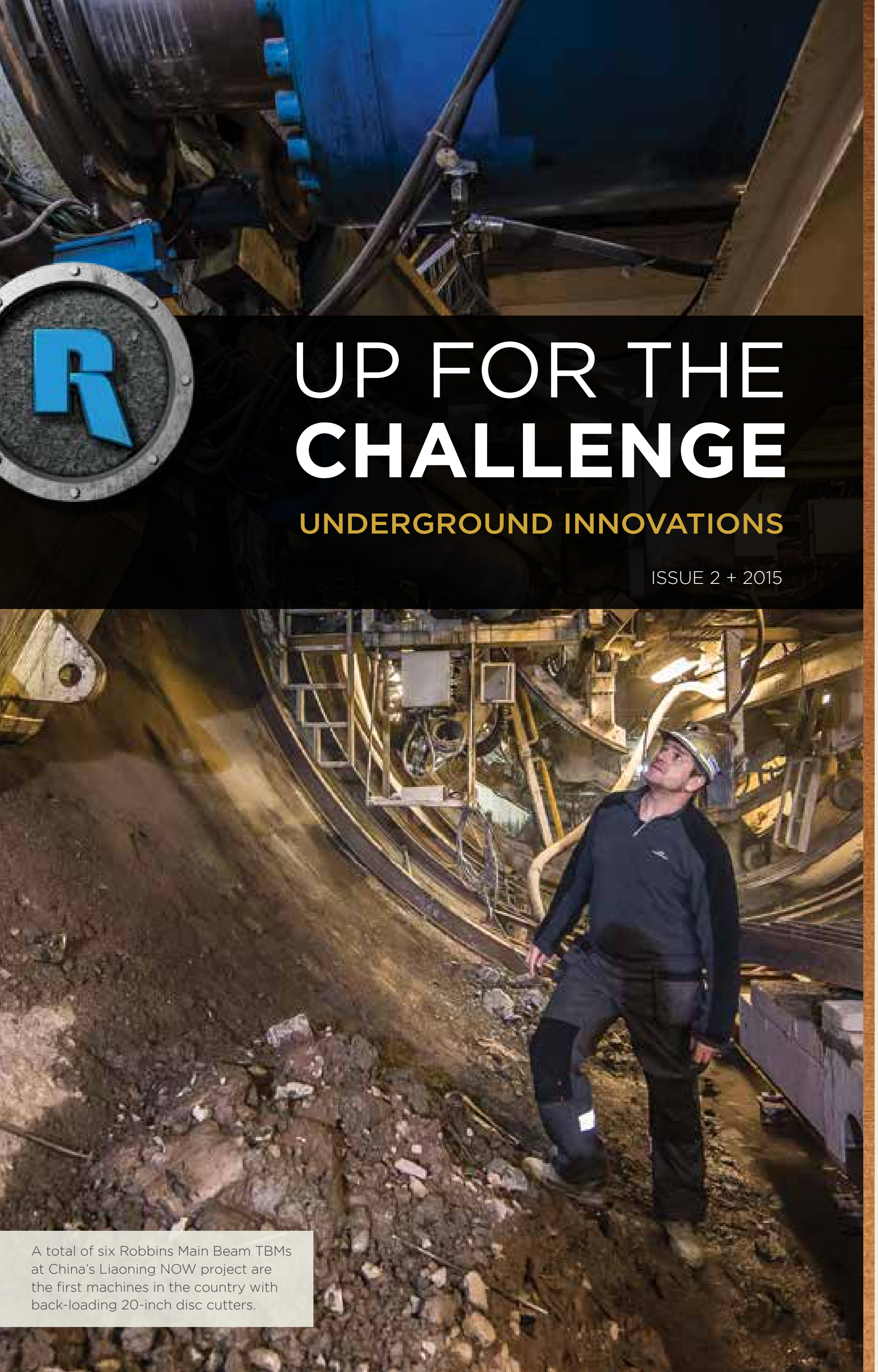


UP FOR THE **CHALLENGE**

UNDERGROUND INNOVATIONS

ISSUE 2 + 2015

A total of six Robbins Main Beam TBMs at China's Liaoning NOW project are the first machines in the country with back-loading 20-inch disc cutters.

