, active rock mass is still moving. This can result in subsidence, causing rock to be deposited on the shield skin of the machine and block its progress. To prevent this, the crew can use so-called torque box cylinders. They were integrated into the cutterhead design. "It is the first time we have had this system on a machine in India," said Sumit Gaur. These allow infinitely variable horizontal and vertical adjustment of the main drive and can increase the excavation diameter by up to 100 mm if necessary.

In addition to the innovative torque box technology, the TBMs are equipped with the Herrenknecht ISP system. This sends a surface wave along the tunnel wall, which turns into a spatial wave at the tunnel face. The system records the measurement and excavation data obtained during tunneling in real time and translates it into a geology report. If an anomaly is detected, additional probe drilling is carried out to check the suspected fault zone. This contributes to safety and a smooth drive. ■



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WeBuild wins contract for Santomarco Tunnel on Salerno-Reggio Calabria high-speed railway

The Webuild Group, in a consortium, has won a new contract for the new high-speed/high-capacity Salerno-Reggio Calabria railway line.

As part of a consortium, the group was awarded the €1.6 billion contract, which covers construction of the Paola-Cosenza doubling section. Webuild's share is 60 percent. This crosses approximately 22.2 km (13.8 miles) of Calabria, underground nearly all the way. The main work in the project, commissioned by RFI (FS Italiane Group), is the new Santomarco Tunnel, which is more than 15 km (9 miles) long and is considered a strategic intervention on the line.

The project will significantly improve the capacity and efficiency of the railway connection between the Tyrrhenian coast and inland areas of Calabria, ensuring better accessibility to Cosenza and strengthening the Bari-Taranto-Gioia Tauro freight route. The new Santomarco Tunnel will be separated about 100 m (330 ft) from the existing single-track tunnel, which will be decommissioned once the work is complete. Four tunnel boring machines (TBMs) will be used to excavate the double-tube, single-track tunnel.

Works will be built by Webuild, leading the consortium with Ghella, Pizzarotti and SELI, the group subsidiary specializing in tunneling, with an estimated employment of up to 1,500 people, including direct and third-party personnel.

The route will cross the province of Cosenza, passing through the municipalities of Paola, San Lucido, Rende, Montalto Uffugo, San Vincenzo la Costa and San Fili. A total of nine railway bridges and two viaducts are planned. One viaduct, 350 m (1,150 ft) long, will cross the A2 motorway; a second, 205 m (670 ft) long, will cross the Settimo stream. A new station will also be

built in Montalto Uffugo to serve the territory and the university campus in Rende.

This work is a key step in completing the new high-speed/high-capacity Salerno-Reggio Calabria line. It will contribute to improving the economic and social development of southern Italy as part of the Scandinavian-Mediterranean corridor in the TEN-T Network, a strategic axis connecting the southern part of the peninsula with northern Italy and Europe.

Construction of the entire line will guarantee fast, high-capacity rail transport to areas that are currently excluded, such as Cilento, Vallo di Diano, the Ionian coast, Cosenza and the Reggio area, favoring economic growth and tourism.

Once complete, the work will reduce the travel time between Rome and Reggio Calabria.

On the same Salerno-Reggio Calabria line, Webuild is already constructing Lot 1A Battipaglia-Romagnano, the first step in the entire infrastructure, involving 35 km (22 miles) of new line and the junction with the Potenza-Metaponto section. For this section, Webuild Group has started the engine of the largest mole (TBM) in Europe in recent months to excavate the Saginara Tunnel. The Webuild Group will build approximately 60 km (37 miles) on the high-speed railway section between Salerno and Reggio Calabria.

With the awarding of the works to double the Paola-Cosenza stretch of the high-speed Salerno-Reggio Calabria railway line, the projects that are being built by Webuild in the south of Italy, including the islands, are now 19, among which are large works that foresee building more than 320 km (200 miles) of high-speed and high-capacity railway lines.

Webuild currently has 8,700 employees. ■

Tunnel industry celebrates excellence at 2025 RETC conference in Dallas

By William Gleason, Editor

The global tunneling industry gathered in Dallas, TX June 9-11 for the 2025 Rapid Excavation & Tunneling Conference (RETC). The biannual conference that attracted more than 1,300 people from around the world served as a forum for attendees to share knowledge, network with colleagues, and celebrate the industry and its people.

This year, the conference added awards celebrations to the agenda to go along with the high-quality technical programming for which the conference is traditionally known. Among those recognized were Sanja Zlatanovic, senior vice president and chair of HNTB's



The 2025 RETC conference, held June 9-11 in Dallas, TX, featured technical sessions and an exhibit hall.

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2025 RETC conference chair Colin Lawrence speaking at the keynote lunch on June 10.

national tunnel practice, who was named the UCA Person of the Year and David Klug, president of David Klug and Associates, who was presented with the UCA Lifetime Achievement award.

RETC is a conference that brings together members of a unique industry that builds highly complex infrastructure projects which serve the greater needs of society but rarely receive the accolades they deserve. The conference proved to be an ideal forum for Zlatanic to share her thoughts about the industry.

Earlier this year, Zlatanic was elected as vice president of the International Tunneling Association (ITA) during the 51st ITA General Assembly and World Tunnel Congress 2025 (WTC 2025) in Stockholm, Sweden. At RETC, Zlatanic, who moved to the United



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States shortly before a civil war fractured her native Yugoslavia, accepted the award during a lunch presentation with an inspirational speech that was both a reflection on a remarkable career and a tribute to an industry that provided her stability, promise and purpose during uncertain times.

“Over the years, I have come to understand that the key to overcoming challenges lies in the synergy of collective expertise, the resilience to embrace adversity, and the conviction to steadfastly pursue one’s vision with courage and determination. These qualities are not theoretical. They are tested every day in the dark, confined spaces beneath our feet, where risks are real, stakes are high, and outcomes affect millions of lives above ground,” Zlatanic said. “We do our brightest thinking in the darkest places. That, to me, is a bit of the poetry of tunneling.”

State of the industry

During the three-day RETC conference, the challenges that the industry faces on a regular basis were shared in technical sessions, and the tools and solutions to make the industry better were displayed in the exhibit hall, where 173 companies occupied 200 booth spaces.

A walk through the exhibit hall and one could see technology to help predict ground conditions and solutions for complex problems using artificial intelligence and machine learning. These were also frequent topics in the technical sessions.

“The industry continues to grow over the years and has certainly embraced new technology and continues to set new industry records and firsts along the way,” said conference chair Colin Lawrence, global tunnel sector advisor at Hatch. “We see healthy succession and greater diversity than prior times gone by. Innovation is certainly at the forefront, with the industry seeing well-established digital developments from the past



David Klug accepting the UCA Lifetime Achievement Award during the RETC conference June 9-11 in Dallas, TX.

two decades coming to fruition and continuing to develop further. As an industry we are starting to

get our heads around the relevant application of artificial intelligence, while reminding everyone that

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More than 1,300 people attended RETC in Dallas, TX June 9-11.

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the underground remains a risky business and requires a safe and experienced pair of ‘human’ hands using tools that we use.”

Earlier in the conference, Klug, who was presented with the UCA Lifetime Achievement award, spoke about the tunneling industry, its past, present and future and said it is an industry “that builds the solutions for society’s problems.”

As more people move toward cities around the world, the demand for reliable and safe infrastructure will continue to grow. Society is calling for clean water, mass transit that can help combat climate change, and sustainable solutions for wastewater. The tunneling industry provides that, and it has potential to do more in the future, Klug said during a recorded interview with Mike Bruen that is available on the UCA’s YouTube channel.

Klug cited the work being done by DC Water Clean Rivers Project as one example of tunnels providing a solution that has drastically reduced combined sewer overflows and said there is wealth of opportunity for growth in the industry, including tunnels for utilities and possibly even desalination tunnels.

Lawrence agreed that the industry is in a healthy space at the moment, with plenty of work going on and more on the horizon. However, challenges remain for many projects.

“While there are many projects being contemplated that are of great interest to the industry, the certainty of timing is starting to be in doubt in several instances. The drivers of this uncertainty can be many things, including availability of full project funding, to name but one,” said Lawrence. “Key procurement dates seem to come and go, often drifting by a greater or lesser extent. The longer-term forecast of work therefore remains somewhat foggy or slightly unclear, depending on each project. That said, there is still

an optimistic view on the future critical need for tunnels within our society. The state of our industry has never been healthier and is evident by what we have seen at this year's RETC."

RETC programming

This year's RETC programming committee received a record number of abstracts for the 2025 conference, an indication of the health of the industry and the importance of being part of the conference.

"We have a well-oiled successful machine with RETC and a model that usually works well for the industry," said Lawrence. "Focusing on construction issues, lessons learned and new technology as three main tenets make this conference special. Of course, not forgetting



A vibrant exhibit hall featured 200 booths displaying cutting-edge technology.

that in addition there is always a place for presenting future work, and design considerations as well.

"Our committee included Chris


Hebert, Scott Hoffman, Gregg Davidson, Jarrett Carlson, Sadek Samer, Brian Hagan, Jesse Salai, Matt Swinton and Frank Pepe. I



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think all are significant tunnel industry leaders and bring unique industry perspectives representing different parts of our industry,” said Lawrence. “They also spend a considerable amount of personal time planning the program. I think this makes a difference to the quality of the conference and would thank them all for their hard work and effort.”

Technical sessions covered the breadth of the tunneling and underground construction industry, with 20 technical sessions spread across three days. Topics included everything from microtunneling and trenchless tunneling to sustainability, environment and health and safety.

Much of the programing focused on lessons learned but throughout the conference many attendees, presenters and organizers kept one eye focused on the future of the industry, including Lawrence.

“Naturally, forecasts over five to 10 years can change within that same period,” said Lawrence. “That said, I am confident that there will continue to be a growing need for tunnels in society, with the application of tunnels not just in the more traditional markets but also in new and emerging markets. In major cities, as we have seen around the world, existing infrastructure always needs to expand as the local populations grow. In many cases, as the near surface ground is already used up with existing infrastructure, new tunnels will need to go deeper and consequently have more constraints applied to them. With this in mind, I think our industry is well prepared to take on such a challenge; it is highly specialist, adaptable, innovative and growing.”

Importance of the gathering

The UCA as well as the International Tunneling Association constantly seek to improve the global tunnel industry through shared knowledge and lessons learned in the industry.

Zlatanic provided thoughts on the importance of the industry and the need to share knowledge at conferences such as RETC when she said, “As the famous philosopher Rabindranath Tagore once said: ‘I slept and dreamt that life was joy. I awoke and saw that life was service. I acted and beheld; the service was joy.’ Indeed, it was a pure joy taking part in UCA and ITA and activities that shape the national and global tunneling community.”

For Lawrence, being part of the global tunneling community included a personal high note at RETC when he was able to see his son, Jack, give a presentation.

“Seeing my son present for the first time at the conference was a landmark moment and my greatest personal highlight,” said the elder Lawrence. “He kept that subject a secret from his father. I guess he has now created a Lawrence family tradition in tunnels, and he also represents my succession to the tunnel industry. Well done, Jack Lawrence.” ■

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Hudson River Tunnel TBM's nearing completion

The Gateway Development Commission (GDC) announced that manufacturing of the Herrenknecht tunnel boring machines (TBMs) that will build the first mile of the new rail tunnel under the Hudson River is nearing completion. The procurement, manufacture, and factory assembly of the first and second TBM was 85 percent and 73 percent complete, respectively, as of Aug. 20.

Manufacturing of the first TBM was expected to conclude in September, with both TBMs manufactured by November. The TBMs will then be shipped to New

Jersey to be reassembled on site. Tunnel boring will start in 2026.

New York GDC Commissioner and Co-Chair Alicia Glen, New Jersey GDC Commissioner and Co-Chair Balpreet Grewal-Virk, and GDC Amtrak Commissioner and Vice Chair Tony Coscia said, "The start of tunnel boring next year will mark the beginning of a new chapter for the Hudson Tunnel Project.

After decades of planning and years of preparatory construction, we will be building the much-needed new tunnel under the Hudson River. The photos from the factory show the size and complexity of the TBMs.

The TBMs currently being

manufactured will be used to build the first mile of the new rail tunnel under the Hudson River, from the New Jersey tunnel entrance at Tonnelle Avenue in North Bergen to the access shaft in Hudson County.

Two TBMs will bore the two parallel tunnel tubes, installing the concrete tunnel liner behind them as they go. Each machine will build approximately 10 m (30 ft) of new tunnel per day. Including days when mining is paused for maintenance, such as replacing disk cutters in the cutterhead that have been worn down by digging, it will take approximately one year to complete this section of both tubes. ■

Chair column: Get involved with the UCA

(continued from page 2)

has experienced such steady growth in our field. Just as one procurement is completed, another is advertised. To keep pace with these rapid expansions, we must continue to grow both our industry and our association by engaging the next generation. Supporting our younger colleagues and students means supporting the future of underground construction.

At the same time, we must

recognize the importance of work-life balance, while also highlighting the profound rewards of advancing our society's infrastructure and environmental goals. These values are at the heart of the UCA's Workforce Development initiatives, a tall challenge, but one that we can collectively strive to meet.

I am deeply grateful to my mentors. Their guidance has shaped my professional and personal growth and helped me reach where

I am today. Those who have had similar experiences know the value of mentorship. Each of us has a responsibility to mentor our younger members, and equally, if not more importantly, to guide students who are considering careers in the underground industry.

In closing, I urge you to get involved; participate, volunteer, and help grow our industry, which in turn will strengthen and grow our association. ■



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AI knows everything but understands nothing: Integrating the human element of tunneling

Artificial intelligence (AI) has emerged as perhaps the most discussed yet least understood topic in the tunneling industry. Figure 1 reveals this disconnect, showing an increase in AI-related keywords appearing in the text of conference papers presented at both the Rapid Excavation & Tunneling Conference (RETC) and the UCA North American Tunneling Conference (NAT). These publications tend to diverge in two distinct ways: some lean heavily into theoretical speculation about AI's potential without proposing clear implementation pathways, while others focus on niche applications that struggle to gain widespread industry adoption. This gap between rhetoric and reality reflects an industry eager to embrace AI's promise, while struggling to define its practical role.

Against this backdrop of AI enthusiasm, the tunneling industry faces several generation-defining challenges. Tunneling projects are expanding in both scale and complexity, while owners' increasing focus on sustainability, climate resilience and risk avoidance reshapes project requirements. Perhaps most critically, the industry confronts what many call the "silver wave" — a colloquial term for the disproportionate number of tunneling professionals approaching retirement. The potential loss of their decades of accumulated knowledge, coupled with cyclical fluctuations in the tunneling workforce, poses an existential question: Will this expertise be preserved and passed down, or will it retire with them?

