UNDERGROUND INNOVATIONS
NEWS FROM ROBBINS

ISSUE 31
SUMMER 2014

TURKEY'S KARGI CHALLENGE OVERCOME

SEVEN BYPASS TUNNELS IN 2 KILOMETERS. Those were just some of the challenges overcome at Turkey's Kargi KIzikirmak Hydrolectric Project. On July 5, 2014, a 10 m Robbins Double Shield TBM triumphed over a gamut of obstacles ranging from fault zones to squeezing ground. Crews made an impressive run and breakthrough, working together to perform in-tunnel machine modifications.

The machine, selected jointly by the owner, consultants, Robbins, and contractor Gülermak, excavated through 7.8 km of tunnel that proved to be a challenge from the outset. Launched in poor geology in 2012, the TBM required the bypass tunnels within the first 2 km of tunneling.

All parties involved worked together to generate solutions in the difficult conditions. The contractor, with the assistance of the Robbins field team, installed a custom-built canopy drill and positioner to allow pipe tube installation through the forward shield. Drilled to a distance of 10 m ahead of the cutterhead, 90 mm diameter pipe tubes provided support across the tunnel crown. Injection of resins and grout protected against collapse.

As a result of the probe drilling, Gülermak was able to measure and back-fill cavities above the cutterhead to over 30 m while detecting fractured rock ahead of the face.

The Robbins TBM made remarkable progress after the modifications. A monthly best of 723 m was achieved in spring 2014. In so doing the TBM significantly outperformed a drill and blast heading at the opposite end of the tunnel. Crews at that heading progressed for 4 km, where they achieved monthly advances of 200 m. The entire tunnel measures 11.8 km.

"This has been the toughest job in my tunnelling career," said Yunus Alpagut, Robbins' Representative in Turkey who was involved in the project from the start. "It is a testament to the skill and dedication of the Robbins and Gülermak teams that it has ended successfully."

Once online the Kargi Kizilirmak Hydroelectric Project, for Norwegian-owned Statkraft AS, will generate 470 GWh annually--enough to power 150,000 homes.

A worker from project owner Statkraft looks on as the Robbins Double Shield at Turkey's Kargi Kizilirmak Hydroelectric Project breaks through on July 5, 2014.

Crew members from the S-K JV and Citizens Energy Group celebrate the breakthrough of a record-setting TBM in Indianapolis, USA on July 11, 2014.

BREAKTHROUGH IN INDIANAPOLIS BY
RAPID ROCK MACHINE

A VETERAN AT NEARLY 35 YEARS OLD, the record-setting Robbins TBM at the Indianapolis Deep Rock Tunnel Connector (DRTC) accomplished more than just a tunnel. The Robbins TBM broke through in record time on Friday, July 11 after setting multiple world records in its size class of 6 to 7 m (20 to 23 ft). The TBM earned the titles of Most Feet Mined in One Day" (124.9 m/409.8 ft), "Most Feet Mined in One Week" (515.1 m/1,690 ft), and "Most Feet Mined in One Month" (1,754 m/5,755 ft). "It couldn't have been done without the guys in the tunnel working so well together while still keeping safe," said Shea-Kiewit Project Manager Stuart Lipofsky.

> **"S-K rebuilt the machine into a hot rod; they built a machine over-engineered for the rock."**
> --Tim Shutters, Construction Supervisor, Citizens Energy Group

The 6.2 m (20.2 ft) diameter Robbins Main Beam TBM, owned by Shea/Kiewit (S-K) JV, was refurbished and redesigned for the job. Originally built in 1980, the TBM has previously been used on at least five other tunnels including New York's Second Avenue Subway. The additions for the DRTC involved new 19-inch disc cutters, variable frequency drive (VFD) motors, a back-loading cutterhead, and a rescue chamber. The machine cut a 12.2 km (7.6 mi) tunnel through limestone and dolomite 76 m (250 ft) below the city.

Tim Shutters, Construction Supervisor for owner Citizens Energy Group, was blown away by the design and resulting advance rates: "SK rebuilt the machine into a hot-rod; they built a machine that was over-engineered for the rock."

A unique Robbins continuous conveyor system was also provided for muck removal that traveled along 90 degree curves--an incredibly difficult but ultimately successful alignment.