ISSUE 2 + 2015

ROBBINS TBMs AND CUTTERS ARE WINNING THE RACE IN LIAONING

In Northeastern China, six Robbins Main Beam TBMs are achieving a number of firsts: The 8.53 m (28 ft) diameter giants are the first machines in China to use back-loading 20-inch disc cutters, a new standard that prolongs cutter life and demonstrates durability. The project is also the first to use multiple Main Beam TBMs from different suppliers in the same geology, all with Robbins continuous conveyors installed behind them. The continuous conveyor systems total eight units, and are removing rock consisting of granite, granite gneiss and some schist with varying competence. The machines are also the first to compete in a race pitting three Robbins TBMs with 20-inch cutters against those of other manufacturers. Also competing in the race are two Robbins/NHI machines with 20-inch cutters, two Herrenknecht TBMs with 19-inch cutters, and one rebuilt Robbins TBM with 19-inch cutters. So far, results have been telling.

Each of the eight TBMs excavating the Liaoning NOW project is boring two consecutive tunnels ranging from 6.5 to 8.0 km (4.0 to 5.0 mi) long, totaling about 15 km (9.3 mi) each. The machines were launched between October 2013 and February 2014. Despite launching two months later than a Herrenknecht machine on the same project, a Robbins TBM with 20-inch cutters completed its first section of the excavation in October 2014, at a point nearly 2.7 km (1.7 mi) ahead of the Herrenknecht machine.

Similarly, the average monthly boring meters using Robbins TBMs and cutters have been as high as 675 m (2,215 ft) per month and nearly 1,300 cubic meters (45,900 cubic ft) bored per cutter. Excessively abrasive ground on the Herrenknecht jobsites created excavation problems that resulted in rates as low as 322 m (1,056 ft) per month and only 139 cubic meters (4,900 cubic ft) bored per cutter. The project owners insisted the contractor switch to Robbins 19-inch discs with the end result that Robbins cutters were installed on the two machines. After the new cutters were installed, excavation rates have steadily increased to a high of 610 m (2,000 ft) per month on average and overall cutter performance increased to 877 cubic meters (31,000 cubic ft) per cutter. These great results were similarly echoed when locally manufactured 20-inch cutters were installed on a Robbins/NHI TBM—high cutter wear (only 198 cubic meters/6,990 cubic ft bored per cutter) ultimately resulted in the contractor switching back to Robbins discs.

PRODUCTION RATES FOR ROBBINS TBMs

675 M

PER MONTH

1,300 M^3

PER CUTTER

Cutter performance is not the only unique aspect of these tunnels. At all of the jobsites, fractured ground has required the use of McNally slats to support the rock and at one site in particular over 50% of the tunnel has required the use of slats as well as shotcrete. "This is the best and most reliable ground support system we have ever used," said an official with contractor Shanxi Hydraulic Engineer Construction Bureau. The system, proposed by Robbins, allows steel slats to be extruded as the TBM advances, forming a lining that protects the tunnel profile and workers from falling rock. Excavation is expected to proceed into early 2016 with increasing monthly advance rates.

At projects like Turkey's Kargi HEPP, it has been proven that TBMs can excavate as well as or better than D&B in difficult ground.

TBM modifications like variable speed electric motors and double gearboxes allow hard rock machines to excavate in heavily fractured ground.

DISPELLING THE MYTH:

Is Drill & Blast Really Preferable to TBMs in Difficult Ground?

LOK HOME, PRESIDENT

There is a misconception in our industry: many consultants and contractors recommend or choose drill & blast excavation over TBMs in difficult ground because they think they will have increased performance or it is less risky. Their choice is predicated on historical anecdotes and a carryover from the earlier days of TBM tunneling when it was considered detrimental to have a TBM in the tunnel if the ground was unstable. In such conditions contractors wanted full access to the face, as provided by drill & blast operation.

With today's technology, this historic belief has been proven wrong. In fact what is better for daily advance—and ultimately safer in difficult ground—is to have the safe haven, potential plug and drill platform that a TBM can provide. A TBM can block raveling ground, high pressures, and running ground, making the operation safer. A TBM can quickly provide the means and measures to bring these conditions under control. This is particularly true of Dual Mode TBMs.