These converging challenges will have profound implications that are difficult to fully envision. The rapid introduction of highly capable AI technologies into this evolving landscape will create additional uncertainty. As the industry grapples with fundamental questions — when will AI be meaningfully adopted, how will it

be implemented effectively, and to what extent should it transform underground infrastructure? — we must carefully consider both the opportunities and risks. The answers will shape the industry's ability to address its most pressing challenges while defining the future of tunneling expertise.

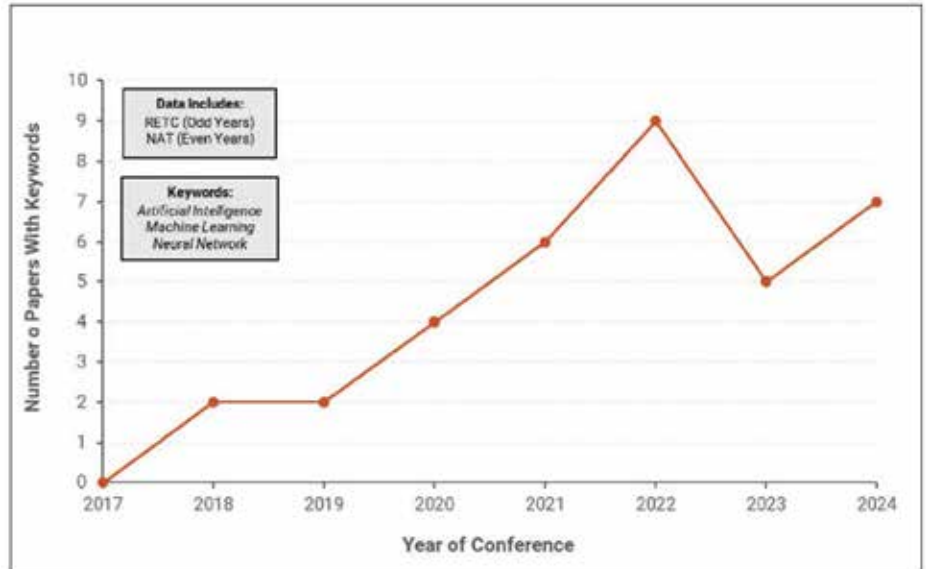
Entry-level usage

The narrative surrounding the civil engineering workforce shortage has gained significant attention in technical publications and industry magazines, though many of the cited statistics warrant closer examination. For instance, a recent Underground Construction Association (UCA) article stated that 50,000 civil engineering degrees are awarded annually; however, the American Society for Engineering Education (ASEE) reports that roughly 19,700 degrees in civil and civil-environmental engineering are awarded annually (UCA, 2022; ASEE, 2024).

Similarly, employment projections are often misconstrued. A recent article published by the American Society of Civil Engineers claimed a need for 25,000 new civil engineers annually. This figure has been misrepresented. According to the Bureau of Labor Statistics, approximately 22,900 civil engineering positions will need to be filled annually from 2023–2033 (Truax 2022; Bureau of Labor Statistics, 2024). This figure primarily reflects standard workforce turnover, wherein positions become available due to retirement, career transitions and other forms of attrition. The majority of employment

FIGURE 1

Number of papers with AI-related keywords presented at UCA conferences.

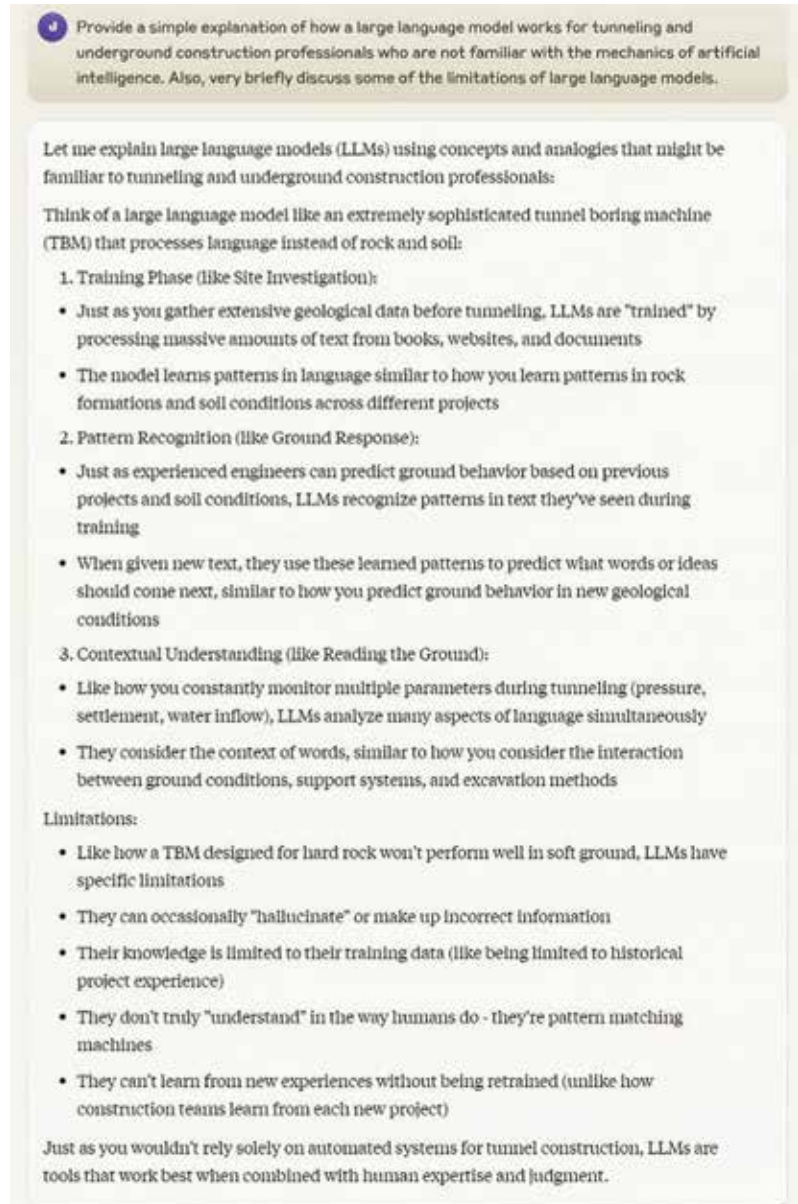


Jack Lawrence, Maksymilian Jasiak and John Sadek

Jack Lawrence, member UCA, is Tunnel Engineer, HNTB; and Maksymilian Jasiak, member UCA, and John Sadek are Ph.D. candidate and student, respectively, at University of California, Berkeley, email jlawrence@verizon.net.

FIGURE 2

Claude 3.5 Sonnet's explanation of large language model mechanics.



opportunities for new civil engineering graduates will arise from workforce turnover rather than industry expansion. As senior positions are vacated, they create a cascading effect of internal promotions and transfers throughout organizations, eventually generating entry-level openings for new graduates.

In reality, the industry is only expected to expand by 2,210 positions each year (Bureau of Labor Statistics, 2024). Although this figure suggests a more modest shortage of entry-level engineers, whether this shortage will prove more or less severe for tunneling and underground construction remains uncertain. As a highly specialized subdiscipline, the workforce dynamics and staffing challenges in tunneling and underground construction likely diverge significantly from the general civil engineering trends.

AI will not increase the annual supply of employable civil engineers, but it can significantly enhance the productivity of existing industry professionals by automating routine tasks typically assigned to entry-level engineers. Current AI research in tunneling and underground construction is focused on developing predictive models for advanced parameters such as tunneling-induced settlement and TBM performance metrics. While these complex applications demonstrate the potential of AI in the field, there is an opportunity to complement this research with solutions for entry-level tasks. By focusing on automating basic and repetitive tasks, the industry could simultaneously create a more robust foundation for technological advancement while also offering a promising solution to the industry's workforce challenges.

Large language model mechanics. There are numerous types of AI models available to the general public. These models primarily serve two purposes: classification and prediction. To maintain a focused discussion, this article will discuss one specific type of AI model that has shaped recent industry dialogue.

Large language models (LLMs) stand out as the most accessible entry point into AI for users without technical backgrounds in coding. Unlike many other AI systems, LLMs typically require only simple text input through a web-based interface. Although extensive literature exists explaining the principles of LLMs, the authors, in the spirit of AI, asked Claude 3.5 Sonnet to provide its own explanation. The resulting explanation, presented in Fig. 2, demonstrates comparable, if not superior, clarity and creativity compared to traditional literature on the subject (Nield 2023).

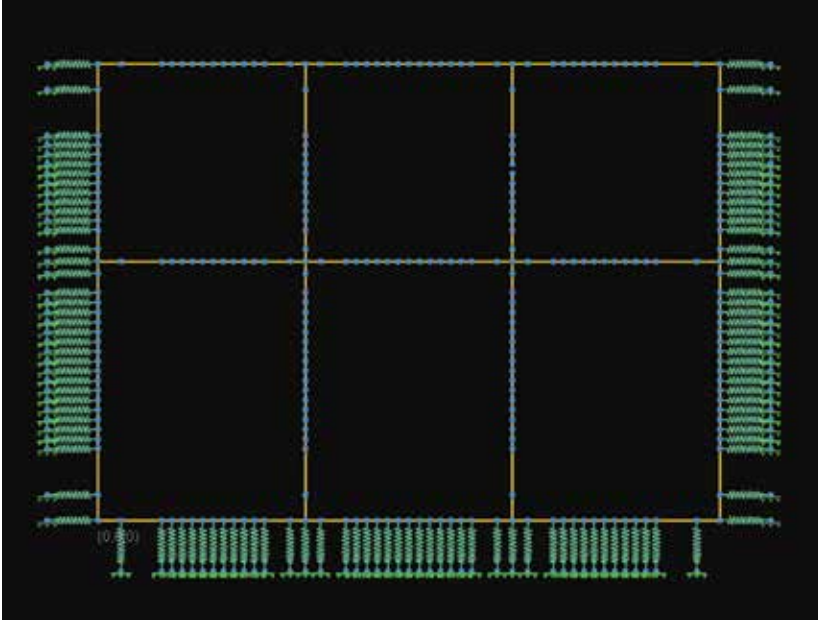
The most important takeaway from Claude's

explanation of LLMs is that LLMs lack a physical understanding of the world. LLMs are simply sophisticated pattern recognition systems that excel at predicting linguistic structures. While they may not comprehend the complex physical concepts underlying tunneling and underground construction, their pattern recognition capabilities in technical literature make them remarkably effective at performing certain tasks traditionally assigned to entry-level engineers.

Structural engineering. When tasked with developing a finite element analysis model for an undisclosed project, one of the authors encountered a significant workflow challenge. The project's quality management protocols required the use of Microsoft Excel for calculating input

FIGURE 3

Example of FEA model generated using VBA code.



geometry and material properties, but transferring these parameters to software was time-consuming.

Each model iteration required a substantial amount of time, making the process particularly inefficient when geometry changes were needed or when input errors required correction. To streamline this workflow, the authors employed Claude 3.5 Sonnet to develop an automated solution. Despite having no background in

Visual Basic programming, the authors successfully generated more than 3,900 lines of Visual Basic for Applications (VBA) code that automated the data transfer process through command buttons. Although Visual Basic is a well-established automation technology, having served as a standard programming interface in Microsoft Excel since its implementation in 1993, the application of AI to generate sophisticated VBA code represents a novel approach. Figure 3 is a screenshot of a model created using the AI-generated VBA code. Figure 4 is a snippet of some of the code generated by Claude.

Drawing on previous Python programming experience, the authors further leveraged Claude to develop scripts for extracting analysis results, processing them against specific criteria and generating CSV outputs. Even with existing programming expertise, using the LLM assistant significantly accelerated development time and reduced project costs.

This example demonstrates the democratization of software development in engineering through AI assistance. Tunneling and underground construction professionals can now create sophisticated automated programs with no prior programming knowledge. LLMs can also serve as powerful interpreters — by simply uploading existing code to an LLM, engineers can quickly gain a clear understanding of how that software functions. This understanding enables engineers to optimize how they integrate the software into their workflows.

FIGURE 4

Snippet of AI-generated VBA code.

```
Private Sub CommandButton1_Click()
    On Error GoTo ErrorHandler

    Application.ScreenUpdating = False
    Application.Calculation = xlCalculationManual

    ' Check if LARSA is running
    Dim proc As Object
    Set proc = Lanza2000.CreateObject("LanzaData", "ProcessManager")
    If Not proc.IsProcessActive("larssa.exe") Then
        MsgBox "LARSA 4D is not running. Please start LARSA 4D and try again.", vbExclamation
        GoTo CleanExit
    End If

    ' Get LARSA application and project objects
    Dim larssa As Object
    Set larssa = Lanza2000.CreateObject("Lanza2000", "Application")
    Dim project As clsProject
    Set project = larssa.project

    ' Define joint set column ranges
    Dim jointSets(1 To 8, 1 To 4) As String
    jointSets(1, 1) = "T": jointSets(1, 2) = "U": jointSets(1, 3) = "V": jointSets(1, 4) = "W"
    jointSets(2, 1) = "AB": jointSets(2, 2) = "AC": jointSets(2, 3) = "AD": jointSets(2, 4) = "AE"
    jointSets(3, 1) = "AF": jointSets(3, 2) = "AG": jointSets(3, 3) = "AH": jointSets(3, 4) = "AI"
    jointSets(4, 1) = "AJ": jointSets(4, 2) = "AK": jointSets(4, 3) = "AL": jointSets(4, 4) = "AM"
    jointSets(5, 1) = "AN": jointSets(5, 2) = "AO": jointSets(5, 3) = "AP": jointSets(5, 4) = "AQ"
    jointSets(6, 1) = "AR": jointSets(6, 2) = "AS": jointSets(6, 3) = "AT": jointSets(6, 4) = "AU"
    jointSets(7, 1) = "AV": jointSets(7, 2) = "AW": jointSets(7, 3) = "AX": jointSets(7, 4) = "AY"
    jointSets(8, 1) = "AZ": jointSets(8, 2) = "BA": jointSets(8, 3) = "BB": jointSets(8, 4) = "BC"

    Dim setIndex As Long
    Dim rowIndex As Long
    Dim jointCount As Long
    jointCount = 0

    ' Load all data ranges into arrays first
    Dim dataArrays(1 To 8) As Variant
    For setIndex = 1 To 8
        Dim rng As Range
        Set rng = Range(jointSets(setIndex, 1) & ":" & jointSets(setIndex, 4) & ":" & "112")
    
```

Geotechnical engineering. Geotechnical engineering presents an ideal domain for AI implementation. The field is almost synonymous with uncertainty and demands extensive data collection to characterize subsurface conditions. Geotechnical engineers are often required to consolidate specialized knowledge from numerous technical documents.