Now that the main tunnel of the DRTC is complete, remaining work includes constructing a 5.5 m (18 ft) diameter cast-in-place concrete liner.

LOK HOME WINS
UCA AWARD

EVERY YEAR, AN OUTSTANDING INDIVIDUAL is recognized by the Underground Construction Association (UCA) of SME at its annual awards banquet. This year, the event was held in Los Angeles, California, USA in conjunction with the North American Tunnel (NAT) Conference.

The distinctive award is given to a person who has made major contributions to the tunneling industry in their career. As David Klug, President of David R. Klug & Associates and past UCA of SME chair, said in award presentation: "We nominated this person not only for his work in the industry as a manufacturer, but also for his work to promote the industry as a whole."

Lok Home, President of The Robbins Company and longtime supporter of the UCA of SME, was chosen for 2014 honors. Home was nominated in large part because of his work to bring the ITA-AITES World Tunnel Congress (WTC) 2016 to the United States. The event will be held in San Francisco, California in collaboration with NAT, marking 20 years since the last WTC conference was held in the U.S.

Upon receiving the award, Home attributed his success to the people he works with. "When it comes down to it, success comes from your team. Build a good team around you and you build a success story."

CARVING HARD ROCK

WITH A SMALL DIAMETER DOUBLE SHIELD

THE HARDEST ROCK MINED IN THE U.S.?

While higher rock strengths may have been bored by larger machines, the recent excavation of 345 MPa (55,000 psi) rock by a 2.2 m (7.3 ft) TBM is certainly a record in its size class.

Excavated in Fairfax, Virginia, the installation of a water main met with more than the usual handful of challenges. Hard Diabase rock stopped an initial attempt with the first contractor using a modified Lovat Double Shield TBM in its tracks. The obstacle required a new contractor, Southland, and a new machine.

On May 8, 2014, a 2.2 m (7.3 ft) Robbins Double Shield TBM broke through, completing 2.7 km (1.7 mi) of hard rock tunneling in a test of endurance and fortitude. For John Marcantoni, Project Manager at Southland Contracting, the accomplishment cannot be overstated: "The rock that we encountered was greater than 50,000 psi in many places. From start to finish, it took about 1.5 years to go 1,890 m (6,200 ft)."

When the contractor was awarded work at the Corbalis to Fox Mill Water Main Project, they removed the stuck TBM at the 730 m (2,400 ft) mark, with the majority of tunneling still left to go. Multiple challenges presented themselves during tunneling: "Our issue was not water inflows, faults, or seams, but the consistently hard rock. We kept pushing—a lot of our success was in maintaining the cutters and the ability to keep pushing as hard as we could. We had rigorous maintenance," said Marcantoni.

The strength of the rock not only tested the equipment, but also generated a lot of heat, making working conditions and cooling the equipment difficult.

> **"I don't know for sure if this is a record, but given the rock strengths...and the raw heat being generated, I wouldn't be surprised."**
>
> --John Marcantoni, Project Manager, Southland

Despite the equipment challenges and higher than normal cutter wear, the machine pushed forward. Overall, the TBM averaged 3.7 to 4.0 m (12 to 13 ft) per day, with crews of 10 working in two 10-hour shifts. "I don't know for sure if this project is a record, but given the rock strengths, the number of cutters we used, and the raw heat being generated, I wouldn't be surprised," said Marcantoni.

LEFT: Lok Home accepts the 2014 Outstanding Individual Award.
TOP RIGHT: The 2.2 m (7.3 ft) TBM in Robbins' Ohio, USA shop.
BOTTOM RIGHT: The Robbins machine set an unofficial record for excavating rock strengths up to 345 MPa (55,000 psi).

HYBRID MACHINE WILL HEAD TO MEXICO CITY

Mexico City's Túnel Emisor Poniente (TEP) II Project is a complex wastewater conduit that promises some challenging ground conditions during excavation. The 5.9 km long tunnel is expected to be more than 90% rock, but with some significant sections of softer ground.

Robbins is providing an 8 m diameter Hybrid EPB/Single Shield TBM, optimized toward rock excavation, for the ALDESA/PROACON/RECSA JV. Much of the TBM design is the result of lessons learned at Kargi (see page 1). The canopy drill designed at Kargi will be preinstalled at TEP, providing another ring for probe drilling close to the cutterhead, or for forepoling. A second probe drill is located further back on the TBM.