A tunnel boring machine combines multiple operations that in drill & blast would be sequential. These operations include advancing (drilling & blasting), ground support, and muck excavation. With modern TBMs, ground support such as the McNally Roof Support System can be used to allow lining to be extruded from the machine as it advances—a very safe option. Any type of ground support used in drill & blast, from shotcrete to spiles to fiberglass rock bolts, can be used while the TBM is boring. Today's modern TBMs are also equipped with all of the same tools and techniques that are used in drill & blast operations to excavate through difficult rock conditions. With sophisticated probing techniques installed on the TBM, the operator can predict what is ahead of the tunneling operation more quickly than drill & blast and react appropriately.

For mixed geological sites like Turkey's Kargi Hydroelectric Project, it has been proven that TBMs can excavate better than drill & blast operations. While it is clear that in good ground TBMs achieve higher advance rates, this has been shown to be the case in even the most difficult zones. On the Kargi project the TBM, a 10 m Double Shield, was fitted with variable-speed electric motors and two-speed gearboxes that allowed the machine to essentially operate in EPB mode in loose ground. In this way, a non-pressurized rock machine is capable of rotating the cutterhead, advancing and holding the ground in place

> "TBMs are capable and recommended to be launched into difficult ground at the beginning of the tunnel without the use of a long drill & blast starter tunnel."
>
> - LOK HOME, PRESIDENT

even when one to two diameters of material are laying above and against the face. The Kargi project, where both TBM and drill & blast were used, ultimately wrapped up with the TBM operation achieving advance rates more than twice that of the drill & blast operation—both in difficult ground and in solid rock.

Today's TBMs are well equipped for difficult ground. In fact, if difficult conditions and fault zones are expected, then countermeasures are built into the design. TBMs are capable and recommended to be launched into difficult ground at the beginning of the tunnel without the use of a long drill & blast starter tunnel. The use of these long drill & blast starter tunnels often creates more problems than advantages and encumbers the installation of final lining. What better place to test the machine's and crew's capabilities in difficult ground than near the portal? These skills are usually needed further along in the tunnel excavation in any event. Even in mixed face geology, today's TBMs represent a very improved efficiency.

SMALL DIAMETER TUNNELING

ROSEMONT ON A ROLL

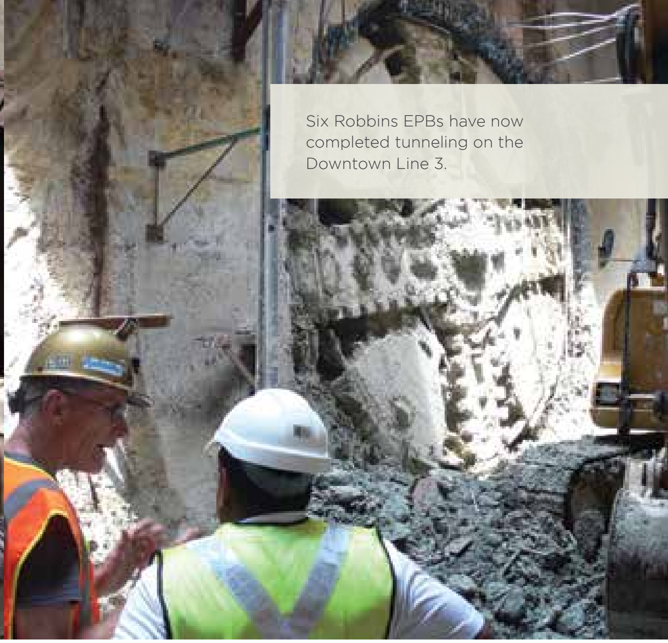
In Montreal, Quebec, Canada, a small diameter TBM is poised to have a big impact. The 3.0 m (9.8 ft) Double Shield TBM was rebuilt in Robbins' Solon, Ohio, USA shop and shipped to Canada to begin work on the Rosemont Reservoir tunnel. "We launched the machine and did the first few meters before Christmas, and we are now working on improving advance," said Roger Lepinay, Equipment Manager for contractor ForAction Inc.

The project is set to revamp the water supply for the city of Montreal, by connecting up to a large potable reservoir that was finished in 1962 and never brought online. The 2.1 m (84 in) I.D., 4 km (2.5 mi) long aqueduct pipe requires excavation through limestone rock with average compressive strengths of 150 to 200 MPa (22,000 to 29,000 psi). The machine was launched from a 33 m (108 ft) deep access shaft with a blasted back gallery 30 m (98 ft) in length and a front gallery of 59 m (194 ft). "We now have all five backup decks assembled. We also just installed a California switch and two trains to take what will amount to about 80,000 tonnes (88,000 US tons) of rock out of the tunnel," said Lepinay.