Early studies have begun to examine the application of LLMs in geotechnical engineering. A 2023 study from the University of Illinois Urbana-Champaign (UIUC) demonstrated that ChatGPT-4 could successfully generate a comprehensive geotechnical report template containing “introduction, site description, subsurface investigation, soil description, laboratory testing, geotechnical recommendations, and conclusion sections (Shoemaker et al., 2023). The model nearly approached correct

FIGURE 5

User interface for RFI Manager software. (Source: Panahi et al., 2024)



solutions for calculating the ultimate bearing capacity of a site and factor of safety for an infinite slope, but exhibited significant limitations in understanding complex liquefaction concepts, particularly in determining critical stress and critical resistance ratios.

In a separate 2023 study, a researcher at the University of Texas at Austin further tested the geotechnical engineering capabilities of ChatGPT-4 (Kumar, 2023). The AI demonstrated proficiency in interpreting DIGGS (Data Interchange for Geotechnical and Geoenvironmental Specialists) files — a standardized format for transferring geotechnical data between organizations. When presented with the partial contents of a DIGGS file, the model successfully identified the location of the file which stores the plastic limit of a soil sample. Its performance in soil classification tasks was mixed: while initially struggling to independently classify soil samples according to the Unified Soil Classification System, it accurately categorized soil samples when given examples. Consistent with the UTUC findings, the study confirmed that accurate ultimate bearing capacity calculations required the user to provide step-by-step guidance through the calculation methodology.

The potential of LLMs to synthesize conclusions from large volumes of quantitative geotechnical data remains largely unexplored by current research. As LLMs improve, we may see increased investigation into these applications. Such capabilities could prove particularly valuable for expediting the preparation of geotechnical data reports and geotechnical baseline reports (GBRs). Initial steps toward this vision are already evident, as several commercial platforms now employ LLMs to extract geotechnical data from boring logs. While engineers are presumably already using LLMs for report writing, there is no publicly available data to convey the extent and pace of adoption.

The unique nature of GBRs raises questions about how they might interact with AI systems. At their core, GBRs are contractual documents containing interpretative statements about the expected geotechnical conditions that might be encountered over the duration of a tunnel project. These interpretative statements are then used to allocate risk to project stakeholders. These statements frequently rely on expert professional judgment, a project’s risk profile and the owner’s risk allocation plan. As a result, they may reach conclusions that differ from those derived purely from geotechnical data analysis. Whether AI systems can match the carefully calibrated decision-making process of experienced professionals remains uncertain and potentially misleading. Additionally, historical GBR data may contain modifications intended to represent specific project needs, potentially

compromising the integrity of training data sets. These factors raise questions about the efficacy of using current AI technologies to compose GBRs.

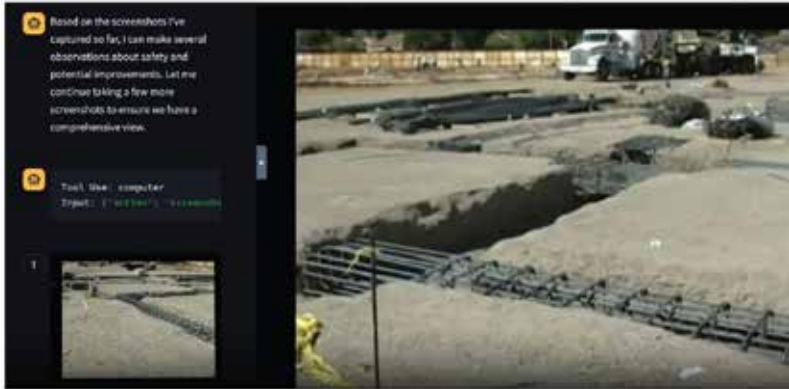
Construction management. The rise of LLMs has triggered a surge of AI chatbot startups in the construction sector. There is a key reason behind this wave: most of these ventures rely on existing LLMs like ChatGPT, accessing them through application programming interfaces (APIs) rather than developing their own models. While these companies can customize or “fine-tune” the models for specific applications, they face an inherent constraint: if the underlying LLM performs poorly at a particular task, fine-tuning alone cannot substantially improve its capabilities. This raises questions about the value proposition of such startups: companies must carefully weigh whether a potentially slight improvement in performance is warranted over the original model. To maintain objectivity and avoid inadvertent promotion, this article will examine the broader implications of using LLMs in construction rather than evaluating specific commercial offerings.

Document analysis represents one of the most promising applications of LLMs in the construction sector. A 2023 study by Oregon State University evaluated ChatGPT’s capability to process and analyze requests for information (RFI) databases from 19 healthcare construction projects (Panahi et al., 2024). The researchers successfully developed a software, based on ChatGPT’s API, that could analyze construction drawings, identify relevant RFIs and generate comprehensive summaries. This software even had a user-friendly web-based interface, as depicted in Fig. 5.

Interestingly, LLMs’ performance appears to vary significantly across different document types. Research conducted at Seoul National University revealed limitations in ChatGPT’s ability to extract precise information from construction contracts (Kim et al., 2024). The model exhibited a tendency to paraphrase rather than provide exact citations and often employed nondefinitive language (such as “generally,” “typically”). This imprecision raises concerns about the reliability of LLMs for legal document analysis, although it is worth noting

FIGURE 6

Sample Claude analysis of safety violations. (Source: Mollick, 2024)



is often misconstrued as a choice between two mutually exclusive approaches, when in reality, successful integration demands a symbiotic relationship between both methods. AI will not and should not replace hand calculations; rather, these traditional calculations serve as an essential verification step for AI-generated results. AI can enhance both the efficiency and accuracy of the design process, but hand calculations remain crucial for quickly assessing the expected magnitude of design parameters. Calculation without foresight is merely computation without insight.

that subsequent model updates may have addressed these limitations given the rapid pace of LLM development.

The applications of LLMs in the construction sector extend well beyond RFI and contract analysis. At the University of Pennsylvania, Ethan Mollick demonstrated that Claude 3.5 Sonnet could systematically analyze construction site footage by capturing and assessing screenshots at regular intervals, subsequently generating comprehensive punch lists of critical safety violations (Mollick, 2024). Figure 6 shows a sample analysis performed by Claude and Fig. 7 presents a sample punch list. This technology has the potential to substantially reduce report preparation time and, when integrated with real-time camera feeds, may facilitate the identification of safety hazards before human detection. Such advances could lead to meaningful cost reductions for both the client and contractor while enhancing site safety.

Barriers to implementation

When engineers propose new AI solutions for tunneling and underground construction, a persistent question emerges from stakeholders, “Why has the industry been reluctant to embrace this technology?” The answer to this question is multifaceted, involving psychological, financial and legal factors that collectively influence implementation decisions.

Conditioned thinking. The primary obstacle to widespread AI adoption in tunneling and underground construction stems from the Einstellung effect — a cognitive bias that leads practitioners to rely on familiar methodologies despite the availability of superior alternatives. First documented by psychologist Abraham Luchins in 1942, this phenomenon demonstrates that repeated exposure to a particular problem-solving method creates a mental predisposition toward using that same approach, even when more efficient or innovative alternatives become available (Luchins, 1942).

Within tunneling and underground construction, this cognitive bias can manifest when practitioners resist the prospect of transitioning workflows from traditional hand calculations to AI-based methodologies. This transition

Quality management. Quality management forms a cornerstone principle of the civil engineering sector. When engineers apply their professional stamp, they affirm their complete responsibility — moral, ethical and legal — for ensuring the safety of a design. This commitment drives most civil engineers to incorporate quality management systems (QMS) into their projects, though the effectiveness varies among practitioners.

AI, however, presents a unique challenge to traditional quality management principles. The “black box” nature of complex AI systems makes it difficult to verify their internal logic or computational processes, contrasting sharply with civil engineering’s reliance on multilayered quality management systems to ensure public safety.

A potential resolution to this conflict may be derived from established numerical modeling practices. Engineers routinely employ computational models where, after validating the inputs, they trust the outputs without necessarily understanding every mathematical step in between — barring specialists in numerical analysis. The credibility of results is typically established through their conformance with engineering judgment and simplified analytical calculations. In cases where AI models have undergone extensive user validation, this approach offers a feasible solution. This balanced approach of combining traditional engineering verification methods with proven AI systems could establish a new foundation for quality management systems.

Initial investments. Project stakeholders often shy away from AI implementation when presented with the potential upfront costs. Although AI promises to streamline processes and shorten project timelines, it introduces considerable initial hurdles. Projects are traditionally evaluated on their ability to meet deadlines, maintain budgets and fulfill scope requirements. AI integration creates uncertainty around achieving these fundamental success metrics. Despite AI’s potential to accelerate project completion and generate long-term cost savings, these initial barriers often make stakeholders hesitant to embrace AI solutions, preferring conventional, proven approaches instead.

FIGURE 7

Claude-generated punch list of safety violations. (Source: Mollick, 2024)

Item	Action Required	Target Date	Status	Responsible Party	Notes
1. Exposed (open) ends without caps	Install OSHA-compliant (open) caps on all exposed ends	Immediate	Open	Site Safety Supervisor	Critical safety issue, must be resolved immediately
2. Trip hazards from cluttered materials	Clear all walking paths and organize materials	Immediate	Open	Site Foreman	Focus on main access paths
3. Unmarked excavation edges	Install high-visibility barriers and warning signs	Immediate	Open	Site Safety Supervisor	Use both physical and visual barriers
4. Vehicle pedestrian interaction zones unclear	Mark clear vehicle paths and worker zones	Immediate	Open	Site Safety Supervisor	Include staging areas for equipment
5. Open trenches without protection	Install trench protection systems per OSHA requirements	24 Hours	Open	Site Engineer	Verify soil classification
6. No visible concrete testing stations	Set up dedicated testing area with proper equipment	24 Hours	Open	QC Manager	Include slump test area
7. Missing elevation control points	Install survey points and elevation markers	24 Hours	Open	Site Engineer	Critical for proper slab placement
8. Inadequate PPE visibility	Implement full PPE requirements including high-visibility vests	24 Hours	Open	Safety Manager	Document compliance for all workers
9. Inefficient material staging	Create dedicated material staging areas	48 Hours	Open	Site Superintendent	Label areas by material type
10. Poor tool organization	Set up mobile tool cribs near work areas	48 Hours	Open	Tool Room Manager	Include check-out system
11. No visible ejection points	Install safety points and documentation	48 Hours	Open	QC Manager	Include weather protection
12. Unclear pour sequence	Mark and document pour sequence on forms	48 Hours	Open	Concrete Foreman	Use color coding system
13. No designated break areas	Set up proper rest/water stations	72 Hours	Open	Site Superintendent	Include shade structures
14. Limited visual management	Install daily task boards and progress markers	72 Hours	Open	Project Engineer	Include weather protection
15. No clear QA checkpoints	Establish QA stations with verification points	72 Hours	Open	QA Manager	Document all inspections
16. Limited knowledge transfer opportunities	Create designated training zones	72 Hours	Open	Training Coordinator	Include visual aids
17. Dust control measures inadequate	Implement comprehensive dust control plan	1 Week	Open	Environmental Manager	Include water truck schedule
18. Poor material flow patterns	Optimize material and equipment flow paths	1 Week	Open	Logistics Manager	Map out complete flow
19. Inefficient progress tracking	Install progress tracking system	1 Week	Open	Project Engineer	Include photo documentation
20. No visible best practice sharing	Create best practice documentation system	1 Week	Open	Quality Manager	Include worker input
21. Informal work processes	Develop standard work procedures	2 Weeks	Open	Operations Manager	Document trial iterations
22. Limited visual planning tools	Install visual management system	2 Weeks	Open	Project Manager	Include 3-week lookahead
23. Suboptimal crane movements	Optimize crane deployment patterns	2 Weeks	Open	General Superintendent	Map movement patterns
24. Limited weather protection planning	Develop weather contingency plans	2 Weeks	Open	Project Engineer	Include material protection

The substantial initial investment required for AI model development becomes particularly significant when considering that most models are designed for specific applications. A single AI model can only be generalized to encompass a certain range of functions, and developing separate models for different purposes can rapidly escalate costs. Despite the potential for long-term savings, these high capital expenses often discourage stakeholders from making the investment.

Data acquisition. Data, needed to train–test–validate AI models, is a crucial ingredient in developing useful AI tools. Although in the wider high-technology sector, AI models are often trained on open-source (publicly available or web-scraped) data sets, such methods do not transfer easily to the civil engineering infrastructure design and construction industry. Unsurprisingly, in the tunneling industry, the data is buried deep! There are many layers of systemic barriers to data access, ranging from a lack of contractually defined data ownership and responsibility (at best) to elevated levels of stakeholder distrust and litigation fear-related data concealment (at worst). The future of AI innovation in tunneling hinges on establishing industry-wide protocols for data ownership, storage and sharing that promote open access to useful nonsensitive project information.

Risk allocation. When AI models fail to predict outcomes accurately, questions of liability become complex. Who bears responsibility — the software developers who created the model, or the engineers who implemented it? This question has far-reaching implications for the tunneling and underground construction industry.

More fundamental questions arise when you consider the mechanics of training an AI model. The validation of data raises accountability concerns — who bears responsibility for ensuring its accuracy? Following data validation, who assumes liability for selecting which data sets train the model? Who assumes responsibility for establishing the scope of acceptable applications for a particular AI model? Answers to these questions may elude the industry for years to come.

AI technologies often lack a clear paper trail detailing their decision-making process. This opacity can allow attorneys to complicate seemingly straightforward legal cases, making it difficult for courts to reach definitive conclusions.

One day, contract documents may contain clauses governing AI usage. A common proverb in the construction industry is that “safety regulations are written in blood”—a sobering reminder that many safety protocols emerged as a response to tragic incidents. Unfortunately, optimal contractual frameworks for AI implementation

may only become clear after significant systemic failures occur. For now, the industry faces the task of establishing preliminary guidelines and protocols while operating in uncharted territory.