High torque/breakout torque is another feature added to the TEP machine after experiences at Kargi. Two-speed gear boxes can be activated in bad ground to free the cutterhead. The unique TBM is expected to launch in spring 2015.

SINGLE SHIELD TO BORE RAIL TUNNEL IN TURKEY

A high-speed railway system in Southeastern Turkey is slated to improve connections between centers of agriculture and trade. As a part of this system, twin rail tunnels will be built between Bahçe and Nurdağı towns.

The Bahce-Nurdagı Railway Tunnel will consist of two parallel 10.1 km tunnels, excavated by both drill and blast (2 x 2.9 km) and TBM (2 x 7.2 km).

Contractor Intekar Yapi Turizm Elektrik Insaat San. ve Tic. Ltd. Sti chose an 8 m Robbins Single Shield TBM to excavate two sections. Mixed ground ranges from sandstone, quartzite, and mudstone to weathered shale and limestone. Excavation of the tunnels is expected to begin in October 2015.

LEFT: Robbins Microtunneling Machines are now available worldwide, in both custom sizes and DN standard sizes.
RIGHT: The new line of Robbins Microtunneling Machines features all electric drives, and the option to use SBU disc cutters on the cutterhead.

ROBBINS MICROTUNNELING MACHINES

OPEN FOR BUSINESS

MICROTUNNELING IS THE LATEST FACET of the Robbins Total Supply concept, making the company one of the few manufacturers who offer a suite of equipment from small diameter to large diameter.

The line of microtunneling machines is well-suited to a wide range of conditions, from soft ground to mixed face and hard rock projects, and can be used below the water table at pressures up to 3 bar.

Grahame Turnbull, Pipe Jacking & Microtunneling Systems Manager. is optimistic about Robbins' venture into the microtunneling market, saying "There is a lot of growth happening in developing countries, from SE Asia to Africa, that are now making major infrastructure improvements."

The line of Robbins microtunneling equipment includes complete packages with the machine, pipe jacking station, and separation plant: "Everything but the generator and the pipe,"says Turnbull.

The equipment is custom-manufactured to size, and can be produced at sizes other than DIN standards, as well as sizes DN250 to DN3000. Turnbull explains the advantage: "If you are building a tunnel with 48 inch Hobas pipe, you will be able to use a 60-inch diameter DN standard machine. But, if you want to use concrete pipe, the diameter might be different, say 64 inches. If you are using another company's stnadard DN-sized machine, you would have to upsize the cutter wheel and add a skin to the machine shield to accommodate the difference."

In addition to custom sizing, Robbins Microtunneling machines are manufactured with all electric drives rather than hydraulic, and have the option of being mounted with Robbins' durable SBU cutters. Face access can also be designed for machines over 43 inches in diameter (DN 1100) to allow for changing out of back-loading cutters in rock conditions without significant water.

Turnbull has high hopes for the new product line, and is pleased to offer it along with Robbins' world-class services. "We have global field service capabilities, and we are there to help customers--from training up to machine breakthrough."

2014 EVENTS CALENDAR

Robbins will participate in the following trade shows:

Tunnel Expo Turkey
August 28-31
Istanbul, Turkey
Robbins Technical Sessions:
The Kargi Challenge
Robbins EPBs: Performance under Pressure

Australasian Tunnelling Conference
September 17-19
Sydney, Australia
Robbins Technical Sessions:
TBMs in Mining
Hybrid TBMs in Mines

BTS Conference
September 23-24
London, U.K.
Robbins Technical Sessions:
Keeping up with ITAtech
Presented by Lok Home

4th Mexican Congress on Tunnels & Underground Works
October 8-10
Mexico City, MX

Robbins

TO SUBSCRIBE TO THIS NEWSLETTER, PLEASE CONTACT:

Desiree Willis, Technical Writer
e willisd@robbinstbm.com
p +1 253 872 0500

The Robbins Company
29100 Hall Street
Solon, Ohio 44139 USA
p +1 440 248 3303
f +1 440 248 1702
www.TheRobbinsCompany.com