ForAction anticipates several challenges including excavation directly below the Montreal subway. The section will cross 50 ft (15 m) below the subway and seismic monitors have been installed around the existing structure. ForAction expects the ground conditions to be good throughout: "The rock is of good quality and so far we haven't had to install any rock bolts in the bored tunnel. We can do so, along with wire mesh, if conditions require it." Geotechnical surveys identified two sections of fractured rock on the drive, but these were cement grouted from the surface ahead of tunneling. Breakthrough into a 45 m (147 ft) deep exit shaft is anticipated in the latter half of 2015, and while tunneling has only just started, Lepinay is optimistic: "So far so good, particularly with the quality of the rock."

The Robbins machine is excavating in competent limestone rock on a 4 km (2.5 mi) water conduit for the city of Montreal.

The Robbins EPBs were launched from small jobsites close to sensitive structures including condominiums and schools.



Six Robbins EPBs have now completed tunneling on the Downtown Line 3.

RECORD-SETTING MACHINE

SUCCESS IN SINGAPORE

On January 19, 2015, the final of six Robbins EPBs boring in Singapore broke through. The TBM, for Korean contractor GS Engineering, marked the close of the C925 tunneling contract after achieving a national record of 4 rings in 24 hours.

The Downtown Line 3 will add 21 km (13 mi) of tunnel for the Land Transportation Authority (LTA) using 29 TBMs boring between 16 station sites. Geology ranges from clay, mudstone, and sand to boulder fields. For three of the Downtown Line 3 contracts, C925, C927, and C937, logistics were particularly complex. A total of six 6.6 m (21.7 ft) diameter Robbins EPBs were launched in mixed ground conditions at small jobsites close to critical structures.

Contract C925, consisting of two 800 m (0.5 mi) blind tunnel drives, may be one of the smallest jobsites in Singapore. The narrow site is quite long at 1.5 km (0.9 mi) but with little space for storage and just meters away from condominiums, a main road and a school.

The machine was launched in December 2013, and quickly began ramping up excavation using a muck pump for spoil removal in old alluvium. "It's the first time a muck pump was used here. We achieved good advance rates, the fastest advance rates in Singapore, in fact. We started our excavation at 1 ring a day, then very quickly moved to two, and by the time we reached rings 50 to 60, we were getting up to 4 rings per day, which is the first time that has been done here in a 24 hour period," said Andy Birch, Robbins Field Service Manager. Settlement also had to be kept to a minimum in the 30 m (98 ft) deep tunnel: "The operators knew about continued conditioning in front of the head, and that the material had to be kept at a certain consistency. We injected foam and monitored the earth pressure sensors continuously."

The Robbins EPB finished its first drive in April 2014—a result that was within five months of its startup and within its 180 m (590 ft)/ month program average. To facilitate in-tunnel disassembly of the machine so it could start its second drive, Robbins designed each of the major components to be easily disassembled, transported and reassembled in the new shield. The process took about 16 weeks, but was ultimately successful. Following its second hole through the machine will again be disassembled, and the shield abandoned with the components withdrawn through the completed tunnel.

PREPARING TO LAUNCH

FIELD EXPERIENCES STREAMLINE MEXICO'S DUAL MODE MACHINE

Lessons learned from Turkey's Kargi HEPP are now applied to the new generation of Dual Mode TBM designs.

An 8 m (26 ft) Robbins Dual Mode EPB/Rock TBM is preparing its 2015 launch on a 5.9 km (3.7 mi) long tunnel for Mexico City's Túnel Emisor Poniente (TEP) II Project. The contractor, Aldesa/Proacon/Recsa joint venture, has selected Robbins' innovative Onsite First Time Assembly (OFTA) method for the project as it allows substantial savings in both time and schedule. The complex wastewater conduit promises many challenges, from geology to site logistics. Difficult ground conditions are expected including significant rock on most of the tunnel alignment and the last 10% in soil. In addition there is limited space for OFTA in the very narrow assembly and launching pit.