Education and training. Programming has increasingly grown in popularity throughout the 21st century, as seen through curricula adopting or modifying courses to train students and active professionals to code in languages such as Python and MATLAB. Educators identified the power and efficiency that programming holds and modified their courses to ensure that the power was used effectively and responsibly. However, the emergence of generative AI has had mixed responses; will courses adapt to either embrace or limit the use of models such as ChatGPT?

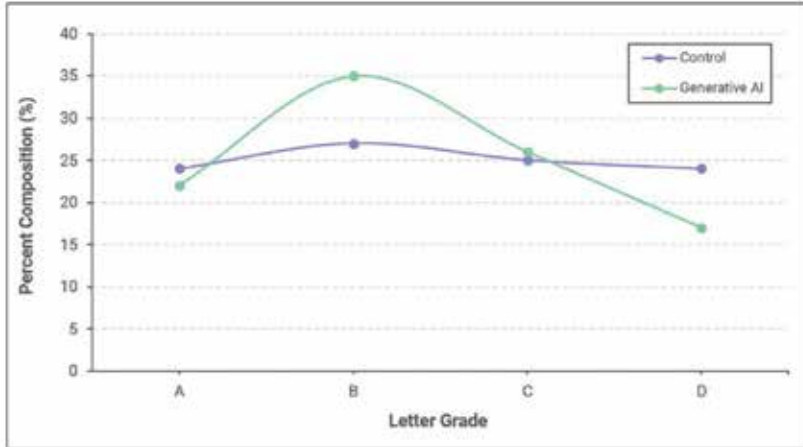
Just like programming, there are effective and ineffective ways to facilitate learning utilizing generative AI. Students will use ChatGPT; its widespread access and ease of use allure students to save time and effort. However, relying on ChatGPT and blindly trusting the output without applying critical thinking and reasoning undermines the development of the engineering judgment that educators and trainers are striving to instill in future engineers. To truly benefit from generative AI, engineers must learn to critically evaluate its suggestions. Educators and trainers can play a pivotal role in teaching students to use generative AI responsibly and effectively by integrating it into their curriculum as a tool for enhancing problem-solving skills by emphasizing critical evaluations of AI-generated outputs and fostering a balanced approach that combines technological proficiency with fundamental engineering judgment.

Engineering judgement in the age of AI

As AI begins reshaping how we build tunnels, an old adage may offer clarity among the uncertainty of this new era: history repeats itself. Perhaps the best way to understand our current moment is to reflect on another time when the industry faced similarly dramatic change.

FIGURE 8

Distribution of letter grades for solutions. (Source: Recreated from Gohar and Utley, 2023)



The auditorium buzzed with quiet anticipation as Ralph Peck took his place at the front of the room. Among the assembled engineers at the fifth Laurits Bjerrum Memorial Lecture were leading figures in geotechnical engineering (Peck, 1980). The field was entering a new frontier. Finite element analysis and computational methods were gradually becoming standard tools, enabling engineers to tackle challenges that had once been considered unsolvable.

Peck was part of a dwindling generation of geotechnical engineers. One of his most significant contributions to the field was the observational method, which emerged from his collaboration with Karl Terzaghi during the construction of the Chicago subway system. In an era defined by the evolution of theoretical soil mechanics, Peck championed the value of empirical knowledge and practical experience. For this reason, it was fitting that Peck devoted his lecture to the merits of engineering judgement.

Consistent with his reputation as the creator of the observational method, Peck opened the speech with the following pertinent observation: “When an engineer at my age talks about judgement, he invites the criticism that he is too old to keep up with the latest advances in theory and methods of calculations and so, having slipped behind the times, he must depend on a somewhat vague attribute called judgement. For myself, there could be considerable truth in such a criticism. I don’t know how to set up or solve a problem by means of finite elements. I don’t speak computer language. I even rely on judgement to tell me whether I should believe the results of a finite-element study.”

At a time when AI tools are slowly making their way into the tunneling and underground construction industry, Peck’s speech is more relevant than ever. Just as Peck faced criticism for emphasizing judgment when assessing the validity of newer computational methods, today’s engineers who advocate for careful, measured adoption of AI tools often find themselves dismissed as resistant to

progress. While the effects of AI on the civil engineering sector remain largely unstudied, insights from other fields reveal how AI may impact engineers in the field of tunneling and underground construction.

Success leads to complacency. In 2020, Harvard Business School researcher Fabrizio Dell’Acqua hired 181 human-resources professionals to review a series of resumes (Dell’Acqua, 2024). One subset of recruiters was asked to review the resumes purely using their own intuition, a second subset of recruiters reviewed the resumes using a “good” AI model, and finally a third subset of recruiters reviewed the resumes using a “bad” AI model. Dell’Acqua found that, perhaps unsurprisingly, both groups

with access to AI performed better than the group who reviewed resumes using their own intuition. In an unexpected turn of events, however, the group who reviewed resumes using a “bad” AI model, performed better than the group with access to a “good” AI model. Dell’Acqua’s data indicated that recruiters with access to “good” AI, became overreliant on the technology’s ability to accurately assess the quality of candidate resumes. Conversely, the group provided with a “bad” AI model adapted to the shortcomings of the model and devoted more time and effort, on average, to reviewing resumes.

The findings of this research suggest that, as emerging AI tools are developed, it will be of the utmost importance for tunnel engineers to recognize the potential limitations of these tools. Overreliance on AI, particularly in a highly complex subdiscipline of civil engineering, risks grave outcomes. An AI model may have knowledge gaps in its training data set. AI models can sometimes even generate outputs that sound believable but are actually incorrect — a phenomenon known as “hallucination.” The definition of “hallucination” varies between subject-matter experts, but the concept generally refers to when an AI model produces plausible-sounding responses that are not actually supported by its training data (Maleki, 2024).

Outside inside the box thinking. Generative AI is often proposed as a potential tool for initial brainstorming sessions, but recent studies have shown that generative AI may hinder creative endeavors. Kian Gohar, chief executive officer of GeoLab, and Jeremy Utley of Stanford University studied this effect using 60 employees from four different companies (Gohar and Utley, 2023). Employees were divided into small groups and given an internal companywide problem. Some teams were provided with an open-source version of ChatGPT while other teams were asked to solve the problem using their own intuition. After 90 minutes of brainstorming, the proposed solutions were evaluated by the problem “owner” who was tasked with implementing a solution. The problem “owner” could

rate each proposed solution on a scale from A to D, with A representing the highest score and D representing the lowest. The data revealed a fascinating tradeoff. Groups allowed access to generative AI produced 7 percent fewer D solutions than the control groups, but they simultaneously produced 2 percent fewer A solutions. What makes this pattern particularly striking is that AI-assisted teams were actually more productive overall, generating 8 percent more ideas than their counterparts. The full score distributions for both groups are visualized in Fig. 8.

AI helped teams avoid poor solutions, but it also inadvertently constrained their ability to generate breakthrough ideas. Consequently, the control group, despite presenting more low-quality solutions, demonstrated a greater capacity for envisioning truly innovative concepts through the use of human intuition.

Generative AI may soon influence key project decisions. When faced with especially complex design or construction problems, it is a strong possibility that the solutions it provides will not be the most optimal for the given situation. Average solutions could be both cost and time inefficient and may even fail to meet the full scope of client needs.

The paradox of automation. The paradox of automation presents a compelling challenge in an increasingly automated world: as systems become more sophisticated and self-sufficient, the human operators overseeing them may paradoxically become less capable of managing critical situations. This phenomenon, as described by journalist Tim Harford in a 2016 article for *The Guardian*, manifests in three key ways (Harford 2016):

- Inexperienced practitioners cannot learn from mistakes when using an automated system.
- Without regular use, a practitioner’s skills will slowly atrophy over time.
- When automated systems encounter problems, they tend to be unusually complex and demanding.

The paradox of automation implies that mastering the core competencies of tunneling and underground construction will remain crucial for the next generation of aspiring engineers. From these skills, young engineers will eventually develop sound professional judgment. In turn, this process may create a circular problem — traditionally, engineers learn these essential skills through hands-on experience, but as automation reduces direct involvement in day-to-day operations, we face an important question: How can we effectively train the next generation of engineers when they have fewer opportunities for practical, hands-on learning?

The challenges associated with the paradox of automation may even extend beyond the engineering profession. As tunnel boring machines incorporate more autonomous features, a new circular problem emerges:

while these features enhance both efficiency and safety, they simultaneously reduce opportunities for operators to gain vital hands-on experience. The industry will need to find alternative training approaches as these features become more popular.

Where has all the judgement gone? As Peck drew his speech to a close, he offered one final observation that still remains relevant to today: “As long as the myth persists that only what can be calculated constitutes engineering, engineers will lack incentive or opportunity to apply the best judgement to the crucial problems that cannot be solved by calculation. Where has the judgement gone? It has gone where the rewards of professional recognition and advancement are greatest — to the design office where the sheer beauty of analysis is often separated from reality.”

The future role of AI in tunneling and underground construction remains uncertain — it could become as ubiquitous as spreadsheet software or remain limited in adoption.

What is clear, though, is that the optimal path forward is not the wholesale rejection of AI technology. Instead, the tunneling industry would do well to approach AI as it has other innovations throughout its history: by leading with engineering judgment.

Conclusion

Poll 100 tunnel engineers about AI’s future in their field, and you will likely encounter 100 different opinions. Through exploring historical context and practical applications, this article sought to address prevalent misconceptions about AI implementation. The question facing the tunneling industry is not whether AI will impact the field, but rather when and to what extent. The path forward will not be shaped by academic debates or industry discourse. The future of AI in tunneling lies in the hands of those at the front lines — the owners, consultants, contractors and suppliers who confront and solve the challenges of tunneling projects every day.

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Disclaimer

The views, opinions, and conclusions expressed in this article are those of the authors only and do not necessarily

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Artificial intelligence below ground: Innovation and hurdles in North American tunneling

The tunneling and underground construction industry is primed for a technological transformation driven by artificial intelligence (AI). The past year has spurred significant interest of engineers in developing intelligent and automated workflows that can partially or completely replace the repetitive human effort. The global tunneling community has already deep-dived into applying AI-driven solutions to improve design procedures, optimize construction processes, especially tunnel boring machine (TBM) performance, sharpen predictive risk assessment and support automated tunnel inspections. This transformation represents more than incremental improvement — it constitutes a paradigm shift toward proactive construction management.

These AI-based solutions are currently serving as supplementary technologies but carry the potential of main actor catalysts transforming the conventional practice — from conceptualization and initial design through construction monitoring and long-term asset management. During the construction phase, the traditional tunneling practice has relied heavily on subjective assessments and retrospective analysis/forensics, whereas machine learning (ML), a subset of AI, has enabled real-time pattern recognition, predictive modeling and autonomous system adjustments — a significant advancement. The limited ML-enabled solutions have proven to be effective in creating affordable solutions; however, the scalability of the solutions remains a problem to be solved. As underground construction and tunnel projects grow increasingly complex in North America, navigating dense urban environments and challenging geological-geotechnical conditions, the prospect of applying AI-ML-based solutions presents a compelling opportunity.

What are AI and ML in tunneling context? The terms AI and ML are often used interchangeably in engineering contexts, but they represent distinct concepts with important differences when developing solutions for tunnel construction. AI encompasses the entire field of developing machines that can mimic human cognitive functions such as learning, reasoning, problem-solving and decision-making. In tunneling applications, AI includes everything from smart TBMs that adapt to changing ground conditions to comprehensive tunnel management systems that integrate multiple data sources as a decision-making support. ML is a subset of AI that focuses on learning from experience and improving performance over time by identifying patterns in data. In tunneling contexts, ML specifically refers to data-driven approaches that learn from historical tunneling data to make predictions or optimize operations. In a practical sense, an ML model may analyze vibration data to predict when a TBM cutter head needs maintenance. An AI system would take that prediction, consider project schedules, tools

inventory records, and safety protocols, then automatically coordinate the maintenance workflow and adjust the construction timeline.

Potential AI/ML applications in tunneling

This article explores applications of AI/ML in tunnel design optimization, predictive risk assessment, construction optimization, tunnel inspection and asset management — spanning the lifecycle of a typical tunnel project. Further, the article discusses the primary challenges in integrating AI solutions with traditional practices and explores the meaning of a successful AI model pertaining to the tunneling practice.

AI advantages in tunnel planning and design.

Tunnel alignment optimization has emerged as a critical application in which AI algorithms analyze vast amounts of geological data, topographical information, design criteria and environmental constraints to generate optimized tunnel routes that balance construction cost, structural stability and alignment coherence. The information model (IM) approach developed for tunnel alignment optimization demonstrates how AI-powered multiobjective optimization algorithms can effectively explore the decision space to find admissible solutions that designers might not have conceived, utilizing evolutionary algorithms to handle conflicting criteria such as cost minimization and urban area benefits maximization. Contemporary research shows that AI-driven tunnel location optimization models can incorporate key factors including construction cost, geotechnical risks, structural stability and alignment coherence to determine optimal tunnel paths through complex terrain.

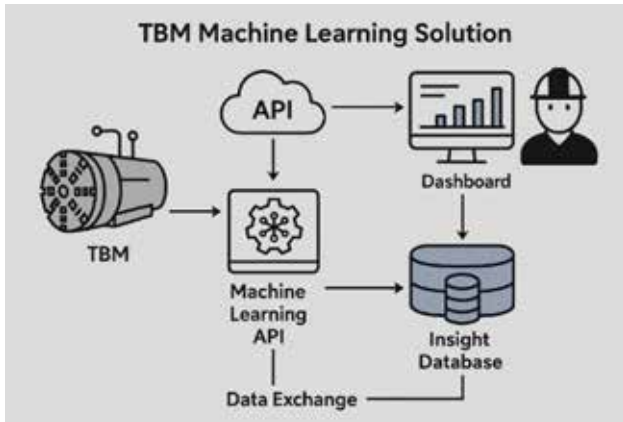
Geological risk assessment applications leverage ML algorithms to analyze comprehensive data sets including geological surveys, soil properties and historical performance data to identify patterns and predict potential risks with accuracy. Deep-learning models excel in identifying complex patterns within geological data, enabling sophisticated risk assessment methodologies that can predict geological characteristics, classify ground types and assess geological hazards through real-time analysis of high-resolution images and TBM sensor data. The predictive modeling techniques enable simulation of subsurface conditions, with ML algorithms capable of processing geospatial data, geological surveys and

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FIGURE 1

Example workflow of ML implementation on real-time data from TBM operations.



laboratory test results to categorize soil types and determine engineering properties while predicting soil behavior.

Optimization of geotechnical design parameters has been significantly enhanced through AI-driven analysis that can optimize foundation design, ground support systems and excavation strategies by processing vast data sets related to soil properties, load conditions and structural requirements. ML techniques including artificial neural networks, support vector machines and genetic programming have demonstrated success in predicting soil behavior, load capacity, settlement patterns and optimizing geotechnical designs while handling complex nonlinear relationships. In this sense, there lies an excellent opportunity to develop AI systems to rapidly assess impact of varying subsurface conditions or parameters on tunnel stability, quantify potential risks and evaluate tunnel efficiency with real-time update of subsurface conditions.

The emergence of automated design documentation represents another significant advancement, where AI systems can generate detailed reports, 3D models and construction drawings, increasing productivity up to about 50 percent through purpose-built tunnel modeling and automated analytical model creation. Contemporary implementations show that AI-enhanced geotechnical workflows enable dynamic numerical models that continuously update based on observed behavior, rapid evaluation of multiple scenarios through cloud computing, and seamless integration of data from multiple sources including site investigations, laboratory tests and historical studies. These technological advances present excellent opportunities for design consultants and tunneling contractors to deliver more accurate geological models, optimize tunnel alignments with data-driven risk assessments, reduce design iteration cycles and provide clients with scientifically validated feasibility studies that enhance project success rates while minimizing construction risks and costs.

Construction phase transformation. AI and ML technologies are emerging solutions to automate TBM operations, forecast average spalling of concrete tunneling

lining, provide real-time geological insights and predict equipment maintenance needs while aiming to mitigate tunneling risks. AI-guided TBM operations have displayed remarkable capabilities in autonomous decision-making and real-time parameter optimization, demonstrating success in major urban tunnel projects. The Kuala Lumpur Metro project exemplifies this technological evolution, where a fleet of 12 TBMs were operated autonomously using sophisticated AI algorithms analyzing real-time sensor data to adjust drive parameters, excavation strategies and slurry operations. This groundbreaking implementation has set the stage for the adoption of autonomous TBM technology, with the same innovations now being successfully deployed in Australia's Sydney Metro West project, where Gamuda's autonomous TBM (A-TBM) technology has been launched. A first-of-its-kind implementation in Australia represents a significant milestone in tunneling automation, with TBM Betty featuring sophisticated AI models that automatically steers, operates and monitors the machine while maintaining human oversight for critical decision-making.

Gamuda's Tunnel Insight platform represents AI integration in tunneling operations, combining automated anomaly detection, visual trend analysis and predictive analytics to support tunneling projects across Malaysia, Australia and Singapore. The platform demonstrates how ML technologies can consolidate various data sources into user-friendly interfaces, enabling actionable insights that optimize project management and reduce operational risks. The system's success in Australia's highway tunnel projects has validated its effectiveness in navigating complex geological conditions while minimizing disruptions to surrounding infrastructure.

The Colorado School of Mines Center for Underground has pioneered physics-based understanding of the TBM-ground interaction. The center published research with data from actual tunnel projects showing the success of data-driven ML models in predicting ground conditions and optimizing tunneling speed while limiting tunneling-induced deformation. Research at the University of California, Berkeley has been instrumental in developing AI systems for earth pressure balance (EPB) TBMs utilizing streams of sensor data in real time, with practical applications demonstrated in collaboration with industry partners including Sixense and Shimizu Corp. These systems have developed frameworks that use ML algorithms structured to follow human cognitive models of sensing, perceiving and decision-making, enabling real-time geological condition interpretation and ground movement prediction.

Singapore's tunneling industry has paved the way for adopting AI and ML technologies through implementations that demonstrate their practical viability in urban environments. The Mass Rapid Transit (MRT) construction projects in Singapore have successfully integrated AI systems to monitor the construction environment in real time, detect potential risks and

optimize operational parameters in the construction phase. Time-series prediction models have been successfully implemented in Singapore tunnel projects, with explainable AI approaches showcasing exceptional performance in predicting TBM performance. There have been initiatives to apply AI systems to optimize TBM performance learning from TBM-ground interaction on multiple past tunnel projects. These implementations have validated the effectiveness of AI-driven decision support systems in complex urban tunneling environments, providing a blueprint for other metropolitan areas seeking to implement similar technologies.

Predictive maintenance applications have demonstrated significant potential in reducing unplanned downtime and extending equipment lifespan through AI-powered analysis of TBM operational data. Advanced ML algorithms, including random forest, XGBoost and support vector machines, have been successfully applied to predict cutter tool wear rates, optimize maintenance schedules and reduce maintenance costs through early detection of potential issues. The China Railway Engineering Equipment Group (CREG) developed the Tunnel Boring Machine Component Conditions Online Monitoring and Diagnosis System (TOMD), which represents the first predictive maintenance system for full-face TBM condition monitoring. This system has been successfully deployed on the Shenzhen Metro Airport Line project, demonstrating how AI-powered predictive maintenance can enhance TBM operational efficiency and reduce costly downtime.

For tunneling contractors, AI and ML applications offer competitive advantages through improved operational efficiency, reduced equipment downtime, enhanced safety protocols, and the ability to adapt quickly to unexpected ground conditions, ultimately leading to more profitable and successful project outcomes. The convergence of these technologies is creating a new era of intelligent tunneling construction where human expertise is augmented by machine intelligence, enabling safer, faster and more economical underground construction practices that will define the future of the tunneling industry across diverse geographical and geological environments.

Operation and maintenance. AI and ML integration in automated tunnel inspections enhances real-time condition monitoring and enables predictive maintenance, significantly improving operational efficiency and reliability. Arup's Loupe 360 platform exemplifies this technological shift, integrating 360-degree imagery capture with ML algorithms to automate defect detection and classification across tunnel infrastructure. The platform employs robotic systems, including Boston Dynamics'



Boston Dynamics' Spot robot, equipped with multicamera arrays, on display during RETC in Dallas, TX.

Spot robot, equipped with multicamera arrays and specialized sensors to capture high-resolution imagery of the completed tunnel. Recent advances in using computer vision for structural health monitoring and tunnel inspection application have demonstrated remarkable precision in detecting cracks in the segmental liner.

Traditional deep-learning approaches for tunnel damage detection require vast amounts of labeled training data to achieve high accuracy. However, obtaining real-world images of tunnel damage presents a unique challenge. Precast concrete tunnel lining (PCTL) damage types such as delamination or rebar exposure on concrete surfaces are not commonly seen, making it difficult to build comprehensive training data sets. The emergence of generative AI techniques has addressed the critical challenge of limited training data by synthesizing realistic tunnel damage scenarios, with systems capable of generating 10,000 concrete damage images within 24 hours to train detection models. This presents a significant breakthrough in addressing the most persistent challenge of data scarcity in automated tunnel inspection.

Three-dimensional digital twin technologies, also known as virtual design and construction (VDC) models, now enable virtual inspection capabilities, allowing engineers to conduct remote assessments with georeferenced damage documentation and predictive maintenance scheduling. Current research trajectories indicate convergence toward multimodal sensing platforms that combine high-resolution imaging, lidar scanning, thermal analysis and ground-penetrating radar within unified robotic inspection systems, supported by real-time AI processing capabilities that provide immediate structural condition assessments and auto-mated reporting.

Developed by ETS Ingegneria (Italy) as part of the comprehensive Management and Identification of the Risk for Existing Tunnels (MIRET) methodology, MIRET-Tunnel AI represents a groundbreaking advancement

in tunnel inspection technology. Within the platform, AI algorithms are integrated to detect and classify various types of structural anomalies including cracks, spalling, water ingress and subsurface voids through analysis of high-resolution imagery and thermal data. The system complies with diverse and well-balanced training data sets, fair metrics during model development, quality management systems, data privacy protections, cybersecurity measures and human supervision throughout the decision-making process. The ethical implementation framework in MIRET ensures that AI algorithms serve as decision support tools and balances the technological innovation with responsible AI governance.

Current challenges in AI adoption in North America

As these technologies mature, the North American tunneling industry faces both unparalleled opportunities and implementation challenges. While AI offers tremendous potential for improving efficiency, safety and cost-effectiveness in tunneling projects, its development and integration requires robust data management practices and specialized expertise. Currently, the North American tunneling industry is working tirelessly toward workforce sustainability. The incoming workforce could potentially fill in for the serious shortage of AI-skilled personnel and escalate AI implementation on projects. The specialized knowledge required to develop, deploy and maintain AI systems is scarce. This leads to another challenge of needing extensive training programs to upskill the existing workforce requiring a significant amount of time and upfront capital.

The underground construction, tunneling, geotechnical and mining industry culture has been conservative and marred with inertia in trying out innovative technologies. The uncertainty in the cost-benefit relationship or cost performance index (CPI) for AI applications makes it further challenging to justify investments without proven performance metrics. Despite a few excellent research published in North America, AI is still largely a black box. There is relatively low transfer rate of applications from academia to real-world

tunnel projects leading to inhibited decision-making. Unfortunately, academic research is more publication-oriented and the practical applicability of AI/ML models on actual, time-consuming, cost-spiking problems has remained lower than expected. As a community, we must focus on simplifying the AI language, mathematics and solutions for an engineer sitting in a construction trailer for wider adoption.

The absence of standardized guidelines presents a significant barrier to widespread adoption and effective implementation of AI in tunneling. Without clear, industry-wide protocols and best practices, contractors and designers face uncertainty regarding the safe, ethical and optimal use of AI systems in tunneling projects. This lack of standardization leads to inconsistent application, with each organization developing its own ad hoc solutions, resulting in interoperability issues, increased risk of project delays, and challenges in regulatory compliance. Moreover, the absence of unified guidelines complicates efforts to validate AI-driven decisions, making it difficult to establish accountability and build trust among stakeholders. Establishing standards is essential to ensure that innovations are deployed safely, reliably and in a manner that maximizes their benefits across the tunneling sector.

The examples presented in this article demonstrate AI's proven potential — the North America region now must act decisively to realize this potential within its own tunneling industry. The paradigm shift is not just technological but cultural, requiring the tunneling community to embrace data-driven and intelligent decision-making, continuous learning and collaborative innovation. Organizations that successfully navigate this transition will gain significant competitive advantages, while those that resist may find themselves increasingly disadvantaged in a rapidly evolving market. The successful integration of AI in the underground and tunneling industry requires collaborative efforts between academic institutions, technology developers and industry practitioners to establish standardized frameworks that maximize their benefits while addressing legitimate concerns regarding data quality, algorithm transparency and system reliability. ■



Women in Tunneling; Carving space and driving change

The underground construction industry has always been marked by its formidable challenges — demanding conditions, high-stakes engineering and relentless problem-solving. Yet, despite these complexities, it remains one of the most critical and rewarding sectors in the built environment. Within this landscape, Women in Tunneling (WIT) is leading a quiet revolution. As an initiative under the Underground Construction Association (UCA) of the Society for Mining, Metallurgy & Exploration (SME), WIT is dedicated to amplifying the presence, voices, and impact of women in this historically male-dominated space.

WIT was founded on the belief that diversity and representation not only strengthen project teams — they elevate the entire industry. Our mission is clear: to empower, connect and elevate women across all dimensions of tunneling and underground work — from early-career engineers and seasoned contractors to academics, consultants and project owners. We achieve this through a dynamic blend of mentorship, networking events, technical knowledge sharing and leadership development.

This is not about inclusion for inclusion’s sake. It is about opening the door to new perspectives, stronger collaborations and better outcomes — both on and off the jobsite. WIT members represent a broad spectrum of disciplines and experiences, yet we are united by a common goal: to ensure that women have not only a seat at the table but a hand in shaping the future of underground construction.

In an industry defined by pushing through rock and forging new paths, WIT’s message resonates: “We don’t just stand behind women in tunneling — we help them lead the way.”

We invite you to join us — whether as a member, ally, mentor or sponsor — and help build a future that reflects the full talent and diversity our field has to offer. The tunnel is long, but together, we move forward.

The history of Women in Tunneling

“It began with a coffee break and a shared experience — now it’s a movement.”

The history of WIT is a powerful story of grassroots energy, shared purpose and community-driven growth. What started informally around 2006 — often as impromptu conversations during conferences — was born from a clear need: Women in the underground construction industry lacked visibility, support networks



2025 Women in Tunneling tour in Akron, OH.

and a sense of belonging in a field where they were vastly underrepresented.

For more than a decade, WIT operated without formal structure or affiliation. It was a self-sustained community powered by the dedication of its early members. These women came together to support each other, exchange stories and create space in an industry that had long overlooked them.

A major turning point came in 2012, when WIT began holding organized meetings alongside major tunneling conferences. These gatherings became an anchor for connection and mentorship. Still unofficial, WIT continued to grow organically until 2019, when it was formally adopted as an initiative under the UCA. With Zuzana Skovjsova as its first chair and Elisa Comis as co-chair, WIT entered a new era — gaining legitimacy, structure and broader outreach potential.

Since then, WIT has gained impressive momentum. At the Rapid Excavation & Tunneling Conference (RETC) 2025, more than 150 people attended the annual WIT Breakfast, reflecting a thriving and supportive community. Other regular events — including bimonthly coffee chats, tunnel site tours and annual planning sessions — continue to foster connection, learning and leadership.

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2020 Women in Tunneling tour — in front of a TBM.

Looking ahead, WIT is focused on building a sustainable and inclusive legacy. Its goals include establishing consistent leadership, increasing local and national engagement, and preserving the evolving story of women in tunneling. With every connection made and every path forged, WIT advances its mission: to grow the presence of women in tunneling through support, education and leadership development.

Facing the rock: Challenges for Women in Tunneling

Despite notable progress, women still represent a small percentage of the tunneling workforce. According to recent data, women comprise less than 15 percent of the civil engineering profession overall — and within tunneling, that number is even lower, particularly in field operations and executive leadership. The reality is clear: while the industry continues to evolve technically and operationally, cultural and structural barriers remain.

Women entering or advancing within tunneling often face a unique combination of challenges — limited access to mentorship and sponsorship, a lack of visible role models, and persistent biases about gender roles in construction and engineering. These issues are compounded in field environments, where long hours, remote sites and male-dominated crews can create added hurdles to inclusion, retention and growth.

WIT exists to confront these challenges head-on. Through programming focused on mentorship, leadership development and professional networking, WIT is creating a culture shift — one that does not just accommodate women but recognizes them as essential contributors to the future of the industry. The organization also serves as a platform for honest dialogue about the systemic issues that have long gone unspoken.