The challenges are not without precedent, however. The experienced Robbins team and Project Manager, Martino Scialpi, were able to make some key decisions in the design process that will be crucial for excavation at TEP II. These design changes are based on lessons learned from a successful project at Turkey's Kargi HEPP. "Kargi was a great experience for us and an example of unexpected geology that now informs some of our engineering decisions. We went through a rock mass with a 10 m Double Shield TBM, but it would have worked best using a Dual Mode machine or even EPB—the actual geology turned out to be very poor and weathered rock; it could not really be called solid rock," said Scialpi. The latest generation of Robbins Dual Mode machines has been improved by these experiences—for instance, the successful canopy drill design from Kargi was pre-installed on the TEP II TBM, providing another ring for grout drilling or forepoling close to the cutterhead. As used at Kargi, the canopy drill will operate in the top 120 degrees of the tunnel, while a second probe/grout drill is located further back on the machine, allowing two different patterns of holes.

A complex excavation at Kargi has prepared the team for the varied ground at TEP II. High torque/breakout torque is another feature added to the TEP II machine, so that two-speed gear boxes can be activated to achieve high torque at a low speed, similar to how an EPB operates. With two-speed gear boxes, the cutterhead can be freed in bad ground where it might otherwise become stuck.

While crew members at the Kargi site had to generate immediate solutions to improve progress, the TEP II crew was able to borrow from the lessons learned. The team at TEP II has a difficult excavation ahead of them, but with the informed machine design, they are on the right track.

THE NEXT PUSH FOR SMALL DIAMETER

Since its introduction in 1996, the Robbins Small Boring Unit (SBU-A) has revolutionized auger boring in rock conditions, and has been proven on hundreds of projects across North America. The line has expanded to include products like the Motorized SBU (SBU-M) for drives over 500 ft (150 m) that require precision line and grade control, but it hasn't stopped there. Robbins is now looking to expand internationally with the SBU product line, by exploring machinery with a smaller footprint that is not constrained to operation with Auger Boring Machines (ABMs).

Internationally, boring with an ABM is uncommon. "Auger boring really started in the U.S. with our abundant use of steel, which meant that the dominant method here for placing utility tunnels was to insert a steel casing as a primary liner. But internationally that is not the case, so SBUs can be a difficult sale," says SBU Sales Manager, Kenny Clever. In order for SBUs to gain worldwide acceptance, Robbins recognized that it needed to develop a product to better match contractor requirements outside of the U.S., where concrete pipe jacking is the method of choice and microtunneling machines are often specified for rock.

THE SMALL SBU-M IS A PERFECT EXAMPLE OF ROBBINS' COMMITMENT TO RESEARCH & DEVELOPMENT

In order to compete in the small diameter hard rock tunneling industry internationally, Robbins has developed the smallest SBU-M on the market at 36 inches/900 mm (standard SBU-Ms range from 48 to 78 inches/1.2 to 2.0 m). Not only does the new SBU-M have compact size on its side, but it also comes equipped with several unique features: it can be applied in hard rock and mixed ground, it is used with pipe jacking systems, and it is remotely operated, making it the perfect alternative to traditional microtunneling in hard rock. The development team is currently experimenting with unique spoil removal techniques compatible with the machine's limited space.

At the moment, the 36-inch SBU-M is being tested within the U.S. market, and there are plans to introduce it internationally soon. If demand is as high as expected, Robbins may develop an even smaller steerable machine. "We think we can take this down to 30 inches (760 mm) if the industry wants it, but if we have a really good, steerable 36-inch rock machine, that will probably fulfill the majority of the market," says Clever.

The small SBU-M is a perfect example of Robbins' commitment to R&D. Aside from the SBU-M, Robbins is also developing small diameter EPB machines and slurry microtunneling machines for soft and mixed ground applications.

Robbins has a rich history in India, working as a partner for contractors since 1991.

At the Chennai Metro, Robbins India crews mapped ground ahead of the machine in order to successfully navigate changing ground conditions.

BUILDING PARTNERSHIPS IN INDIA

FROM THE HIMALAYAS TO DOWNTOWN JAIPUR, THE FOCUS IS TEAMWORK

Robbins has a rich history in India, having supplied hard rock TBMs, mixed ground EPBs, and Small Diameter Boring Units (SBUs) on projects throughout the region for many years. Earlier projects, such as the Parbati HEPP, solidified Robbins as a viable tunneling partner for Indian contractors. At Parbati, Robbins helped the contractor maneuver an older-generation TBM through difficult Himalayan rock conditions by providing technical expertise and invaluable field service experience. This tradition of partnership lives on today, and Robbins continues to support some of India's toughest tunneling projects, from large water diversion projects to urban metro tunnels.