WIT's work is not just about advocacy — it is about action. From regular coffee chats and technical presentations to spotlighting female engineers and site leads, WIT is actively building a more inclusive and

supportive industry. It is also influencing how companies recruit, retain and promote women in underground construction roles.

As one senior engineer put it: “The tunnel industry has always been about grit — women have plenty of it. Now it’s about opportunity.”

The rocks are still there — but together, we are finding new ways to break through.

Lighting the way: Women in Tunneling initiatives

Coffee chats and virtual meetups. WIT coffee chats and virtual meetups are held every two months, offering an informal and inclusive space for women across the tunneling industry to connect. These virtual sessions create opportunities for networking, mentorship and open dialogue in a relaxed, judgment-free environment. Designed as safe spaces, they encourage honest conversations about career growth, challenges and lived experiences.

In 2024, WIT successfully hosted four coffee chats on impactful topics such as Building a Professional Network, Overcoming Imposter Syndrome, and Setting Boundaries. These sessions not only fostered meaningful connections but also provided actionable insights and peer support.

With plans to expand in the coming years, WIT aims to grow these meetups into a cornerstone of professional development and community building.

Tunnel tours. WIT's tunnel tours are an immersive, hands-on experience designed to inspire participation and build a network for women in tunneling, as this is often the first time for women to meet other women on a jobsite from the industry.

These site visits foster direct exposure to real engineering projects — igniting interest, building confidence and sparking connections between attendees. While women have been organizing jobsite tours for many years, the official WIT committee tunnel tours include:

- 2020 — San Antonio Water System — CWIP Segment 5-1 Tunnel: The inaugural tour, attended by approximately seven women, marking WIT's first direct engagement at a live tunneling site.
- 2023 — AlexRenew — RiverRenew Tunnel System: This tour drew 23 participants, offering an in-depth look at operations, project workflows, and networking with project leaders.
- 2024 — Hampton Roads Bridge-Tunnel (HRBT): With the WIT tours gaining traction, the HRBT project hosted about 26 women on the guided exploration. The tour got up close with the TBM that was just starting to mine the second tunnel run. Additionally, a WIT member, Kayla Alvarez, gave a presentation about the extensive planning

required to perform the TBM “U-turn” in the shaft in order to mine the second tunnel run.

- 2025 — City of Columbus-Lower Olentangy Tunnel and City of Akron — Northside Interceptor Tunnel: WIT’s most attended tour to date, with about 30 women in attendance. The tour had a jam-packed schedule where attendees visited two tunnel jobsites within a day, which required a two-hour bus drive between projects. The timing could not have been better as the attendees were able to observe a TBM start its excavation journey in a starter tunnel. The day ended with an ice-cream treat at the jobsite trailers. These tours not only showcase the engineering and complexity of tunnel construction, but also emphasize networking, mentorship and real-world career inspiration. As WIT expands, tunnel tours remain a cornerstone of its outreach — bridging the gap in the industry by igniting enthusiasm and encouraging more women to explore and lead in underground construction.



Women in Tunneling Tour - Hampton Road Bridge Tunnel Project in 2024.

Breakfasts at RETC, NAT and WTC. The WIT Breakfast, an annual event held at UCA’s RETC and North American Tunneling (NAT) Conference, has evolved from a networking event held the Sunday evening of the conference to a flagship event. Its primary objective is to facilitate specific networking opportunities and present programming related to industry challenges. This year’s breakfast, held at RETC, centered on a panel discussion on workforce sustainability. The previous year’s program featured a presentation on mentorship and sponsorship, highlighting their role in championing women in the tunneling industry.

Happy hours and social mixers. Since 2023, WIT has been bringing industry professionals together in a refreshing and engaging way — through its nationwide Happy Hour campaign. These informal, in-person gatherings offer members a chance to unwind, connect and spark meaningful conversations over drinks in cities across the country. Designed to strengthen camaraderie and build a vibrant community within the tunneling industry, the events are quickly becoming a favorite tradition. So far, four successful happy hours have taken place — three in the dynamic city of Austin, TX, and one in the nation’s capital, Washington, DC. With more cities on the horizon, WIT’s Happy Hour is proving to be more than just an event — it is a growing movement to foster connection, collaboration and a shared passion for the tunneling field.

Mentorship and student outreach. “Tunnel tours sparked something in me — I finally saw someone like me wearing a hard hat,” said a student attendee.

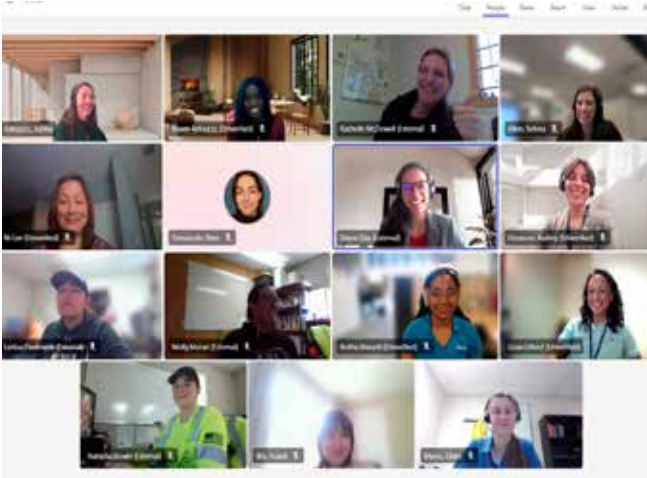
WIT is committed to bridging the gap between classroom learning and real-world tunneling through focused mentorship and outreach. By connecting students with seasoned industry professionals, WIT helps cultivate the next generation of women in underground construction. These relationships offer invaluable guidance, practical insights and early exposure to the challenges and rewards of the field.

Beyond traditional mentorship, WIT leverages social media to expand its reach and inspire young women globally. Through engaging posts, personal stories and interactive content, WIT highlights career paths, celebrates achievements and fosters a sense of community — making tunneling more accessible and inviting to a broader audience.

As WIT’s digital presence continues to grow, so does its ability to build a vibrant, inclusive network. This community serves not only as a space for learning and support but also as a platform for collaboration and innovation. WIT’s mission is clear: empower women, shape the future and strengthen the tunneling industry through diversity.

Legends of the underground: Women who paved the way

Across decades of underground construction, women



A virtual coffee chat meet up.

have broken barriers, challenged norms and helped shape the industry from the inside out. From early legal battles to today’s boardrooms and jobsites, the contributions of women in tunneling are vast and immeasurable. While there are far too many to name in a single page, below are just a few whose stories stand as powerful examples of courage, leadership, and legacy:

- Janet Petra Bonnema made history by standing up against gender-based exclusion in the 1970s. Hired to work on the Eisenhower Memorial Tunnel in Colorado, she was initially banned from the tunnel due to outdated superstitions. Refusing to accept this discrimination, she took legal action — and won. On Nov. 9, 1972, she became the first woman to legally enter and work inside a major tunnel in the United States, paving the way for generations of women to follow.
- Priscilla P. Nelson, Ph.D., a leader in underground engineering and education, has shaped tunneling through her groundbreaking research, mentorship and leadership roles. As head of mining engineering at Colorado School of Mines and an active member of the WIT Committee, she continues to guide and empower new talent in the industry.
- Lizan Gilbert, chair of WIT (2024–2027) and a UCA board member, is a tireless advocate for women in underground construction. A member of The Moles — a prestigious organization of industry leaders — she has championed inclusion and progress in the field. Through tunnel tours, outreach events and mentorship programs, she has helped build a more connected and supportive tunneling community.

These women — and many others — remind us that progress in tunneling is not just about digging deeper, but also about lifting others up.

“You can’t be what you can’t see. We’re changing that, one tunnel at a time.” — Women in Tunneling Leadership

Looking ahead: Future goals and call to action

While WIT became an official committee in UCA of SME in 2019, we first must look back and recognize all the women that opened many doors prior to 2019. As we look ahead, WIT wants to continue to create a community and network for women in addition to partnering with the entire industry to uplift the underground construction community. WIT, as a relatively new committee, is currently working toward keeping all initiatives discussed above sustainable and ongoing. Simple actions like creating a file-sharing system, establishing roles and responsibilities for leadership positions, or setting up rules for selecting board members are all important processes that contribute to the success and sustainability of the committee.

As WIT grows, it will be important to have a constant flow of new volunteers who can get involved, make a difference and feel connected to this industry. Currently, all these processes are being developed to keep the fast-growing momentum of WIT rolling into the future. In addition to internal growth, WIT is currently brainstorming ways to uplift the entire industry such as by providing tailored leadership courses. These leadership course would be aligned with the tunnel conferences throughout the year and cover subjects such as workforce sustainability, where people from across the industry can discuss ways to bring in and retain people in the underground industry. There are so many different avenues that WIT can take into the future. Looking forward, WIT plans to continue aligning with the WIT mission statement, continue executing on actionable goals to maintain the ongoing initiatives at WIT as well as dreaming big, utilizing the resources of UCA, and continuing to strengthen and connect the underground industry.

Closing thoughts

WIT represents more than just a professional network — it is a growing movement rooted in connection, courage and a shared commitment to change. In an industry defined by complexity, grit and innovation, WIT is working to ensure that women are not only present but thriving. Our community brings together individuals from across the underground construction world — engineers, geologists, contractors, academics and students — each contributing unique perspectives and strengths.

Whether you are deep in the field, leading in the boardroom, researching in a lab or just beginning your career path, WIT offers a place where you can connect, learn and lead. Through mentorship, education, networking and advocacy, we are building a future where women are recognized as essential to the success and advancement of tunneling.

The progress we have made is just the beginning. With every conversation, every breakthrough and every woman who steps into the tunnel, we move closer to a more inclusive and innovative industry. Join us — and help shape what comes next. ■

Central City Parallel Storm Tunnel Project required infrastructure repairs in tight spaces

Minneapolis, seated on the banks of the Mississippi and Minnesota Rivers, is home to a bustling population of more than 425,000 citizens. The largest city in the state, Minneapolis is supported through extensive underground infrastructure — most of which is decades old. The most pressing concern when it comes to this infrastructure is the deterioration of the stormwater tunnels beneath the city.

PCiRoads, a highway and heavy civil general contractor based in St. Michael, MN, won the bid for a three-year project enlarging portions of the existing stormwater tunnel, constructing a new parallel tunnel and creating new tunnel access in downtown Minneapolis. Excelling in specialized solutions for complex projects, PCiRoads tackles project difficulties like narrow tunnel access, difficult equipment logistics and strict safety codes. They chose to partner with Brokk to rework more than 243 m (800 ft) of stormwater tunneling underneath the heart of Minneapolis and mine 1,097 m (3,600 ft) of new parallel tunnel. The final system will be 1,280 m (4,200 ft) long.

The old system

Originally built in 1939 and 1940 to move stormwater to the river, the tunneling system below Minneapolis was designed to negate flooding based on the drainage needs of the time. However, the rapid growth in population in the last 80 years combined with a 30 percent increase in rainfall per hour in the last 50 years means the tunnels can no longer keep up with demand. And, while the Public Works Department conducted ongoing repairs to the tunnel lining totaling close to \$600,000 annually over the past several years, the fact remains that the system simply was not designed to support today's vastly different population level. The strain of excessive amounts of water caused cracking, breaking and other concrete deterioration, resulting in an urgent need for repair.

In 2021, the City of Minneapolis Public Works Department approved a \$60 million overhaul of the stormwater tunnel system. The Central City Parallel Storm Tunnel Project's goal is to create a tunnel system that can last another 100 years. The plan is to create a tunnel twice the size of the current system to move stormwater from downtown Minneapolis to the Mississippi River.

"When the stormwater tunnels start to fail, we see



The drum cutters — or road headers — with the Brokk 520Ds meticulously shaved away the sandstone and shale to precisely meet the template shape.

dangerous flooding and other damages to underground infrastructure," said Nap Scott, estimator and project manager for PCiRoads. "The repair of the current system and addition of the parallel stormwater tunnel will be a huge step forward in handling the increased demands of the city."

The Central City Parallel Storm Tunnel Project includes both repairs to existing tunnels and the new parallel primary tunnel that will reduce the pressure in the current system. This will increase the lifespan of the current system, reduce annual repair costs and provide additional support for rainwater runoff.

Tight spaces

The PCiRoads crew found a number of logistical



PCiRoads chose to partner with Brokk to rework more than 240 m (800 ft) of stormwater tunneling underneath the heart of Minneapolis.

challenges with the Central City Parallel Storm Tunnel Project. Throughout the project, Scott said the most difficult part was the intense planning required at each stage. The tunnels were so small that equipment could not pass one another. If a different piece of equipment was needed, the original piece would need to be removed from the tunnel and new equipment brought in, significantly slowing down progress. Careful planning and intense equipment choreography helped the PCiRoads team minimize equipment changes and significantly limit the impact such processes had on the overall project timeline.

The first challenge PCiRoads faced with the project was that workers and equipment needed to be lowered by crane 24 m (80 ft) into the system. Finding equipment small enough to fit into the existing tunnel systems with enough power to get the job done was tough. Traditional equipment, like 4.5-t to 9-t (5- to 10-st) excavators, could not get into such tight spaces.

“One of the main challenges of the project was the size of the tunneling system and the size of the equipment. Excavators just can’t work safely in such close quarters with the risk of falling debris and pinch points,” Scott said. “We really needed smaller demolition equipment we could power underground where the operators could work at a safe distance from any falling material.”

PCiRoads’ 12 years of experience in the tunneling industry gave them a leg up in choosing the perfect equipment for such a large project. In the past, they used Brokk demolition robots for similar, smaller-scale projects.

To complete the Central City Parallel Storm Tunnel Project, PCiRoads purchased two new Brokk 520Ds and a used Brokk 400 diesel model. They found that the power-to-weight ratio of these machines gave the best hitting power for its size. A 5.4-t (6-st) Brokk 520D is 1.6 m (5.25 ft) wide, with a vertical reach of 7.1 m

(23.4 ft). To get the same hitting power as a Brokk 520D, they would need to use a 9-t (10-st) excavator with a width of approximately 2.1 m (7 ft) and a vertical reach of 2.4 m (8 ft). The lighter weight and smaller size of the robots made lowering them down the tunnel’s 24-m (80-ft) shaft easier and safer than larger equipment.

“The Brokk diesel models are easier to power since they don’t need a generator — but that means we needed to make sure there was proper ventilation in the tunnels before we could start,” Scott said. “Once it was set up, the diesel models offered unparalleled versatility because we didn’t need to worry about generators or cords.”

Increased versatility and safety

PCiRoads took advantage of the Brokk demolition robots’ versatility by using multiple attachments throughout the project. With remote-controlled operation featuring a range of more than 290 m (950 ft), the operator and crew were removed from the danger zone while the equipment worked. For mining the new tunnel, they used the breaker attachment with the Brokk 520Ds. This part of the process required crews to break the sandstone and shale down up to the limestone and remove it from the area to create a box tunnel configuration.

The project required PCiRoads to carve a cathedral shape out of the sandstone using a predetermined template. The tunnel comes to an arch at the top to provide additional support for the tunnel system. Crews used green lasers to draw the template outline, then completed removal with the Brokk robot.

The PCiRoads team chose the Brokk Drum Cutter 250 attachments as the best option for mining sandstone after realizing that the breaker was not the best tool for precise shaping.

The drum cutters — or road headers — with the Brokk 520Ds meticulously shaved away the sandstone and shale to precisely meet the template shape. Crews then removed the powdered material from the tunnel via skid steer and lifted out by crane. At the project’s halfway mark, they already hauled out more than 9,175 m³ (12,000 cu yd) of sandstone.

Following the removal of the sandstone and shale, PCiRoads moved on to breaking through bedrock at the riverbed. The crew rented an additional Brokk 300 with a breaker attachment to tackle the bedrock. During the bedrock removal phase, the team intermittently stopped to install ground control. They used a TEI 80 Rockdrill to install rock bolts. The bolts held mesh in place to catch loose rock and debris and protect crew against rock falls and tunnel collapse.

Once PCiRoads completes this part of the project, new forms will be rolled out for the tunnel, concrete will be placed under those forms, and the new tunnel will be tied into the current system. ■

New UCA executive committee members begin terms

Leon “Lonnie” Jacobs was named UCA Chair during the 2025 Rapid Excavation & Tunneling Conference (RETC) in Dallas, TX June 11. Jacobs will serve as chair for two years. Colin Lawrence was named UCA Vice Chair during the meeting, and Erika Moonin moved to the role of Past Chair. John Huh, Mike Rispin, Paul Schmall, Mike Vitale and Mussa Wone completed their terms on the executive committee.

David Dorfman, Jon Hurt, Martino Scialpi and Lauro Lacerda were elected to serve on the executive committee as directors.

The 2025 UCA Executive Committee consists of Jacobs (Chair), Lawrence (Vice Chair), Moonin (Past Chair), Shane Yanagisawa, Lacerda, Paul Madsen, Jay Arabshahi, Michael Bruen, Matthew Crow, Mark Johnson, Hurt, Jonathan Klug, Sarah Wilson, Dorfman, John T. DiPonio, Everett Litton, Steffen Dube, Scialpi and Anthony Pooley.

Leon “Lonnie” Jacobs has almost 40 years of New York metropolitan area heavy civil and underground construction experience. Jacobs began his underground career working for a joint venture of McLean-Grove, Grow Tunneling and Kiewit in 1982 as a co-op student and then after graduation in several engineering positions on the New York City Third Water Tunnel.

In 1988, Jacobs went to work for Perini as a project engineer on numerous transit and wastewater projects in the New York City region until joining Frontier-Kemper in 1995. Some of the projects he has constructed with Frontier-Kemper over the past 28 years include the



Lonnie Jacobs

New York City Department of Environmental Protection Water Tunnel Shaft 26B; the 26 Ward Water Pollution Control Plant Pilot Program; the New Croton Aqueduct Rehabilitation Project; the TBTA Queens Midtown Tunnel Rehabilitation Project; the NJ Transit Hudson Bergen Light Rail Weehawken Tunnel/Bergenline Avenue Station Project; rehabilitation of the New Croton Aqueduct; MTA East Side Access Manhattan North Structures and the Cleaning and Inspection of City Tunnel No. 3, Stage 2, in Queens and Brooklyn.

Jacobs’ professional responsibilities at Frontier-Kemper have covered all facets of heavy construction from project management to engineering and includes experience in design, schedule, cash flow, insurance, safety, accounts payable, accounts receivable, payroll, estimating, budget production, risk management, quality control, change-order negotiation, customization of equipment, design of specialized equipment, value engineering, claims, depositions, human resources and strategic planning.

In addition to his work experience, Jacobs has served several industry associations and presented at numerous conferences. Highlights include serving on the UCA George A. Fox Conference committee since 2007, including serving as chair in 2008, 2009, 2015 and 2016. He was recently nominated as vice chair of the North American Tunneling (NAT) Conference planning committee and has participated in organizing the 2012, 2014 and 2016 NAT Conferences. He was vice chair of the 2016 NAT Conference committee when it was held in conjunction with the World Tunnel Congress.

Jacobs earned a bachelor of science in civil engineering, cum laude, degree from Northeastern University in Boston in 1985, and a master of science in construction management from Brooklyn Polytechnic University in 1988. He is a



(left to right) 2025-2027 UCA Chair Lonnie Jacobs, 2023-2025 UCA Chair Erika Moonin and 2021-2023 UCA Chair Mike Rispin.

licensed Professional Engineer in the states of New York, New Jersey, Maryland and Virginia. He is also a board-certified Safety Professional. He is a member, trustee and Publicity Committee chair of The Moles, a fraternal organization of heavy construction industry distinguished professionals. Besides the UCA, Jacobs’ industry association memberships include the Civil Engineering Honor Society, Chi Epsilon, New York State Society of Professional Engineers and ASCE.

Colin Lawrence is a world-renowned tunnel engineer within the industry. He has more than 40 years of tunnel experience including some of the world’s most challenging tunnel projects and has been involved in all aspects of underground project implementing from planning, design and project management through to construction management and project comple-



Colin Lawrence

tion. His tunnel experience encompasses all types of tunnel projects in a variety of markets such as transportation, water, wastewater, oil, and mining projects in a variety of very challenging ground conditions in soil, rock and mixed-face conditions, in subaqueous, seismic and mountainous environments.

Over the last 25 years he has been very active in supporting the tunnel industry with past participation on the UCA board and currently ending his tenure in June this year on the RETC executive committee. He has also served on the organizing committees for the NAT, Cutting Edge and George A. Fox conferences. He was also fortunate to participate on the organizing committee for the ITA's World Tunnel Congress when it was held in San Francisco in 2016.

His proudest industry achievement was as an editor and contributing author to the UCA book *History of Tunneling in the United States*.

David Dorfman is a 1995 graduate of Wentworth Institute of Technology in Boston, MA, with a bachelor of science in building construction technology. He has 30 years' experience working for contractors in tunnels and underground construction in the New York City area.



Dorfman's tunneling career began as an intern on the Boston Big Dig program. Since then, he has worked on numerous sections of the NYC Water Tunnel, LIRR East Side Access tunnels, NYC 2nd Ave Subway, and New Jersey Transit Hudson-Bergen Light Rail tunnels, serving as general superintendent and construction manager. Dorfman's experience includes tunnel and shaft construction, drill and blast excavation, TBM hard rock excavation, road header excavation, raise bore

excavation, frozen shaft excavation, shaft and tunnel concrete, shotcrete initial support and final lining, rock mass grouting, tunnel rehabilitation, subway station fit out, and mechanical work for water supply systems.

Dorfman has been involved in the UCA throughout his career. He has been a member of SME since 2011 and has served as session chair for RETC and NAT numerous times. He is currently vice chair of the George A. Fox Conference committee. He is also a member of the Moles.

Martino Scialpi graduated from the Polytechnic University of Turin in Italy in 2006 as a civil and environmental engineer with an M.S. in tunnel design and construction. Since then, he has been particularly active in mechanized tunneling as well as TBM design, operation, and modifications for difficult or varying ground conditions. His experience as tunnel manager for contractors, project manager for a TBM manufacturer, and tunnel designer for engineering firms spans five continents. In 2020, Scialpi joined the Program Management Organization of DC Clean Rivers as tunnel design lead, and he is currently performing construction oversight for the Potomac River Tunnel project.



Martino Scialpi

Based in the United States for the last 13 years, he has been technical director of Pini Group USA, a subsidiary of ARX, since 2022.

Over the years, Scialpi has contributed to WTC, RETC, NAT, and TAC publications concerning mechanized tunneling. He has provided active support to the UCA mentorship program since its inception, and he is a member of the UCA Working Group 17 — Long Tunnels at Great Depth. As vice animateur of the ITA Working Group 14 —

Mechanized Tunneling, Scialpi is leading Task Group #2 — Recommended Guidelines for TBM specifications.

Jon Hurt, P.E., is a principal working in Arup's Tunnel Practice in the Americas. He has a wide range of experience in the management, design and construction of major tunneling projects. Hurt's experience includes underground construction projects on five continents including High Speed 1 in London, New York's Second Avenue Subway and Lake Mead Intake No.3. Hurt graduated from the University of Cambridge with a degree in engineering.



Jon Hurt

Lauro Lacerda is presently the North American civil engineering business development and key account manager for SNF Holdings Inc. SNF is the world leader in water-based polymers that are extensively used in many industries, including tunneling and deep foundation. He is a P.E. and received B.Sc. and M.Sc. degrees in mining engineering and has had



Lauro Lacerda

civil engineering training and experience. Lacerda spent more than 20 years working underground as a geotechnical engineer and in mine management roles for large mining companies such as Hecla and Barrick. Over the past 20 years he worked for Master Builders, Traylor Brothers and the Normet Group. He joined SNF two years ago. He has been chair of the ITA-UCA Working Group 12 — "Spray Concrete Use" since 2012. ■

Leaders in the tunneling industry recognized during RETC 2025

For the first time, the UCA annual awards were presented during the Rapid Excavation & Tunneling Conference (RETC) in Dallas, TX on June 9. David Klug became the first person to receive the UCA Lifetime Achievement Award during RETC.

Klug received the award for the enthusiasm, leadership and extensive contributions he has brought to the tunneling industry for the advancement of tunneling and underground construction industry practices. He has continuously demonstrated his dedication to fostering collaboration, embracing innovation, and educating industry practitioners and owners, both internationally as well as in the United States.



David Klug

In addition to the Lifetime Achievement Award, the following awards were presented:

UCA Muddy Boots Award: David Dorfman, Walsh Construction Company. The Muddy Boots Award was created to recognize field supervisors able to implement efficient work operations, mentor future leaders, provide high-quality work and demonstrate a record of fostering a strong safety culture. This year, David Dorfman received the Muddy Boots Award for his dedication, contributions and leadership in the underground and tunneling industry.



David Dorfman

UCA Young Member Award: Luis Augusto Avila, WSP USA. Avila received the award “for outstanding

achievements and contributions in his early career to both the tunneling industry and the Underground Construction Association.”



Luis Augusto Avila

UCA Project of the Year: Washington Metropolitan Area Transit Authority (WMATA) Yellow Line Tunnel Rehabilitation Project — Kiewit Infrastructure Co. The project included updating two 40-year-old tunnels about 3,000 ft in length. The work involved rehabilitating the steel-lined structure to provide structural support of the existing tunnel and restoring the structural integrity of the tunnel and extending its useful life for at least another fifty years. Congratulations to Kiewit Infrastructure Co. and WMATA.

In addition to the UCA awards, the RETC committee also presented two awards.

Person of the Year: Sanja Zlatanic, “In recognition of exceptional contributions to the tunneling and underground construction industry and efforts in promoting its global significance and development.”

Zlatanic is an internationally recognized tunnel and infrastructure engineering expert with more than three decades of leadership on the world’s most complex underground transportation projects. Graduating at the top of her class from the University of Belgrade, Serbia, in 1988, she began her career amid the turbulence of political conflict in her home country, eventually



Sanja Zlatanic

establishing herself in the United States as a strong leader in developing tunneling and underground engineering projects and promoting the industry.

Zlatanic has directed and delivered all phases of major, multibillion-dollar tunnel projects across the globe — including New York, Seattle, Los Angeles and Istanbul — bringing unmatched technical expertise in underground risk management, large-diameter single-bore transit solutions, and the design and construction of complex tunneling systems beneath urban environments.

As chair of HNTB’s national tunnel practice since 2016, secretary-general of the international nonprofit nongovernmental organization Associated Research Centers for Urban Underground Space (ACUUS), and member of the Executive Council of the International Tunneling Association (ITA-AITES), she has mentored generations of engineers while fostering innovation, excellence and inclusiveness nationally and internationally.

Outstanding Educator Award: Youssef Hashash, “For outstanding research, design, and mentorship contributions to the understanding of interaction of underground structures with their surroundings.”

Hashash holds a B.S., an M.S. and a Ph.D. (1992) in civil engineering from the Massachusetts Institute of Technology. He began his career with the PB/MK TEAM in Dallas, TX on the Superconducting Super Collider Project and then Parsons Brinckerhoff in San Francisco, CA, working on underground construction projects in the United States and Canada, including the Boston Central Artery/Tunnel project. He is a licensed Professional



Youssef Hashash

(continued on page 50)

Sanja Zlatanic named vice president of International Tunneling Association

During the 51st ITA General Assembly and World Tunnel Congress 2025 (WTC 2025) in Stockholm, Sweden Sanja Zlatanic was elected vice president of the ITA Executive Council.

Zlatanic, a member of UCA, has more than 35 years of experience in tunnel and underground infrastructure projects. She has contributed to complex, high-profile developments across the globe. Her expertise spans design management, independent verification and technical consultancy for major transit and infrastructure initiatives. Zlatanic's extensive experience and global perspective make her a distinguished leader in underground engineering, bringing innovative solutions and technical excellence to complex infrastructure challenges.

Andrea Pigorini of Italy was elected as ITA president for 2025-2028. Arnold Dix remains on the executive council as immediate past president for the coming three years.



Sanja Zlatanic

Zlatanic is one of three new vice presidents. She is joined by Klaus Rieker of Germany, first vice president and Damian McGirr of the United Kingdom, vice president. New executive council members are Elena Chiriotti of France, Isago Nobuharu of Japan, Zhigou Zhang of China, Hamdi Aydin of Turkey and Johan

Mignon of Belgium.

WTC 2025 was also the first for new ITA executive director Helen Roth, who took the helm of the association on Jan. 1, 2025.

In other news, Papua New Guinea was agreed and welcomed as the 81st Member Nation of ITA. Jinxiu Jenny Yan, ITA past president 2019-2022, was appointed as an adviser to the ITA and executive council. Five leaders of the industry were appointed Fellows of ITA in recognition of their contributions: Ray Stirling, USA; Rakesh Kumar Khali, India; Giuseppe Lunardi, Italy; Kari Korpela, Finland; and Randall Essex, USA.