Robbins is currently working on jobsites in Jaipur, Chennai and Bangalore, all metro projects. At the Jaipur Metro, Robbins is supplying two refurbished 6.65 m (21.8 ft) EPBs from previous tunneling on the New Delhi Metro. The machine rebuilds included customization specific to Jaipur geology: cutterhead modifications, new A+B grout and foam systems, and an upgrade for active articulation, allowing the TBMs to handle curves. Once launched, the machines will bore parallel 1,800 m (1.1 mi) tunnels, and will pass below the ancient Chand Pol Gate, a majestic entrance to the walled city.

At the Chennai Metro project, a 6.65 m (21.8 ft) Robbins mixed ground EPB broke through in July 2014, completing one of two parallel 1,063 m (0.7 mi) drives. Shortly after its initial launch, the machine hit unexpected ground conditions that battered the cutterhead and caused high cutter consumption. Alongside the contractor, Robbins Field Service assisted in further geological testing and subsequent development of operating parameters. Once these guidelines were implemented, cutter wear was drastically reduced, and the machine achieved advance rates of up to 44.8 m (147 ft) per week with the help of the Robbins crew, who remained onsite to assist. The machine was re-launched in January 2015 for the second tunnel.

At the Bangalore Metro, similarly to Parbati, Robbins has taken over responsibility for two 6.45 m (21.2 ft) EPBs provided by a competing manufacturer and is providing support for the remainder of the project: two 750 m (0.5 mi) tunnels in mixed ground conditions including granite and soil. The package provided by Robbins includes field service, spare parts, and all consumables including ground conditioning and grouting materials.

> With the help of Robbins' experience and expertise, contractors can rest assured their projects will be supported at every turn.

Each of these projects has its own set of challenges, from difficult ground to operational takeover of a project already underway. There are no guarantees underground, but with the help of Robbins' experience and expertise, the contractors for the Jaipur, Chennai and Bangalore Metros can rest assured knowing that their projects will be supported at every turn.

THE FUTURE OF MINING & TBMs

EFFICIENT, SAFE & FAST

Today's mine extraction projects are typically no longer being done from near the surface. Worldwide, easily accessible ore deposits have been spent. Today's mines are looking towards deep ore bodies, often kilometers underground, to access rich deposits. With the changing mine environment comes a need for access tunnels, first to reach the ore, then to provide long-term muck haulage. Tunnel boring machines provide efficient, safe, and fast access to those ore bodies.

Mines around the world are accustomed to methods such as drill & blast, roadheader, and other types of conventional excavation. However, TBMs have been proven on multiple projects to complete tunnels two to three times faster than drill and blast; when considering roadheaders that number is five to ten times faster. Multiple other benefits outweigh lead times and initial costs for TBMs—such as a smooth, round tunnel profile requiring less ground support.

WITH THE GLOBAL DEMAND FOR MINERALS INCREASING, **MINES CAN ONLY BE PUSHED IN ONE DIRECTION—DEEPER.**

We are seeing the changing face of mining worldwide, from Australia to Europe to the U.S. In this newsletter you'll read about the Grosvenor Decline Tunnel, an operation that marks the first use of a TBM in an Australian coal mine. That successful example is not an isolated one—operations like the Stillwater Mining Company in Montana, USA have been using TBMs for mine access tunnels for over three decades. Their most recent project, the Blitz Tunnel, will be at least 6.8 km (4.2 mi) long, and is being excavated at a rate 5.75 times faster than a drill and blast heading 1,800 m (5,900 ft) directly overhead. The mine has also proven that while the capital cost for a TBM is 1.5 times that of a conventional mining fleet, the operational costs of a TBM are only 33% that of drill and blast. This result more than makes up for any initial costs by the time of project completion.

With such direct operational evidence from the field, it is no wonder that mines are beginning to explore mechanized tunneling. With the global demand for minerals increasing, mines can only be pushed in one direction—deeper. Early adopters of the TBM method will be able to better meet increased demand and extend the life of their mine—a result every miner hopes for.