Singapore was selected to host WTC 2028. WTC 2026 will be hosted in Montreal, Canada, and WTC 2027 will be hosted in Antwerp, Belgium. ■

Awards: Industry leaders earn accolades

(continued from page 49)

Engineer in California.

Hashash joined the faculty of the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign in 1998. He teaches courses and conducts research in geotechnical engineering, numerical modeling in geomechanics, geotechnical earthquake engineering, tunneling in soil and rock, and excavation and support systems. In addition, he works on geotechnical and tunneling applications of deep learning, artificial intelligence, visualization, augmented reality and imaging.

He has published more than 300 articles and is co-inventor on four patents. His research group developed the software program DEEPSOIL that is used worldwide for the evaluation of soil response to earthquake shaking. His work on seismic design of underground structures is extensively used in engineering practice.

UCA members recognized as SME Fellows

As the most prestigious award presented by SME, the SME Fellow Award recognizes professionals for significant and sustained contributions

to the minerals industry and to the Society. This year marks the 50th anniversary of the SME Fellows Award, previously the SME Distinguished Member Award. In celebration of this momentous milestone, the SME Board of Directors voted to award additional deserving members with the Fellows designation, including the following UCA members.

Robert Goodfellow is the president of Aldea Services Inc. He is a licensed Professional Engineer in the United States and Canada and has more than 30 years of experience in the tunneling industry. He is a former chair of the UCA Executive Committee and a member of the Moles. Goodfellow has experience working on major transportation and water/wastewater projects on five continents and is an industry expert in risk management for underground projects.

David R. Klug is the president of David R. Klug and Associates Inc. and Klug Construction Systems LLC, based in Wheeling, WV. Klug has more than 47 years of industry involvement in many of the major tunnel programs constructed in the United States and Canada.

Mike Roach has served on the editorial advisory committee for the *Tunneling & Underground Construction* (T&UC) magazine, chair of the Scholarship Committee and chair of the UCA Executive Committee. Roach has more than 45 years of experience in the tunnel construction business, serving in various capacities, from miner to project manager throughout the successful procurement and construction of more than 20 projects.

Michael "Mike" Rispin, a proud American and Canadian, is a graduate mining engineer from McGill University in Montreal, Canada, a Professional Engineer, and vice president of tunneling for Strata Worldwide. He has more than 42 years' experience in the underground industry, both tunneling and mining. His areas of experience include the excavation cycle, drilling and blasting, ground support, underground heavy equipment and mechanical excavation.

Dave Rogstad has 45 years of heavy civil and underground experience. He is a graduate of the University of Washington, where he earned his B.S. in building construction in 1979 and M.B.A. in 2001. ■

Leon “Lonnie” Jacobs: An interview with the 2025-2027 UCA Chair

During the 2025 Rapid Excavation & Tunneling Conference (RETC) in Dallas, TX June 9-11 Leon “Lonnie” Jacobs began his two-year term as Chair of the UCA.

T&UC recently interviewed Jacobs about the role, his career in the tunneling and underground construction industry, and his vision for the UCA for the next two years.

T&UC: Please explain your UCA path to Chair of the UCA Division?

Jacobs: My path to UCA Chair began many years ago when I was “tapped on the shoulder” and volunteered to join the George A. Fox Conference planning committee by one of my mentors. That was about 25 years ago. While I continue to serve on the George A. Fox Conference planning committee, I have grown within the organization serving as North American Tunneling (NAT) Conference and RETC session chairs, on NAT Conference Committees, as NAT Conference Vice Chair in 2016, when we hosted the World Tunnel Congress in conjunction with NAT, and NAT Chair in 2018. These opportunities to serve the association led to my nomination to the UCA Executive Committee in July 2014. Since then, I have served two four-year terms followed by a term as Vice Chair and now Chair. Along the way, I have served on various subcommittees such as the Awards Committee, Down For That Development Committee and ASCE Legislative Fly-in. I have met a phenomenal group of individuals from across the country, learned a tremendous amount along the way, grew professionally, mentored and participated in the Association’s growth.

T&UC: What are your plans for the UCA for the next two years?

Jacobs: The UCA is an education levels, getting into the classrooms and exposing the next generation to our industry. We need to explain first-hand the rewarding career

opportunities that exist and the diversity of our industry’s needs. Expanding our relationships with teachers and professors will facilitate the introduction of relevant topics into the curriculum and a conduit between the classroom and the Association. We also need to work with the teachers and professors to provide relevancy between classroom curriculum and real-world applications. I know many of our members are professors or adjunct professors and members have family members who are teachers. One of my goals is to organize this list of individuals already connected to the Association and the classroom to leverage their knowledge and experience to grow this group beyond our immediate community to foster relationships with the students.

Expanding our relationship with teachers and professors should also lead to our Association’s growth. Teachers and professors would hopefully join to access the UCA’s resources and students will join while in school and after graduation to expand their knowledge of our industry.

T&UC: What advice do you have for someone just joining UCA or SME?

Jacobs: Get involved. I tell the student scholarship recipients attending NAT or RETC they can move from session to session and take in the presentations in their own little world or move from session to session sitting next to new acquaintances, introducing themselves and participating in networking opportunities. Fill the empty seat at the lunch table, attend the UCA breakfast. Participate. Our industry is filled with cordial, friendly people willing to share their knowledge. A phenomenal industry attribute.

T&UC: What are your thoughts about the near-term future of the Division?

Jacobs: We are an association of volunteers. This past July we had a



Leon “Lonnie” Jacobs

few executive committee members complete their service and new members join the executive committee as part of the leadership transition. I am looking forward to working with the volunteers as we collectively lead the association into the future. The past UCA Chairs and executive committee members have grown and developed the association from its days as the AUA and SME’s acquisition to where it is today. We need to continue the attendance growth at our Association’s conference and strive to enhance the membership benefits.

T&UC: What are your thoughts on state of the tunneling industry?

Jacobs: The volume of underground work is at an unprecedented level and our aging industry professionals and trades people creates a serious challenge. I believe the industry depends on the Associations growth, networking opportunities and professional development offerings to meet this challenge. Our strategic plan was developed based on these challenges and it will take all of us to promote the rewarding careers, mentor our younger colleagues and attract our successors. ■

TUNNEL NAME	OWNER	LOCATION	STATE	BID YEAR	TUNNEL USE	LENGTH (FEET)	WIDTH (FEET)	STATUS
Minneapolis Central City Parallel Tunnel	City of Minneapolis	Minneapolis	MN	2024/2025	CSO	4,200	10-19	Final planning
Alameda Wet Weather Conveyance	Commission (SFPUC)	San Francisco	CA	2024	CSO	3,800	12	Under procurement
The Portal (Downtown Extension)	Transbay Joint Powers Authority (TJPA)	San Francisco	CA	2025	Transit	3,400	Varies	Shortlist announced
CA High Speed Rail (Northern Section)	CA High Speed Rail Authority	Fresno	CA	2026/2027	Transit	TBD	TBD	Design 1Q 2026
CA High Speed Rail (Southern Section)	CA High Speed Rail Authority	Bakersfield	CA	2026/2027	Transit	TBD	TBD	Design 1Q 2026
Eastside Connection	LACMTA	Los Angeles	CA	2025/2026	Transit	TBD	20	Under design
Ontario Connect Project	San Bernardino Co. Trans. Authority	San Bernardino	CA	2025	Transit	22,000	24	Under procurement
Gateway Manhattan Tunnel	Gateway Development Commission	New York	NY	2025	Rail	2 x 700	varies	Awarded Frontier Kemper
Gateway Hudson River Tunnel	Gateway Development Commission	Hoboken/ NYC	NJ/NY	2025	Rail	2 x 7,400	25.17	Proposals due 10/08/2025
Gateway Systems and Fit Out	Gateway Development Commission	Secaucus to NYC	NJ/NY	2026	Rail	2 x 22,000	varies	Procurement TBD
Gateway NJ Surface Alignment	Gateway Development Commission	Secaucus to North Bergen	NJ	2025	Rail	2 x 7,400	N/A	Procurement TBD
Gateway Existing Tunnel Rehabilitation	Gateway Development Commission	Union City/ NYC	NJ/NY	2036	Rail	2 x 13,000	varies	Procurement TBD
2nd Ave. Phase, Contract 2	NYS-MTA	New York	NY	2025	Subway	16,000	20	Awarded FCC/ Halmar
2nd Ave Phase, Contract 3	NYS-MTA	New York	NY	2025/26	Transit	89,600	20	RFQ due Sept. 2025
2nd Ave Phase 3& 4	NYC-MTA	New York	NY	2027/29	Subway	varies	20	Under study
Three Creeks Tunnel	City of Columbus	Columbus	OH	2027	Sewer	12000	14	Planning
Yonge North Subway Extension	Metrolinx / Infrastructure Ontario	Toronto	ON	2025	Subway	40,000	20	Awaiting Award
Blue Line Extension	Societe de transport de Montreal	Montreal	QC	2025	Subway	19,000	33	Awarded Pomerleau
REM-S Project	Societe de transport de Montreal	Montreal	QC	2026	Subway	23,000	33	Under design
Quebec City - Levis Tunnel	Quebec Transportation Ministry	Quebec City	QC	2026	Transit	27,300	60	Under design
Mill Creek Trunk Improvements	City of Nashville	Nashville	TN	2026	CSO	13,800	10	Delayed for additional study
Nose Hill Project	City of Calgary	Calgary	AB	2024	CSO	10,800	10	Delayed for additional study
Silver Line Extension	Boston Transit Authority	Boston	MA	2024	Transit	8,400	22	Delayed for additional study
ALCOSAN Ohio River Tunnel #1	Allegheny Co. Sanitary Authority	Pittsburgh	PA	2025	CSO	20,000	18	Under procurement
ALCOSAN Ohio River Tunnel #2	Allegheny Co. Sanitary Authority	Pittsburgh	PA	2025	CSO	5,800	14	Under procurement
ALCOSAN Allegheny River	Allegheny Co. Sanitary Authority	Pittsburgh	PA	2028	CSO	33,000	18	Planning

To have your major tunnel project added to the Tunnel Demand Forecast, or to update information on a listed project, please contact Sanja Zlatanic at szlatanic@hntb.com.

TUNNEL NAME	OWNER	LOCATION	STATE	BID YEAR	TUNNEL USE	LENGTH (FEET)	WIDTH (FEET)	STATUS
ALCOSAN Monongahela River Tunnel	Allegheny Co. Sanitary Authority	Pittsburgh	PA	2030	CSO	28,000	18	Planning
Germantown Winghocking Relief	City of Philadelphia Water	Philadelphia	PA	2025	CSO	28,000	20	Under design
West Seattle to Ballard Extension	Sound Transit	Seattle	WA	2026	Transit	2,800	19	Under design
Downtown to Ballard Extension	Sound Transit	Seattle	WA	2027/28	Transit	22,500	19	Under design
Taylor Massey Tunnel	City of Toronto	Toronto	ON	2027	CSO	20,000	15	Under study
Del Mar Bluffs Tunnel	SANDAG	San Diego	CA	2025	Transit	TBD	TBD	Under design
Fraser River Tunnel	BC Ministry of Transportation	Vancouver	BC	2024	Highway	3,000	TBD	Awarded FCC Pomerleau
Deepwater Intake	Ontario Power Generation	Pickering	ON	2025	Sewer	15,000 m	13 m	RFP Ongoing
Stormwater Control Program	Harris Co. Flood Control District	Houston	TX	2028	CSO	52,800	25-40	Under study
LA Metro Sepulvada Pass Corridor	LACMTA	Los Angeles	CA	2026	Transit	55,000	TBD	LOI received - EIS submitted Q3
D2 Subway - 2nd light rail alingment	Dallas Area Rapid Transit	Dallas	TX	2028	Transit	7,230	22	Delayed
Flushing Bay CSO Tunnel	NYC-DEP	New York	NY	2026	CSO	16,500	22	Under study
Cross Harbor Freight Tunnel	NYC Regional Develop. Authority	New York	NY	2028	Rail	25,000	30	Delayed
Superconducting Maglev Project -	TNEM/BWRR	Washington	DC	TBD	Rail	146,500	43	Delayed
Big Creek Storage Tunnel	NEORS	Cleveland	OH	2026	CSO	22,450	20	Under design
I-94 Drainage Tunnel	MDOT	Cleveland	OH	2025	Storm	6,000	14.5	RFQ Q3 2025
Metro Tunnel Program - Northern Tunnel	MWRA	Boston	MA	2028	Water	23,760	10	Under final design
Southern Tunnel				2027	Water	50,160	10	Under final design
Horizon Lateral Tunnel	Southern Nevada Water Authority	Las Vegas	NV	2027	Water	42,000	9	Delayed
Inner Harbour West Tunnel	City of Toronto	Toronto	ON	2027	CSO	18,400	20	Under design
Piney Branch Tunnel	DC Water & Sewer	DC	MD	2024	CSO	2,200	18	RFQ May 2024
West Transmission Line Relocation tunnel	Hydro One	Toronto	ON	2024	Cables	11,500	10	RFP Ongoing
Pickering Outfall	Ontario Power Generation	Toronto	ON	2024	Water	5,000	43	RFQ ongoing
Delta Conveyance Tunnel	CA Dept. of Water Resources	Sacramento	CA	2027	Water	236,500	36	Under design
Blue Line Extension	Societe de transport de Montreal	Montreal	QC	2024	Transit	19,000	33	Shortlist announced
Black Creek STS Relief System	CA Dept of Water Resources	Sacramento	CA	2027	Water	236,500	36	Under design



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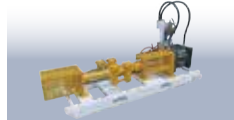
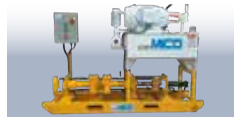
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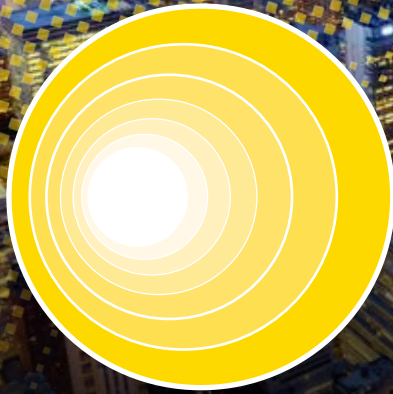
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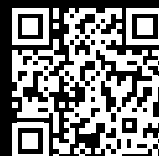
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