SUBMERGED & INOPERABLE BUT NOT FORGOTTEN

AFTER A NATURAL DISASTER A TBM COMES BACK TO LIFE

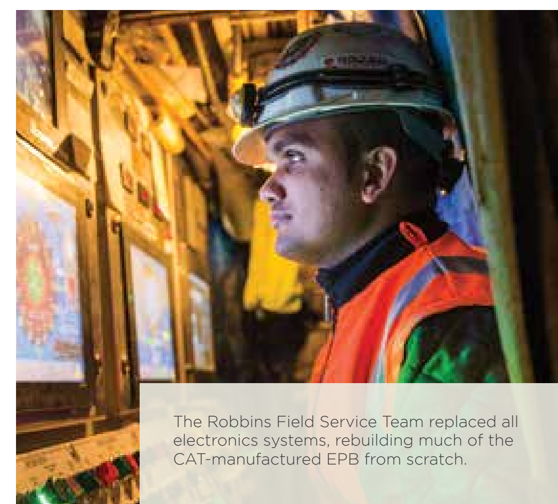
An embattled project has overcome long odds to end in success. The 3.6 m (11.8 ft) EPB TBM at the New York City's Harbor Siphons Project broke through on January 28, 2015. The initial mandate to replace two shallow water lines across the New York Harbor was always expected to be demanding, but no one foresaw the challenges soon to come. Started in August 2012, the Siphons Project required boring the 2.9 km (1.8 mi) long traverse between Brooklyn and Staten Island through high pressures, clay and sand with a Caterpillar-manufactured EPB. A few months later, the unexpected happened. Hurricane Sandy swept the eastern coast of the United States, devastating all that stood in its path, including the Harbor Siphons jobsite. After excavating just 460 m (1,500 ft), the machine came to a standstill, completely submerged and inoperable.

Following the storm, the saltwater-damaged machine sat idle until late July 2013. Contractors Tully/OHL JV turned to Robbins for extensive repair work and a team was immediately dispatched to the Staten Island site to begin. Robbins coordinated the effort to replace corroded hydraulic components and all new electrical systems, commencing action in mid-December 2013. The refurbishment also centered on removing the rear eleven gantries and belt conveyor to be cleaned, evaluated and repaired. The refurbishment project took about four months, and crews were able to return to mining on April 14, 2014.

To ensure that the project stayed on the incline to success, Robbins field service personnel remained onsite to support ongoing maintenance of the TBM. With their help, machine performance steadily increased, eventually reaching rates as high as 108 ft (32.9 m) per day and as much as 24 rings in 24 hours in June 2014.

Just as excavation was picking up, ground conditions changed from a silty clay to sand with excessive water ingress, resulting in extremely slow propulsion rates. After brainstorming, the management team installed four auxiliary cylinders in the lower propulsion system and were able to re-establish forward progress under high water pressure. The constant hurdles continued into early October when the machine encountered a pocket of glacial soils comprised of large stones. Despite the new obstacles, the crew were able to steadily increase the rate of excavation to 5 to 7 rings per day. The successful completion of the challenging project is a testament to the organization, determination, and perseverance of the entire Siphons project team.

Workers from the local tunneler's union, known as the Sandhogs, celebrate as the EPB breaks into the slurry wall of the exit shaft.



The Robbins Field Service Team replaced all electronics systems, rebuilding much of the CAT-manufactured EPB from scratch.

Below: An 8.0 m Dual Mode EPB/Rock TBM completed tunneling in February 2015 at an Australian coal mine.
Right: The TBM was transported between tunnels by way of custom dollies.

TBMs IN MINING

FASTER MINE EXCAVATION

Robbins Sets the New Standard

A unique Robbins TBM is breaking new ground and breaking through! On February 9, 2015, an 8.0 m (26.2 ft) Dual Mode Single Shield/EPB TBM completed tunneling at the Grosvenor Decline Project in Queensland, Australia—a Greenfield coal operation utilizing TBM technology to bore two mine access tunnels for the first time on the continent.

The machine for the Anglo American mine is an industry game-changer: it is equipped with many unique features making it suitable for operation in mine conditions. The TBM needed to be able to bore in soft rock and mixed ground geologies while in the presence of methane gas, maintain full ground support at all times, and be removed swiftly from the first lined tunnel (at a grade of 1:8 for conveyors) for reassembly in a second (at a grade of 1:6 for men and materials).

Due to the mine's potentially gassy conditions, the machine was designed as Class 1, Division 2, and is coal mine compliant to ERZ-1. Custom features include extraction ventilation by way of a snuffing box at the discharge of the screw conveyor, and flame-proof machine components.

Only the first approximately 300 m (984 ft) of each tunnel require EPB mode, so the TBM was optimized towards hard rock excavation. In EPB mode, the machine utilizes a two-stage, center mounted screw conveyor. In hard rock mode, a muck chute deploys around the screw. The cutterhead can be outfitted for both modes, with knife bits and scrapers in mixed ground, and cutters in hard rock.

A Robbins-designed "Quick Removal System" allows the inner core of the machine to be removed from the first tunnel, leaving behind its shields for constant ground support, a requirement in all Australian tunnels. Excavation of the first tunnel began in December 2013, and in August 2014, the machine was dismantled and rolled out from the conveyor decline tunnel. A new set of shields were added to the machine once it arrived at the second tunnel heading 2 km (1.2 mi) away, and excavation for the men and materials tunnel began in November 2014.

Custom features include extraction ventilation by way of a snuffing box at the discharge of the screw conveyor, and flame-proof machine components.

With the completion of its second tunnel, the machine has set 732 segment rings in just 88 days at a maximum rate of 18 segments (25.2 m) in 24 hours. At that rate, the TBM bored ten times faster than the traditionally-used roadheader method, and has set an example for mining owners around the world that are willing to challenge convention and try new methods. Once brought online, the mine expansion is anticipated to allow the Grosvenor Coal Mine to produce five million tonnes of coal per year over the next 26 years.

2015 WEBINAR SERIES

Robbins hosts three complimentary webinars annually, geared towards project owners, contractors and engineers. Attend a Robbins webinar to hear from our company executives, lead engineers, and onsite Field Service staff about the latest tunneling trends and ways to save time and money on your upcoming projects.

DRILL AND BLAST VS. MAIN BEAM TUNNELING
April 2015

TBMS IN MINING
June 2015

MAXIMIZING THE VALUE OF YOUR TBM
September 2015

Exact dates to be announced soon

Visit www.TheRobbinsCompany.com and join our LinkedIn Group, The Robbins Company, for updates and registration.

2015 TECHNICAL PAPERS & PRESENTATIONS

+ WTC

May 22-28 | Dubrovnik, Croatia

Extreme Excavation in Fault Zones and Squeezing Ground at the Kargi HEPP in Turkey

Optimizing Soft Ground Excavation: Development and Design of EPB and Slurry Cutterheads

TBM Design for Long Distance Tunnels: How to keep Hard Rock TBMs boring for 15 km or more

TBM Tunnelling in Karst Conditions: Lessons Learned from the Field

Unique Hybrid EPB Design for use in Coal Mine Drifts

+ RETC

June 7-10 | New Orleans, Louisiana, USA

Rescue and Refurbishment of a TBM inundated with Flood Waters at the New York City Harbor Siphon Project

Extreme Excavation in Fractured Rock and Squeezing Ground at Turkey's Kargi Hydroelectric Project: A comparison of TBM and Drill and Blast Methods

Decision Process and Guidelines for Selection of a Preferred Tunneling Method

Preparation for Tunneling, Northgate N125 Project in Seattle Washington

+ UNDERGROUND DESIGN & CONSTRUCTION CONFERENCE (UDCC)

September 11-12 | Hong Kong

Keynote Lecture by Lok Home, Robbins President
To Build a Tunnel Boring Machine: Why Assembly on Location is the Next Industry Advancement

Dual Mode TBMs: The Next Step for Earth Pressure Balance Machine Tunnelling

+ TBM DIGS INTERNATIONAL CONFERENCE ON TBMS IN DIFFICULT GROUND

November 18-20 | Singapore

Keynote lecture by Lok Home
Trends in New Applications of TBMs

Robbins will also give technical presentations at the following conferences:

+ NASTT NO DIG

March 15-19 | Denver, Colorado, USA

+ ITACET MECHANIZED TUNNELING SEMINAR

March 23-24 | Santiago, Chile

+ ASCE WILLIAM BARCLAY PARSONS LECTURE

April 23 | NYC, New York, USA

+ CSM UNDERGROUND CONSTRUCTION AND MINING SHORT COURSE

May 18-20 | Golden, Colorado, USA

SHARING OUR KNOWLEDGE
TO ENCOURAGE INNOVATION.

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High cover tunneling is progressing at a rapid pace at China's Liaoning NOW water project.